GREENFIELD CONSTRUCTION PERMIT APPLICATION

WestRock Lithia Springs Preprint Plant > Lithia Springs, Georgia

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1. APPLICATION SUMMARY

This application summary, being submitted to the Georgia Environmental Protection Division (EPD) pursuant to the Georgia Rules for Air Quality Control (GRAQC) Chapter 391-3-1-.03, contains a brief overview of the permit application including the project description, a regulatory applicability summary, and a summary of the elements specific to Nonattainment New Source Review (NNSR) construction permitting. WestRock is requesting review of this application via EPD's expedited permitting program.[1]

1.1. PROJECT DESCRIPTION

WestRock will be locating a new preprint plant in a leased warehouse at 600 Riverside Parkway, Lithia Springs, Georgia, in Douglas County. This proposed facility consists of the installation and operation of a new, innovative flexographic preprint press, a printing plate processor, and ancillary equipment. Linerboard and water-based inks will be used by the press to create preprinted roll product, which will be shipped to corrugated and folding carton packaging plants for use in consumer packaging. Water-based materials will be used to adjust the viscosity of the inks and for cleaning the press. A plate processor, using pre-formed photopolymer sheets and a low vapor pressure solvent, will be installed to create the printing plates for use in the preprint press. Ancillary equipment includes tanks for the storage of water-based material, process wastewater, and recovered solvent.

1.2. REGULATORY APPLICABILITY

The Lithia Springs facility will be a major source with respect to NNSR for volatile organic compound (VOC) emissions only. The site will be a minor source of oxides of nitrogen (NO_X) and fine particulate matter ($PM_{2.5}$) emissions under the NNSR program, and a minor source for all other pollutants under the Prevention of Significant Deterioration (PSD) regulations. As summarized in Table 1-1, the potential emissions of VOC for the proposed facility exceed the designated New Source Review (NSR) major source threshold. Accordingly, the proposed emission increases are then compared to the applicable de minimis threshold of 25 tons per five calendar-year period to determine that the proposed project is subject to full NNSR review for VOC emissions. Section 4.1.2 presents a detailed discussion of the required elements of the NNSR permit application package for the Lithia Springs facility, including emission offset acquisition, control assessment, alternatives analysis, major source compliance statement, and toxic air pollutant (TAP) assessment.

As a project exceeding the NNSR de minimis threshold subject to emission offset requirements, WestRock is proposing an annual VOC emission limitation equal to the facility's potential to emit VOC or 38 tons per year (tpy). The company will acquire emission reduction credits (ERCs) or offsets to cover the facility's VOC emissions at a ratio of 1.3 to 1as required. For this project, WestRock will be acquiring approximately 49.4 tpy VOC ERCs.

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[1] Memorandum to Stationary Source Permitting Group, Air Protection Branch from Mr. Judson Turner, EPD Director, *"Approval of Standard Operating Procedures for the Expedited Permitting Program in the Georgia EPD – Air Protection Branch"*, May 20, 2013.

Table 1-1. Proposed Facility NSR Source Status

Emission Unit ID	Emission Unit Name	NO_X	CO	VOC	Total PM_{10}	Total $PM_{2.5}$	SO_2	Lead	Total CO_2e[2]
1	Pre-Print Flexo. Press	--	--	34.50	--	--	--	--	--
	Pre-Print Dryers	5.46	4.58	0.30	0.41	0.41	0.03	2.73E-05	6,514
2	Printing Plate Processor	--	--	3.15	--	--	--	--	--
3	Overprint Varnish Storage Tank	--	--	8.49E-06	--	--	--	--	--
4	Solvent Recovery Tank No. 1 & Solvent Recovery Tank No. 2	--	--	2.07E-04	--	--	--	--	--
Total Emissions		5.46	4.58	37.94	0.41	0.41	0.03	2.73E-05	6,514
NSR Major Source Threshold[1]		25	250	25	250	100	100	250	75,000
Above Threshold?		No	No	Yes	No	No	No	No	No

1. The Lithia Springs plant will be a major source located in an existing 8-hour ozone nonattainment area which is also one of the original thirteen Atlanta 1-hour ozone nonattainment counties with a VOC and NO_X major source threshold of 25 tpy. While Douglas County has been redesignated as a $PM_{2.5}$ attainment area, pursuant to Georgia Rules for Air Quality Control (GRAQC) 391-3-1-.03(8)(c)16(i), sources located in Douglas County retain a major source threshold of 100 tpy of $PM_{2.5}$ and SO_2.

2. Greenhouse gas emissions should only be compared to the 75,000 tpy threshold for CO_2e if NNSR or PSD is triggered for another regulated pollutant

No New Source Performance Standards (NSPS) or National Emission Standards for Hazardous Air Pollutants (NESHAP) will apply to the facility.

Several GRAQC requirements apply to this project, including the requirement to obtain a construction permit and general manufacturing and fuel-burning equipment rules. A complete Georgia EPD construction permit application is included in Appendix B, including the required expedited permitting program entry application form. .

1.3. BACT DETERMINATION

Although project emissions exceed the NNSR de minimis emission increase threshold for VOC of 25 tons per five calendar-year period, the facility-wide potential emissions of VOC are less than 100 tpy, so the proposed emission sources are subject to Best Available Control Technology (BACT) requirements for VOC rather than Lowest Achievable Emission Rate (LAER) requirements.[2] Accordingly, a BACT analysis is required for each new VOC emission unit associated with the project. As summarized in the detailed BACT assessment presented in Section 5 of this application, WestRock proposes appropriate work practice standards for the Lithia Springs emission sources. Specifically, WestRock proposes that use of water-based materials containing less than 5% VOC, a 34.5 tons 12-month rolling VOC emission limit, and good operating practices, be established as BACT for the state-of-the-art preprint press. A closed-loop solvent recovery system with good operating practices with a 3.15 tons 12-month rolling VOC emission limit is proposed as BACT for the state-of-the-art plate processor. Larger storage tanks will be equipped with submerged fill pipes to minimize emissions during transfer operations. A detailed BACT analysis is presented in Section 5 of this application package.

[2] GRAQC Chapter 391-3-1-.03(8)(c)13(iii) defines an increase that is not de minimis as a modification for purposes of that subsection, *Additional Provisions for Ozone Non-attainment Areas for Counties that were Formerly Part of the 1-hour ozone Non-Attainment Area"*. Therefore, modifications at a major source with facility potential to emit less than 100 tpy are subject to BACT instead of LAER.

1.4. AIR QUALITY ANALYSIS

An air quality analysis has been performed for facility-wide TAP emissions. No modeling demonstration was required for VOC, as it is a precursor to ozone formation in a nonattainment area. Ozone is unique as the United States Environmental Protection Agency (U.S. EPA) has established a de minimis level based on a mass emission rate (100 tpy) instead of an ambient concentration basis. Georgia EPD historically has not required air dispersion modeling for VOC in the Southeast as the area is NO_X limited as an ozone precursor. No additional adverse effects on visibility at any federally protected Class I areas is anticipated given the low magnitude of emissions of visibility impairing pollutants such as particulate matter (PM), sulfur dioxides (SO_2) and NO_X. Details on this analysis are provided in Section 6 of this application package.

1.5. ADDITIONAL NNSR REQUIREMENTS

An analysis for alternate siting, processes, and control technologies indicate that no viable alternatives exist for the proposed site location, processes, and control technologies.

All major stationary sources owned or operated by WestRock in Georgia are in compliance, or on a schedule for compliance, with all applicable emission limitations and standards.

Refer to Section 7 of this application package for more detailed discussion related to the various additional NNSR requirements, as well as a discussion on additional impacts.

This section presents a detailed description of the proposed facility and emission sources.

2.1. PROJECT OVERVIEW

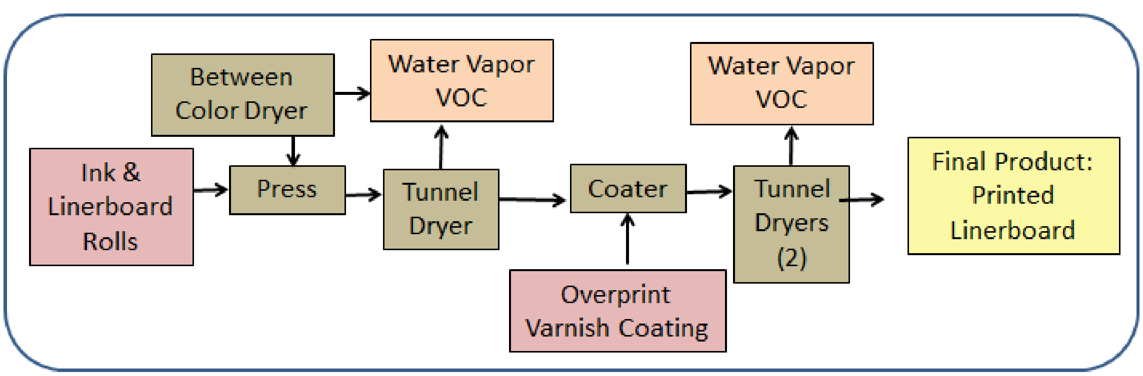
WestRock is planning to install a state-of-the-art, nine color flexographic preprint press, machinery for the production of printing plates and associated equipment in an existing, leased building located at 600 Riverside Parkway, Lithia Springs, Douglas County, Georgia. The Lithia Spring preprint plant will produce high quality printed linerboard that is incorporated into corrugated boxes and other packaging, as well as point of purchase displays.

“Preprint” generally refers to the printing that is done on the outside liner of a box, before the paperboard undergoes corrugating and/or converting operations. The Lithia Springs plant will use a water-based flexographic process to print on various substrates, including kraft and coated white top linerboard, supplied by paper mills within the WestRock system and by third parties. A top coat or overprint varnish will be applied to the printed surface to protect against damage when the sheet is subjected to high heat, steam, hot plate pressure, scuffing from belts and rollers, and rubbing during box forming operations (performed at other manufacturing locations). Drying via in-line natural gas burners occurs after initial ink application and after overprint varnish application. Finished product will be rewound onto a roll or fed through a splicing unit. The finished, preprinted rolls will be shipped to corrugated and folding carton plants, including WestRock facilities throughout the country, where they will be converted into packaging and merchandising display products.

The Lithia Springs production line has been designed to print rolls of linerboard (110" max web width) at a maximum speed of 2,500 feet per minute, with anticipated sustained speeds of 1,500-1,800 feet per minute. The plant’s production volume is targeted at 12,000 rolls per year, but actual volume will be driven by customer demand. The maximum production rate is estimated at 15,000 rolls per year. The main chemicals used in the process will be water-based inks and overprint varnish with a low VOC content (approximately 1-3% by weight on average).

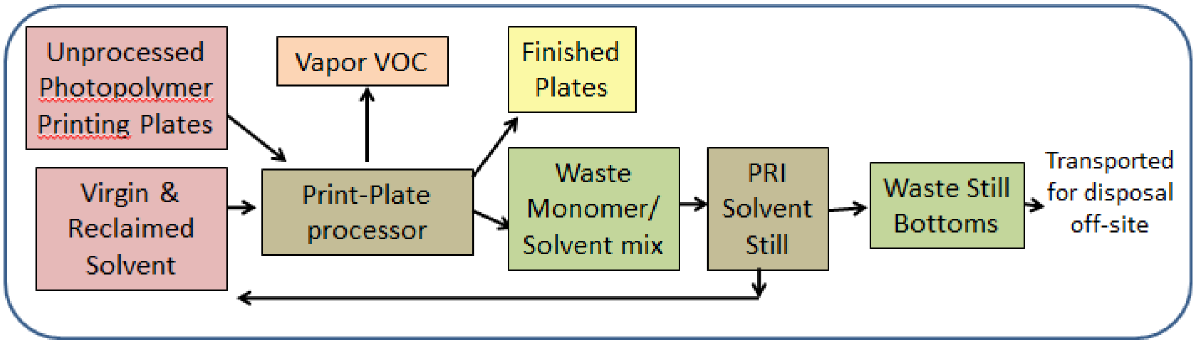
A block flow diagram of the Lithia Springs preprint process is provided in Figure 2-1. The preprint process is an in-line system, but each step has been detailed for reference.

Figure 2-1. Preprint Process Diagram



The press will be supplied with plates made onsite with a digital solvent plate maker. The plate making process involves exposing pre-formed photopolymer sheets to ultraviolet light by a digital laser to form a graphic image through a carbon ablative mask. Once exposed, the sheets are fed into the sheet processor. The sheets are showered with a washout solvent and gently brushed with rotary brushes. Brushes remove unexposed areas creating "relief" in the plate. The plate automatically processes through the machine in a series of post exposures and electrical dryers. Total plate production for the Lithia Springs plant is conservatively estimated at 288,000 square feet per year. The plate-making process is depicted in the block flow diagram shown in Figure 2-2. The plate processor is an automatic in-line system, but each step has been detailed for reference.

Figure 2-2. Platemaking Process Diagram



2.2. EMISSION SOURCES

A building layout depicting the relative location of each emission source is included in Appendix A.

2.2.1. Printing Press

The flexographic printing press to be installed at the Lithia Springs plant is being manufactured by Bobst-North America and has a print web width of 110 inches. The press is approximately 250 feet long by 60 feet wide and 30 feet tall. The top speed of the press is 2,500 feet per minute. The new press will utilize state-of-the-art technology with robotics and digital controls to print rolls faster and more efficiently to minimize excess ink and linerboard losses. A representational photograph of the press that will be installed at the plant is provided in Figure 2-3.

Figure 2-3. Preprint Press

The press will be equipped with eight print units and one downstream station for a total of nine color printing units. Each of the nine printing units will consist of an ink roller and a plate cylinder. The ink roller, also known as an “anilox roller”, carries the ink to a uniform thickness onto the plate cylinder. Eight of the units print against one large central impression drum. The ninth print unit, further downstream, has its own smaller impression drum. Ink, blended in an ink-kitchen using process color bases and extenders, will be pumped into a chambered inking system. The ink chamber consists of a metering doctor blade and an ink containment doctor blade. As the linerboard moves between the plate cylinder and the impression cylinder, the plate cylinder applies pressure to the impression drum, transferring the image onto the linerboard.

The press will be equipped with four natural gas-fired dryers with burner assemblies manufactured by Maxon Valupak: an in-between the color dryer (dryer 1); a tunnel dryer (dryer 2); and two tunnel dryers after the varnish station (dryers 3 and 4). The printed linerboard will be fed into an in-between dryer so the ink is dry before it goes to the next print unit. After the linerboard has been printed with all colors on the central impression drum, the linerboard will be subjected to an overhead tunnel dryer. Then, the linerboard will be run through a downstream printing station to apply overprint varnish. The printed and coated linerboard will then be fed into the overhead gas fired dryer system. The total heat input capacity of the four dryers is 12.7 million British Thermal Units per hour (MMBtu/hr).

2.2.2. Printing Plate Processor

The printing plate processor will produce flexible photopolymer printing relief plates for use on the preprint press. The plate processor, sold by Dupont, will be manufactured by Vianord. The new processor will be 21.9 feet long by 7.2 feet wide and 3.5 feet tall. The entire machine, including the electric dryer and finisher, will be 52.1 feet long and 6.4 feet high. For solvent recovery, a distillation unit will be installed, at 16 feet long by 4 feet wide and 9.5 feet tall. A similar model currently in use at another WestRock plant is shown in Figure 2-4.

Figure 2-4. Plate Processor

Waste monomers (polymer) and waste washout solvent from the plate making process will be hard piped to a batch distillation unit. The reclaimed solvent is mixed with virgin solvent and pumped back into the processor, completing the closed loop recovery cycle. The distillation process generates still bottoms, which are the cooked down remnants of the polymer. This waste is characterized as non-hazardous and will be collected in a drum and shipped off-site for disposal.

2.2.3. Storage Tanks

An overprint varnish storage tank with a capacity of 7,000 gallons will be installed to store overprint varnish that will be applied to the printed surface in the printing press. A wastewater storage tank with a capacity of 7,000 gallons will be installed to store the wash water from cleaning operations at the press. As discussed previously, the facility will use low VOC cleaning materials and water based inks; therefore, the final VOC content in the wash water from cleaning the press, including its storage, is considered negligible.

Two storage tanks each with a capacity of 300 gallons will be installed as part of the solvent recovery system for the plate making process. Material stored in the pre-distillation tank will be mixture of waste solids and washout solvent from the plate making process. Material stored in the post-distillation tank will be still bottoms, which are mostly waste solids from the plate making process.

2.2.4. Fugitive Piping

Fugitive emissions from piping and related components are not included as the printing industry is not on the list of source categories that must quantify fugitive emissions.[3] Even if fugitive piping were considered from equipment in "VOC service" (e.g., piping within the distillation unit used with the plate processor), the emissions from transfers of a low vapor pressure solvent would be minimal. In addition, piping to connect the overprint varnish tank to the press area would not meet the traditional definition of in "VOC service" since the overprint varnish VOC content is well below the 10% threshold commonly held as being in VOC service.[4]

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[3] GRAQC Chapter 391-3-1-.03(8)(c)(10)

[4] See, for example, the definition of "*in VOC service" at 40 CFR 60.481a: In VOC service means that the piece of equipment contains or contacts a process fluid that is at least 10 percent VOC by weight.*

The proposed facility will result in emissions of VOC, NO_X, carbon monoxide (CO), SO_2, PM, particulate matter less than 10 microns in aerodynamic diameter (PM_{10}), particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$), hazardous air pollutants (HAP), and greenhouse gases (GHGs) as carbon dioxide equivalent (CO_2e). Detailed emission calculations are provided in Appendix C.

3.1. PREPRINTING FLEXOGRAPHIC PRESS EMISSIONS

Primary emissions from the printing press are VOC from the use of water-based inks and overprint varnish (1-3% VOC by weight on average). To change ink colors or printing plates on the press, the printer heads are washed with water and detergent. Ink viscosity may be adjusted to prevent ink sticking with the addition of a pH adjuster mixed with water. Diethylene glycol may be added sparingly to inks as a means to slow ink evaporation. The press is also equipped with four natural gas-fired burners with total heat input capacity of 12.7 MMBtu/hr.

3.1.1. VOC and HAP Emissions

VOC and HAP emissions were estimated based on a mix of materials that are currently used at a sister plant located in Jacksonville, Florida. The Jacksonville press, which is 23 years old, produces 4,800 rolls per year. The new Lithia Springs press is expected to have a potential maximum production of 15,000 rolls per year. The potential ink and overprint varnish types to be used on the Lithia Springs press will be similar to those used at the Jacksonville facility, and ink and overprint varnish usage for the new press was estimated as a function of the usage at the Jacksonville unit. By developing a ratio based on the new facility's maximum production rate to the production rate at Jacksonville, and applying this ratio (3.125) to the Jacksonville usages, the maximum anticipated ink and varnish usage rates were estimated for the Lithia Springs press. WestRock conservatively estimated the throughput of miscellaneous chemicals such as diethylene glycol, cleaning detergent, and pH adjuster based on usages for similar WestRock presses.

It was conservatively assumed that 100 percent of VOC, HAP and TAP are emitted. Potential VOC and HAP emissions were estimated using the potential material usage multiplied by the VOC and HAP content for each input material. VOC content of the flexographic inks were estimated based on the weighted average of applicable inks used at the Jacksonville press. As press emissions presume 100 percent volatilization of VOC, HAP, and TAP contained in the applied materials, emissions from the blending of inks with process color bases and extenders in the ink kitchen were not estimated separately as this would result in a double-counting of emissions.

3.1.2. Toxic Air Pollutant Emissions

The TAP content of each input material was based on information provided by suppliers. Most of these data were taken from product data sheets (PDS). TAP content of the flexographic inks were estimated based on the weighted average of applicable inks used at the Jacksonville press. Potential TAP emissions were estimated using the potential input material throughput multiplied by the TAP content for each input material.

3.1.3. Combustion Emissions

For natural gas combustion, emissions of all criteria pollutants, HAP and TAP are estimated using emission factors from AP-42, Section 1.4, *Natural Gas Combustion*, Tables 1.4-1 through 1.4-4, July 1998. It is conservatively assumed that all PM emissions are $PM_{2.5}$ or PM_{10}. Potential emissions of GHGs, specifically carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), were estimated using the fuel-specific emission factors from 40 CFR 98 Subpart C.[5] GHG emissions are presented in terms of CO_2e based on the global warming potentials (GWP) for each GHG provided in 40 CFR 98 Subpart A.[6] Emission factors in pounds per MMBtu were converted to pounds per million standard cubic feet (lb/MMscf) using natural gas heating value obtained from AP-42, Section 1.4. Potential emissions were calculated by assuming an annual operation of 8,760 hours at the maximum heat input capacity.

3.2. PLATE PROCESSOR

WestRock owns and operates four digital solvent plate processors at sister preprint plants, and as a result has developed a simple mass balance approach for tracking VOC emissions from this process (i.e., solvent purchased minus solvent leaving in still bottoms equals air emissions). Based on communications with the vendor, the new, state-of-the-art model being installed at Lithia Springs is expected to use significantly less solvent per plate than the older units at WestRock's sister plants; however, the exact reduction is unquantifiable given the new designs are just beginning to come into operation. As such, VOC emissions were estimated using basic engineering principles for mass transfer and design details of the equipment. These estimates are also within the range of emissions estimated for the sister plants.

3.3. STORAGE TANKS

The overprint varnish storage tank at the proposed facility will have a capacity of 7,000 gallons. The two tanks associated with the solvent recovery system will have a capacity of 300 gallons each. Emissions from these tanks were calculated based on a Trinity Tank Calculation Tool developed using methods and equations from AP-42, November 2006, Chapter 7. As the overprint varnish has a VOC content below 1%, WestRock assumed 100% water in calculating the total vapor loss from the overprint varnish storage tank. VOC and HAP content were multiplied by the total vapor loss to estimate the potential emissions from the overprint varnish storage tank. Material stored at the two tanks associated with the solvent recovery system will be similar to a heavy hydrocarbon. As a surrogate for the low vapor pressure solvent, the characteristics of diesel were used to estimate potential VOC emissions from these tanks.

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[5] 40 CFR 98 Subpart C, Tables C-1 and C-2.

[6] Per 40 CFR 98, Subpart A, Table A-1 (rule effective January 1, 2014), GWP of CO_2, CH_4 and N_2O are 1, 25, and 298 respectively.

WestRock Lithia Springs is subject to certain federal and state air quality regulations. This section summarizes the air permitting requirements and key air quality regulations that apply to the operations at the facility. Specifically, applicability or non-applicability of the following regulatory programs are addressed: NSR permitting, Title V of the 1990 Clean Air Act Amendments, NSPS, NESHAP, Compliance Assurance Monitoring (CAM), and Georgia State Implementation Plan (SIP) regulations.

4.1. FEDERAL REGULATORY APPLICABILITY

4.1.1. NSR Source Classification

The NSR permitting program generally requires that a source obtain a permit and undertake other obligations prior to construction of any project at an industrial facility if the proposed project results in an increase in air pollution in excess of certain threshold levels. The NSR program is comprised of two elements: NNSR and PSD. The NNSR program potentially applies to new construction or modifications that result in emission increases of a particular pollutant from a facility located in an area classified as "nonattainment" for that pollutant. The PSD program applies to new construction or modifications that result in project increases of pollutants from a facility located in an area classified as "attainment" or "unclassifiable" for that pollutant.

The proposed Lithia Springs facility will be located in Douglas County, which is presently designated as "attainment" or "unclassifiable" for all pollutants with respect to the National Ambient Air Quality Standards (NAAQS), except for 8-hour ozone.[7] Accordingly, the new Lithia Springs facility is potentially subject to traditional PSD permitting requirements for PM, PM_{10}, SO_2, CO, NO_X (as a surrogate for NO_2), and lead. It is subject to NNSR permitting requirements for the nonattainment pollutants VOC and NO_X, which are precursors to ozone. Because Douglas County was previously part of the 1997 annual $PM_{2.5}$ nonattainment area, PSD permitting thresholds are based on the prior nonattainment requirements for $PM_{2.5}$ and SO_2 (precursor to $PM_{2.5}$).[8] For ozone, while presently an 8-hour nonattainment county, the resulting NNSR major source and major modification (or de minimis) thresholds derive from the prior inclusion of Douglas county in the 1-hour Atlanta nonattainment area.[9,10]

Table 4-1 presents the facility potential emissions and applicable NSR thresholds.

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[7] 40 CFR 81.311 - Georgia.

[8] GRAQC Chapter 391-3-1-.03(8)(c)16 establishes requirements for PM2.5 nonattainment areas in Georgia, but still explicitly includes references to counties that comprised the original PM2.5 nonattainment area. In other words, despite redesignation of the counties, the Georgia SIP requirements for the original PM2.5 nonattainment counties still apply.

[9] GRAQC Chapter 391-3-1-.03(8)(c) establishes general requirements for nonattainment areas in Georgia.

[10] GRAQC Chapter 391-3-1-.03(8)(c)13 establishes additional requirements for ozone nonattainment areas for counties formerly part of the 1-hour ozone nonattainment area.

Table 4-1. Proposed Facility NSR Source Status

Emission Unit ID	Emission Unit Name	NO_X	CO	VOC	Total PM_{10}	Total $PM_{2.5}$	SO_2	Lead	Total CO_2e[2]
1	Pre-Print Flexo. Press	--	--	34.50	--	--	--	--	--
	Pre-Print Dryers	5.46	4.58	0.30	0.41	0.41	0.03	2.73E-05	6,514
2	Printing Plate Processor	--	--	3.15	--	--	--	--	--
3	Overprint Varnish Storage Tank	--	--	8.49E-06	--	--	--	--	--
4	Solvent Recovery Tank No. 1 & Solvent Recovery Tank No. 2	--	--	2.07E-04	--	--	--	--	--
Total Emissions		5.46	4.58	37.94	0.41	0.41	0.03	2.73E-05	6,514
NSR Major Source Threshold[1]		25	250	25	250	100	100	250	75,000
Above Threshold?		No	No	Yes	No	No	No	No	No

1. The Lithia Springs plant will be a major source located in an existing 8-hour ozone nonattainment area which is also one of the original thirteen Atlanta 1-hour ozone nonattainment counties with a VOC and NO_X major source threshold of 25 tpy. While Douglas County has been redesignated as a $PM_{2.5}$ attainment area, pursuant to Georgia Rules for Air Quality Control (GRAQC) 391-3-1-.03(8)(c)16(i), sources located in Douglas County retain a major source threshold of 100 tpy of $PM_{2.5}$ and SO_2.

2. Greenhouse gas emissions should only be compared to the 75,000 tpy threshold for CO_2e if NNSR or PSD is triggered for another regulated pollutant.

For PSD applicability, the Lithia Springs facility will be considered a true minor source, since potential facility emissions are less than the applicable 250 tpy PSD threshold.[11] For $PM_{2.5}$, the site is also a minor source since potential emissions of $PM_{2.5}$, NO_X, and SO_2 are less than the applicable 100 tpy NNSR threshold.[12] For NNSR applicability related to the 8-hour ozone standard designation, the site is a major source for VOC since potential emissions exceed the applicable 25 tpy NNSR threshold; however, the site is a minor NNSR source for NO_X purposes.[13] In conclusion, the proposed Lithia Springs facility will be a minor source under all NSR programs with the exception of NNSR for VOC.

4.1.2. NSR Major Source Permitting Requirements

As shown in Table 4-1, the Lithia Springs facility is a major source for purposes of the VOC NNSR permitting program. As a major source, it must be determined if the proposed source potential emissions exceed the applicable de minimis threshold for requiring a NNSR construction permit. Per the GRAQC Chapter 391-3-1-.03(8)(c)13.(ii), the applicable de minimis threshold for major NNSR sources is 25 tons aggregated over a contemporaneous five calendar-year period. Accordingly, as the potential proposed facility emissions exceed 25 tons, the proposed changes for this stationary source require a NNSR permit.

[11] The operations proposed for the Lithia Springs plant are not on the PSD "List of 28" for which a 100 tpy major source threshold applies.

[12] GRAQC Chapter 391-3-1-.03(8)(c)16(i)

[13] GRAQC Chapter 391-3-1-.03(8)(c)13(i)

Permitting of a major NNSR source in the Atlanta nonattainment area requires the following:

1. Emission offset acquisition

   Emission increases must be offset by the purchase of Emission Reduction Credits (ERC). External offsets must be obtained at a ratio of 1.3 to 1.[14] Refer to Section 7.4 of this application for more information related to ERC acquisition and retirement.

2. Best Available Control Technology (BACT) or Lowest Achievable Emission Rate (LAER)

   For major sources such as the proposed Lithia Springs operations, with VOC PTE less than 100 tpy but exceeding the de minimis threshold of 25 tons in a five-year period, BACT can be evaluated for the modification instead of LAER. Refer to Section 5 of this application for the required BACT assessment.

3. Demonstrate all major stationary sources owned or operated by WestRock in Georgia are in compliance, or on a schedule for compliance, with all applicable emission limitations and standards.[15] Section 7.3 provides the required compliance statement.

4. Alternatives analysis

   Demonstrate that the benefits of the proposed project significantly outweigh the environmental and social costs imposed as a result of the proposed modification.[16] Refer to Section 7.2 for the alternatives analysis.

In addition to these prescribed elements, Georgia EPD requires completion of a TAP assessment for all NSR major permitting actions. Accordingly, a TAP assessment is presented in Section 6.3.

4.1.3. Title V Operating Permit Program

Title 40 of the Code of Federal Regulations Part 70 (40 CFR 70) establishes the federal Title V operating permit program. Georgia has incorporated the provisions of this federal program in its Title V operating permit program, GRAQC 391-3-1-.03(10). The major source thresholds with respect to Georgia's Title V operating permit program regulations are 10 tpy of a single HAP, 25 tpy of any combination of HAP, and 100 tpy of other regulated pollutants.[17] In addition, facilities located in Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, or Rockdale Counties that have the potential to emit more than 25 tpy of VOC or NO_X are considered major sources. As the WestRock facility is located in Douglas County and has the potential to emit VOC greater than 25 tpy, it is considered a major source with respect to the Title V permitting program, requiring submittal of a Title V permit application, which will also address the applicability of Compliance Assurance Monitoring (CAM) requirements under 40 CFR 64, within 12-months of commencing operation at the new Lithia Springs facility.[18]

4.1.4. New Source Performance Standards

The NSPS, located in 40 CFR 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best demonstrated technology as specified in the applicable provisions. Moreover, any source subject to an NSPS is also subject to the general provisions of NSPS Subpart A, except as noted.

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[14] GRAQC Chapter 391-3-1-.03(8)(c)13(v)

[15] GRAQC Chapter 391-3-1-.03(8)(c)3

[16] GRAQC Chapter 391-3-1-.03(8)(c)4

[17] GRAQC Chapter 391-3-1-.03(10)(b) incorporates by reference 40 CFR 70.2.

[18] GRAQC Chapter 391-3-1-.03(10)(c)(1)(ii)

4.1.4.1. 40 CFR 60 Subpart Dc, Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

NSPS Subpart Dc, *Standards of Performance for Small Industrial Commercial-Institutional Steam Generating Units*, applies to steam generating units with a heat input capacity greater than or equal to 10 MMBtu/hr and less than or equal to 100 MMBtu/hr that have been constructed, modified, or reconstructed after June 9, 1989. The term "steam generating unit" is defined under this regulation as shown below:

> *"Steam generating unit means a device that combusts any fuel and produces steam or heats water or any other heat transfer medium. This term includes any duct burner that combusts fuel and is part of a combined cycle system. This term does not include process heaters as defined in this subpart."*[19]

The proposed burners within the press dryers will not generate steam and provide direct heating. Additionally, all burners are less than 10 MMBtu/hr heat input capacity. Therefore, 40 CFR 60, Subpart Dc does not apply.

4.1.4.2. 40 CFR 60 Subpart Kb, Standards of Performance for Volatile Organic Liquid Storage Vessels

NSPS Subpart Kb, *Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984,* is potentially applicable to volatile organic liquid storage tanks with a capacity greater than 75 cubic meters (approximately 19,800 gallons); however, there are no storage tanks planned for this location that are larger than 19,800 gallons. Therefore, 40 CFR 60, Subpart Kb does not apply.

4.1.4.3. 40 CFR 60 Subpart QQ, Standards of Performance for the Graphic Arts Industry: Publication Rotogravure Printing

NSPS Subpart QQ establishes VOC performance standards for Rotogravure Printing Presses, defined as any device designed to print one color ink on one side of a continuous web or substrate using a gravure cylinder.[20] As the WestRock facility will utilize a flexographic printing press, which does not meet the definition of a rotogravure printing press. Therefore, the facility is not subject to this rule.

4.1.4.4. NSPS Subpart FFF, Standards of Performance for Flexible Vinyl and Urethane Coating and Printing

NSPS Subpart FFF establishes VOC performance standards for rotogravure printing lines (defined as any number of rotogravure print stations and associated dryers capable of printing or coating simultaneously on the same continuous vinyl or urethane web or substrate, which is fed from a continuous roll) that are used to print or coat flexible vinyl or urethane products.[21] As the WestRock facility will have a flexographic printing line, not a rotogravure printing line, the facility is not subject to this rule.

4.1.4.5. NSPS Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

NSPS Subpart IIII, *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines,* applies to new stationary compression ignition (CI) internal combustion engines (ICE) that commence construction after July 1, 2006 or are modified or reconstructed after July 1, 2006. As there are no plans to install such engines at this location, WestRock Lithia Springs is not subject to these requirements.

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[19] 40 CFR 60.41(c)

[20] 40 CFR 60.431(a)

[21] 40 CFR 60.581(a)

4.1.4.6. NSPS Subpart JJJJ, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines

NSPS Subpart JJJJ, *Standards of Performance for Stationary Spark Ignition Internal Combustion Engines*, applies to spark ignition (SI) internal combustion engines (ICE) based on the date each engine was constructed, reconstructed, or modified. As there are no plans to install such engines at this location, WestRock Lithia Springs is not subject to these requirements.

4.1.4.7. Non-Applicability of All Other NSPS

NSPS standards are developed for particular industrial source categories and the applicability of a particular NSPS to a facility can be readily ascertained based on the industrial source category covered. All other NSPS are categorically not applicable to the proposed project.

4.1.5. National Emission Standards for Hazardous Air Pollutants

The NESHAP, located in 40 CFR Part 63, are generally only applicable to major sources of HAP or specifically designated minor (area) sources. The NESHAP apply to sources in specifically regulated industrial source categories (Clean Air Act Section 112(d)) or on a case-by-case basis (Section 112(g)) for facilities not regulated as a specific industrial source type. The NESHAP allowable emission limits are most often established on the basis of a maximum achievable control technology (MACT) determination for the particular major source. A HAP major source is defined as having potential emissions in excess of 25 tpy for total HAP and/or potential emissions in excess of 10 tpy for any individual HAP. The facility is a minor (area) source of HAP emissions. The Lithia Springs facility is classified as an area source of HAP as potential HAP emissions are less than the major source thresholds. The determination of applicability to NESHAP requirements are detailed in the following sections.

4.1.5.1. 40 CFR 63 Subpart KK, Printing and Publishing Industry

Subpart KK, *National Emission Standards for the Printing and Publishing Industry*, only applies to major HAP sources. [22] Therefore, WestRock is not subject to the requirements of Subpart KK.

4.1.5.2. 40 CFR 63 Subpart ZZZZ, Stationary Reciprocating Internal Combustion Engines

Subpart ZZZZ, *National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines*, applies to stationary reciprocating internal combustion engines (RICE) at a major or area source of HAP emissions, excluding those RICE being tested at a test cell/stand. There are no plans to install such engines at this location; therefore, WestRock Lithia Springs is not subject to these requirements.

4.1.5.3. 40 CFR 63 Subpart DDDDD, Industrial, Commercial, and Institutional Boilers and Process Heaters

40 CFR 63 Subpart DDDDD, also known as Boiler MACT, regulates boilers and process heaters only at facilities that are a major source of HAP. Therefore, further consideration of applicability is unwarranted as the Lithia Springs site will be an area source of HAP.

4.1.5.4. 40 CFR 63 Subpart JJJJJJ, Industrial, Commercial, and Institutional Boilers Area Sources

40 CFR 63 Subpart JJJJJJ, commonly referred to as the Area Source Boiler MACT, applies to affected boilers at area sources of HAP. While the Lithia Springs facility is an area source, the facility will operate direct-fired

[22] 40 CFR 63.820(a)(1)

dryers as part of the preprint press. Dryer burners such as this do not meet the affected source definition for a boiler.[23] Therefore, WestRock Lithia Springs is not subject to the requirements of Subpart JJJJJJ.

4.1.5.5. Non-Applicability of All Other NESHAP

NESHAP standards are developed for particular industrial source categories, and the applicability of a particular NESHAP to a facility can be readily ascertained based on the industrial source covered. All other NESHAP are categorically not applicable to the proposed project.

4.2. GEORGIA STATE AIR REGULATIONS

In addition to federal air regulations, GRAQC 391-3-1 establishes regulations applicable at the emission unit level (source specific) and at the facility level. The rules also contain requirements related to the need for construction and/or operating permits.

4.2.1. GRAQC 391-3-1-.02(2) (a)(6) – VOC Emission Standards

Georgia exempts certain sources from the VOC emission standards contained in this section of the rules. Specifically, sources located <u>outside</u> Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale counties whose potential emissions of volatile organic compounds are not more than 100 tons per year shall not be subject to many of the state VOC standards.[24] As Lithia Springs is located in Douglas County, this exemption does not apply. Therefore, potentially applicable requirements of the state VOC standards are reviewed in subsequent sections of this report.

4.2.2. GRAQC 391-3-1-.02(2)(b) – Visible Emissions

This regulation limits the visible emissions from any emissions source, not subject to another visible emissions limitation under GRAQC 391-3-1-.02, to 40% opacity. By using good operations practice for the press and printing plate processor, compliance with the visible emissions standard can be demonstrated. In addition, by burning exclusively natural gas, the emissions from the burners associated with the printing press dryers will be able to meet this requirement.

4.2.3. GRAQC 391-3-1-.02(2)(d) – Fuel Burning Equipment

This regulation limits PM emissions from all fuel-burning equipment. It also limits opacity and NO_X emissions from equipment constructed or modified after January 1, 1972. Georgia defines fuel-burning equipment as:

> *…equipment the primary purpose of which is the production of thermal energy from the combustion of fuel. Such equipment is generally that used for, but not limited to, heating water, generating or superheating steam, heating air as in warm air furnaces, furnishing process heat indirectly, through transfer by fluids or transmissions through process vessel walls.*[25]

Although the dryers on the preprint press will combust natural gas, they are part of a manufacturing piece of equipment for which the primary purpose is not the production of thermal energy. Georgia EPD has not

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[23] 40 CFR 63.11237 defines boiler as an enclosed device using controlled flame combustion in which water is heated to recover thermal energy in the form of steam and/or hot water.

[24] GRAQC Chapter 391-3-1-.02(2)(a)(6)(i)(I)

[25] GRAQC Chapter 391-3-1-.01(cc)

historically treated equipment like the dryers for the proposed preprint press as fuel burning equipment subject to the requirements of Rule (d).[26]

4.2.4. GRAQC 391-3-1-.02(2)(e) – Particulate Emission from Manufacturing Processes

Both the preprint press and the printing plate processor are subject to a particulate matter limit per this process weight rule, derived using the following equation:[27]

$$E = 4.1P^{0.67}$$

Where *E* equals the allowable particulate matter emission rate in pounds per hour and *P* equals the process weight input rate in tons per hour. Predicted emissions of PM from these operations are negligible and are associated with natural gas combustion in the press's direct-fired dryers, ensuring compliance with this requirement.

4.2.5. GRAQC 391-3-1-.02(2)(g) – Sulfur Dioxide

Georgia Rule 391-3-1-.02(2)(g)(2) requires the maximum sulfur content of any fuel combusted to be less than 2.5 percent by weight for any fuel burning source less than 100 MMBtu/hr. The burners associated with the printing press dryers do not meet the definition of fuel burning equipment; however, the term "fuel burning source" is not defined in this regulation. As the dryers do burn fuel, they are subject to this requirement. Compliance is assured due to the inherently low sulfur content of pipeline quality natural gas that will be combusted in the dryers.

4.2.6. GRAQC 391-3-1-.02(2)(w) - VOC Emissions from Paper Coating

Georgia Rule 391-3-1-.02(2)(w) limits VOC emissions from certain paper coating operations located in specifically identified counties, including Douglas County.[28] While WestRock is located in Douglas County, the facility will conduct printing operations, not coating operations (see discussion in Section 4.2.7). In addition, this rule has historically been applied to stand-alone coaters, whereas the press will be an in-line system with ink and varnish applications integrated into the press where the dryers and other functions of a flexographic press are contained. Therefore, this rule is not applicable to the facility.

4.2.7. GRAQC 391-3-1-.02(2)(mm) - VOC Emissions from Graphic Arts Systems

Georgia Rule 391-3-1-.02(2)(mm) limits VOC emissions from packaging rotogravure, publication rotogravure, or flexographic printing facilities. This rule was modified recently with additional VOC control requirements should the metro Atlanta area, which includes Douglas County, continue in nonattainment for the 1997 National Ambient Air Quality Standard for 8-hour ozone after January 1, 2015.[29] As the metro Atlanta area, including Douglas County, was re-designated maintenance status with respect to the 1997 National Ambient Air Quality Standard for ozone prior to January 1, 2015, the additional VOC control requirements are not in effect.[30]

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[26] See Title V permit No. 2759-115-0095-V-05-0 for Packaging Products Corporation which also operates flexographic printing presses.

[27] GRAQC Chapter 391-3-1-.02(2)(a)(e)1(i)

[28] GRAQC Chapter 391-3-1-.02(2)(w)9

[29] GRAQC Chapter 391-2-1-.02(2)(mm)12

[30] https://www3.epa.gov/airquality/greenbook/gbcty.html

The flexographic press will have potential VOC emissions greater than 25 tpy, and as such, will be subject to the emission limitations of Rule (mm). WestRock must utilize any coating or ink with a VOC content, as applied, of less than or equal to 25% by volume, 40% by volume minus water, or 0.5 pounds of VOC per pound of coating solids.[31] Alternately, WestRock may average on a 24-hour weighted basis the VOC content of all inks and coatings, as applied, for compliance with the rule.[32]

4.2.8. GRAQC 391-3-1-.02(2)(tt) – VOC Emissions from Major Sources

Emissions sources at facilities located in Cherokee, Clayton, Cobb, Coweta, Dekalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale Counties with potential VOC emissions exceeding 25 tpy are subject to the requirements of Rule (tt), which requires a case-by-case analysis of VOC reasonably available control technology (RACT) for all emission units not specifically regulated.[33] This VOC RACT set forth in Rule (tt) only affects those sources that are not otherwise subject to another source-specific RACT standard or by a Georgia Rule.[34] Although the preprint press is a major source of VOC, it is subject to Rule (mm) (refer to Section 4.2.7) and therefore is not subject to the requirements of Rule (tt). As the remaining emission units at the facility have potential VOC emissions less than 25 tpy, none of them are subject to the requirements of Rule (tt).

4.2.9. GRAQC 391-3-1-.02(2)(vv) – Volatile Organic Liquid Handling and Storage

Georgia Rule (vv) applies to facilities located in specifically identified counties, including Douglas County, that handle or store volatile organic liquids. Rule (vv) requires the transfer of any volatile organic liquid from any delivery vessel into a stationary storage tank with a capacity greater than 4,000 gallons to be completed using submerged fill methods. The WestRock facility will install a 7,000 gallon tank to store shipments of overprint varnish, which may contain small amounts of volatile organic liquids. Therefore, the storage tank may be subject to the requirements of Rule (vv) and will be designed with submerged fill for transferring liquid into the tank from a delivery vessel. It is also important to note that the facility will have two (2) solvent recovery tanks that will each have 300 gallon capacity. As these tanks will have a capacity of less than 4,000 gallons, they are not subject to the requirements of this rule.

4.2.10. GRAQC 391-3-1-.02(2)(yy) – NO_X Emissions from Major Sources

Emissions sources at facilities located in Cherokee, Clayton, Cobb, Coweta, Dekalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale Counties with potential NO_X emissions exceeding 25 tpy are subject to the requirements of Rule (yy), which requires a case-by-case analysis of NO_X RACT for all emission units not specifically regulated.[35] As no emission units at the WestRock facility have potential NO_X emissions over 25 tpy, the facility is not subject to this rule.

4.2.11. GRAQC 391-3-1-.02(2)(lll) – NO_X Emissions from Fuel-burning Equipment

This regulation limits NO_X emissions from certain fuel-burning equipment. The WestRock facility is located in Douglas County, which is on the list of subject counties. However, none of the fuel burning equipment at WestRock meets the definition of an affected unit, as the maximum design heat input capacities of each dryer on

[31] GRAQC Chapter 391-3-1-.02(2)(mm)1(i)

[32] GRAQC Chapter 391-3-1-.02(2)(mm)2(i)

[33] GRAQC Chapter 391-3-1-.02(2)(tt)(3)

[34] GRAQC Chapter 391-3-1-.02(2)(tt)(5)

[35] GRAQC Chapter 391-3-1-.02(2)(yy)(2)

the preprint press is less than 10 MMBtu/hr. In addition the dryers used in the press do not meet the definition of an affected unit. Therefore, the facility is not subject to this rule.

4.2.12. GRAQC 391-3-1-.02(2)(rrr) - NO_X Emissions from Small Fuel-burning Equipment

This regulation limits the NO_X emissions from certain fuel-burning equipment. Specifically, this rule applies to fuel-burning units that are not subject to GRAQC 391-3-1-.02(2)(jjj) or 391-3-1-.02(2)(lll) and are located at facilities with site-wide potential NO_X emissions of greater than 25 tpy in one of the listed subject counties. As site-wide potential NO_X emissions at the WestRock facility are less than 25 tpy, the facility is not subject to this rule.

4.2.13. GRAQ 391-3-1-.03(8)(c)(13) - Additional Provisions for Ozone Non-Attainment Areas for Counties that were Formerly Part of the 1-hour Ozone Non-Attainment Area

This regulation requires "major" sources (those with potential VOC emissions greater than 25 tpy) in Douglas County undergoing a modification to undergo a control technology evaluation and obtain VOC emissions offsets. The offsets must be obtained at a ratio of 1.3 offsets for each ton of VOC emission increase. Note that NO_X credits are not required to be obtained as the facility is not a major source of NO_X and the increase in NO_X does not constitute a modification. A detailed discussion of these requirements is provided in Section 4.1.2.

4.2.14. GRAQC 391-3-1-.03(10) - Title V Operating Permits

See discussion in Section 4.1.3.

4.2.15. Incorporation of Federal Regulations by Reference

The following federal regulations are incorporated in the GRAQC by reference, with exceptions noted in the rules, and were addressed previously in this application:

- GRAQC 391-3-1-.02(8) – NSPS
- GRAQC 391-3-1-.02(9) – NESHAP
- GRAQC 391-3-1-.02(11) – CAM

This section discusses the regulatory basis for BACT for the project, the approach used by WestRock in completing the BACT analyses, and the BACT determination for the proposed facility and all associated equipment. Supporting documentation is included in Appendix D.

5.1. BACT DEFINITION

Although project emissions exceed the NNSR de minimis emission increase threshold for VOC of 25 tons per five calendar-year period, the facility-wide potential emissions of VOC are less than 100 tpy, so the proposed emission sources are subject to Best Available Control Technology (BACT) requirements for VOC rather than Lowest Achievable Emission Rate (LAER) requirements. BACT is defined in the Clean Air Act implementing regulations as:[36]

> *…an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR parts 60 and 61.*
>
> [primary BACT definition]
>
> *If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results.*
>
> [allowance for secondary BACT standard under certain conditions]

The five steps of a top-down BACT review procedure can be summarized as follows:

- Step 1: Identify all available control technologies;
- Step 2: Eliminate technically infeasible options;
- Step 3: Rank the technical feasible control technologies based upon emission reduction potential;
- Step 4: Evaluate ranked controls based on energy, environmental and/or economic considerations; and
- Step 5: Select BACT.

[36] 40 CFR 52.21(b)(12)

5.2. REDEFINING THE SOURCE

Based on historical practice, as well as recent court rulings, it is clear that BACT applies to the type of source proposed by the applicant, and that redefining the source is not appropriate in a BACT determination.

Although BACT is based on the type of source as proposed by the applicant, the scope of the applicant's ability to define the source is not absolute. As U.S. EPA notes, a key task for the reviewing agency is to determine which parts of the proposed process are inherent to the applicant's purpose and which parts may be changed without changing that purpose. As discussed by U.S. EPA in an opinion on the Prairie State project,

> *We find it significant that all parties here, including Petitioners, agree that Congress intended the permit applicant to have the prerogative to define certain aspects of the proposed facility that may not be redesigned through application of BACT and that other aspects must remain open to redesign through application of BACT.*[37]
>
> …
>
> *When the Administrator first developed* [U.S. EPA's policy against redefining the source] *in* Pennsauken*, the Administrator concluded that permit conditions defining the emissions control systems "are imposed on the source as the applicant has defined it" and that "the source itself is not a condition of the permit."*[38]

Given that some parts of the project are not open for review under BACT, U.S. EPA then discusses that it is the permit reviewer's burden to define the boundary. Based on precedent set in multiple prior U.S. EPA rulings (e.g., Pennsauken County Resource Recovery [1988], Old Dominion Electric Coop [1992], Spokane Regional Waste to Energy [1989]), U.S. EPA stated the following in Prairie State:

> *For these reasons, we conclude that the permit issuer appropriately looks to how the applicant, in proposing the facility, defines the goals, objectives, purpose, or basic design for the proposed facility. Thus, the permit issuer must be mindful that BACT, in most cases, should not be applied to regulate the applicant's objective or purpose for the proposed facility, and therefore, the permit issuer must discern which design elements are inherent to that purpose, articulated for reasons independent of air quality permitting, and which design elements may be changed to achieve pollutant emissions reductions without disrupting the applicant's basic business purpose for the proposed facility.* [39]

U.S. EPA's opinion in Prairie State was upheld on appeal to the Seventh Circuit Court of Appeals, where the court affirmed the substantial deference due the permitting authority on defining the demarcation point.[40]

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[37] U.S. EPA Environmental Appeals Board decision, *In re: Prairie State Generating Company*. PSD Appeal No. 05-05, decided August 24, 2006, Page 26.

[38] U.S. EPA Environmental Appeals Board decision, *In re: Prairie State Generating Company*. PSD Appeal No. 05-05, decided August 24, 2006, Page 29.

[39] U.S. EPA Environmental Appeals Board decision, *In re: Prairie State Generating Company*. PSD Appeal No. 05-05, decided August 24, 2006, Page 30.

[40] *Sierra Club v. EPA and Prairie State Generating Company LLC*, Seventh Circuit Court of Appeals, No. 06-3907, August 24, 2007. Rehearing denied October 11, 2007, 499 F.3d 653 (7th Cir. 2007).

Taken as a whole, the permitting agency is tasked with determining which controls are appropriate, but the discretion of the agency does not extend to a point requiring the applicant to redefine the source.

5.2.1. Defining the Source

Primary emissions from the printing press and plate processor are VOC from the use of water-based inks and overprint varnish at the press and raw material use at the processor. A small amount of NO_X, CO, PM, PM_{10}, $PM_{2.5}$, SO_2, VOC and greenhouse gases are expected from the natural gas combustion in the preprint press dryers, which have a combined heat input capacity of 12.7 MMBtu/hr. Miscellaneous sources, which include overprint varnish and other material storage tanks, contribute only a minor amount of VOC emissions. As such, emissions from the project are predominantly driven by the press and the plate maker.

To assist in meeting the BACT limit, the source must consider production processes or available methods, systems or techniques, as long as those considerations do not redefine the source. WestRock's objective in pursuing the proposed project is to construct and operate a flexographic press with natural gas-fired dryers, a digital printing plate processor with a solvent recovery system, and associated storage tanks. The BACT selections are based on the design constraints discussed herein, and any potential control methods that would require WestRock to redefine these sources has been explained as such, and were not considered further.

Printing Press
For the press operations, flexographic technology is currently the only viable option for creating the products required by WestRock's customer base. A flexographic press was selected as it is the most effective means of producing the type of product that is planned for this location. The proposed preprint press is a state-of-the-art unit with in-line systems that have several automated features. The result is less waste and more efficient use of raw materials, as compared to existing presses using similar methods of operation. Further, the press uses clean natural gas as fuel for the dryers and is designed to operate at high speeds and to produce high-quality graphics using water-based inks.

Plate Making
For plate making, while multiple technologies exist to make plates for the flexographic printing process, the digital technology was specifically selected by WestRock for the facility. The digital plate making process proposed for the project uses a pre-formed, semi-polymerized sheet plate that undergoes digital laser imaging through a carbon ablative mask. The plate is then processed through an automated processor. Within the WestRock Graphics Solutions Business Units, there are four similar plate making systems in use. The use of this technology allows for consistency in production across the entire division, as well as the development of institutional operational expertise. Also, the press will be "characterized" or "fingerprinted" to these plates.

The plate making technology proposed for the project is a proprietary and unique process created within WestRock's R&D group. The technology produces unique and exceptional print results which cannot be replicated with other printing processes. The exceptional quality of the product produced with these plates that provides the company with a competitive advantage in the marketplace. In addition, the plate making system to be installed by WestRock is state-of-the-art technology that uses an improved volumetric pump and sensitive pressure sensor to allow precision solid content analysis, along with an automatic monomer replenishment system. This design results in reduced monomer use as compared to other, existing plate processors.

The application of any of the other plate making technologies described below would redefine the source.

- Thermal/Digital Photopolymer Plates
- Water Washable/Digital Sheet Plates
- Water Washable Liquid Plates

Thermal/Digital Photopolymer Plates are a pre-formed, semi-polymerized sheet plate utilizing digital laser imaging on a carbon ablative mask, processed through a thermal "wicking" processor. The primary issue with this technology is that it is not suitable for preprint applications, which is the business objective for this location. Thermal plates do not produce the type of plates that are required for very high end detailed flexography. The thermal plates also respond differently during printing due to inks, anilox and other print variables. The inability to meet pre-established customer expectations will present significant business issues for WestRock. The proprietary and unique process created within WestRock's internal R&D group, which gives unique and exceptional print results plus competitive advantage in the marketplace, cannot be replicated in thermal plates.

WestRock consulted with DuPont (the leading thermal plate manufacturer and an industry leader) with the potential use of thermal plates on preprint applications. According to DuPont, in comparison to the plate making process developed internally by WestRock, the productivity of thermal plate making systems is not comparable. The primary reason is the full automation of the WestRock process.. While DuPont testing has shown that good print quality can be obtained from plates made using the thermal process, the thermal process cannot produce as many high quality plates as the technology developed by WestRock.

Water Washable/Digital Sheet Plates are a pre-formed, semi-polymerized sheet form plate utilizing digital laser imaging and a carbon mask, with a process that is somewhat unknown and a product that is manufactured offshore. No such system is presently utilized in the WestRock Graphics Solutions Prepress Business Units. In fact, WestRock is unaware of any competitor across any print disciplines that use this technology today. It is more of a conceptual technology rather than a commercially viable option at this time. Additionally, industry anecdotal concerns are plate wear and longevity, and there is a likely inability to meet pre-established customer expectations with this technology. Aqueous plates have an even greater limitation on the ability to produce the full range of thicknesses planned for this site.

Water Washable/Liquid Plates are a basic and somewhat rudimentary unpolymerized "liquid resin" plate utilizing analog film to create an image, processed through a manual system using water wash and detergents to remove waste polymers. This technology is not suitable for preprint applications, which demand a much higher print fidelity, which liquid platemaking simply cannot achieve, resulting in an absolute inability to meet customer expectations. In addition, the liquid processing system is manual, requiring the plate to be physically moved through six (6) pieces of equipment (Reclaim, Washout, Rinse, Dryer, Finisher, Post-Expose) such that throughput could not meet the requirements for this site. WestRock consulted with MacDermid (the leading water washable/liquid plate manufacturer and an industry leader) with the potential use of these plates on preprint applications. There are no such applications specific to WestRock's customer base.

5.3. BACT REQUIREMENT

As discussed in Section 4.1.2, the Lithia Springs facility is a major source for purposes of the VOC NNSR permitting program. As the VOC PTE from the facility is less than 100 tpy but project emissions exceed the de minimis threshold of 25 tons in a five-year period, BACT can be evaluated instead of LAER. Therefore, a VOC BACT analysis was conducted for the preprint flexographic press, printing plate processor, the overprint varnish storage tank and two storage tanks from the solvent recovery system.

5.4. BACT ASSESSMENT METHODOLOGY

The following sections provide detail on the BACT assessment methodology utilized in preparing the BACT analysis for the proposed new emission units. As previously noted, the minimum control efficiency to be considered in a BACT assessment must result in an emission rate less than or equal to any applicable NSPS or NESHAP emission rate for the source. There are no NSPS or NESHAP standards applying to press printing and plate making processes, so there is no emission limit that would be equivalent to BACT floor.

5.4.1. Identification of Potential Control Technologies (Step 1)

Potentially applicable emission control technologies were identified by researching the U.S. EPA's control technology database, technical literature, control equipment vendor information, state permitting authority files, and by using process knowledge and engineering experience. The Reasonably Available Control Technology (RACT)/BACT/ LAER Clearinghouse (RBLC), a database made available to the public through the U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) Technology Transfer Network (TTN), lists technologies and corresponding emission limits that have been approved by regulatory agencies in permit actions.[41] These technologies are grouped into categories by industry and can be referenced in determining what emissions levels were proposed for similar types of emissions units.

RBLC database searches were performed in June 2016 to initially identify the emission control technologies and emission levels that were determined by permitting authorities as BACT since 2000 for printing/graphic arts sources that are comparable to the press printing and plate making processes. Appendix D presents summary tables of relevant BACT determinations for the following categories that were searched:

- Miscellaneous Metal Parts and Products Surface Coating (RBLC Code 41.013)
- Paper, Plastic & Foil Web Surface Coating (RBLC Code 41.014)
- Printing – Forms (RBLC Code 41.019)
- Printing – News Print (RBLC Code 41.020)
- Printing – Packaging (RBLC Code 41.021)
- Printing – Publication (RBLC Code 41.022)
- Printing/Publication (RBLC Code 41.023)
- Other Surface Coating/Printing/Graphic Arts Sources (RBLC Code 41.999)

In addition to the RBLC search, VOC emission controls were identified from other industries (e.g., wood products, chemical manufacturing) that, if employed, would be considered a "technology transfer" application, which generally requires more time, effort, and cost to make this transition into a new field.

5.4.2. Elimination of Technically Infeasible Options (Step 2)

After the available control technologies have been identified, each technology is evaluated with respect to its technical feasibility in controlling emissions from the source in question. The first question in determining whether a technology is feasible is whether it is demonstrated. If so, it is deemed feasible. Whether a control technology is demonstrated is considered a relatively basic determination.

An undemonstrated technology is only technically feasible if it is "available" and "applicable." A control technology or process is only considered available if it has reached the licensing and commercial sales phase of

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[41] cfpub.epa.gov/RBLC/

development and is “commercially available”.[42] Control technologies in the R&D and pilot scale phases are not considered available. Based on U.S. EPA guidance, an available control technology is presumed to be applicable if it has been permitted or actually implemented by a similar source. Decisions about technical feasibility of a control option consider the physical or chemical properties of the emissions stream in comparison to emissions streams from similar sources successfully implementing the control alternative. The NSR Manual explains the concept of applicability as follows: “An available technology is ‘applicable’ if it can reasonably be installed and operated on the source type under consideration.”[43] Applicability of a technology is determined by technical judgment and consideration of the use of the technology on similar sources as described in the NSR Manual, on which U.S. EPA has relied for decisions regarding applicability.

5.4.3. Ranking Remaining Control Technologies by Control Effectiveness (Step 3)

All remaining technically feasible control options are ranked based on their overall control effectiveness for controlling the pollutant(s) of concern. In certain cases in this BACT analysis, ranking the control technologies based on emissions reduction is not useful in determining BACT. When two technologies are compared that are not mutually exclusive (e.g., two work practices that do not conflict, or design and work practices), both may be selected as BACT. There are also cases where one technology’s quantified emission reduction may depend on the use of another technology (e.g., a vendor’s guarantee of efficiency may assume that good work practices and the vendor’s recommended maintenance package are implemented). However, when a technology is mutually exclusive, or when a clear quantification of the technology’s emissions reduction ability is available, then the technologies are ranked for clarity.

5.4.4. Evaluating Most Effective Controls (Step 4)

After identifying and ranking available and technically feasible control technologies, the economic, environmental, and energy impacts are evaluated to select the best control option. If adverse collateral impacts do not disqualify the top-ranked option from consideration it is selected as the basis for the BACT limit. Alternatively, in the judgment of the permitting agency, if unreasonable adverse economic, environmental, or energy impacts are associated with the top control option, the next most stringent option is evaluated. This process continues until a control technology is identified.

Permitting authorities have historically considered the effects of multiple pollutants in the application of BACT as part of the review process, including the environmental impacts of collateral emissions resulting from the implementation of emission control technologies. To clarify the permitting agency’s expectations with respect to the BACT evaluation process, states have sometimes prioritized the reduction of one pollutant above another. For example, technologies historically used to control VOC emissions frequently cause increases in NO_X emissions (e.g., thermal oxidation). In areas of the country where the formation of ozone is “NO_X-limited”, permitting authorities have prioritized the reduction of additional NO_X emissions over the reduction of VOC emissions in approving VOC control strategies as BACT.

5.4.4.1. Economic Feasibility Calculation Process

Economic analyses are performed to compare total costs (capital and annual operating) for potential control technologies. Capital costs include the initial cost of the components intrinsic to the complete control system.

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[42] NSR Workshop Manual (Draft), Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (NNSR) Permitting, page B.18.

[43] Ibid.

Annual operating costs include the financial requirements to operate the control system on an annual basis and include overhead, maintenance, outages, raw materials, and utilities.

For a full BACT analysis, the capital cost estimating technique used is based on a factored method of determining direct and indirect installation costs. That is, installation costs are expressed as a function of known equipment costs, consistent with the latest U.S. EPA OAQPS guidance manual on estimating control technology costs.[44] Annual costs are comprised of direct and indirect operating costs. Direct annual costs include labor, maintenance, replacement parts, raw materials, utilities, and waste disposal. Indirect operating costs include plant overhead, taxes, insurance, general administration, and capital charges. Replacement costs, such as the cost of a carbon bed replacement for an adsorber, are included where applicable, while raw material costs are estimated based upon the unit cost and annual consumption.

5.4.5. Selecting BACT (Step 5)

In the final step, the BACT emission limit is determined for each emission unit under review based on evaluations from the previous step. Although the first four steps of the top-down BACT process involve technical and economic evaluations of potential control options (i.e., defining the appropriate technology), the selection of BACT in the fifth step involves an evaluation of emission rates achievable with the selected control technology. BACT is an emission limit unless technological or economic limitations of the measurement methodology would make the imposition of an emissions standard infeasible, in which case a work practice or operating standard can be imposed.

5.5. AFFECTED UNIT

Prior to initiating the top-down step-by-step analysis, a more detailed description of emission units potentially subject to BACT requirements is provided.

5.5.1. Flexographic Printing Press

VOC released from the preprint press is largely due to the application of low-VOC, water-based inks in up to nine separate printing decks configured on a wide-web (up to 110-inch width) central impression flexographic printing press. The inks are preliminarily heatset in between deck dryers coupled to each printing deck, followed by final ink curing in a tunnel dryer that completes the curing process. The vast majority of the VOC that evaporates in this process occurs within the various dryers that cure the inks. The partial pressures of ink VOC constituents within the waterborne ink formulations are extremely low, and minimal fugitive emission loss outside of the dryers is expected. The decorated web exits the tunnel dryer, passes through chill rollers for required cooling, and then proceeds into a stack coater that applies a water-based overprint varnish. This overprint varnish has even less VOC than the inks, contains over 70% water, and is also expected to create negligible fugitive VOC emissions outside of the stack coater dryers. The coated web exiting the stack coater then sequentially passes through two tunnel dryers located on the bridge between the stack coater to the final set of chill rollers. The decorated and coated web is cooled and then rewound at the exit of the printing press.

Low-VOC, waterborne inks formulated for this flexographic press can be generally characterized as containing about 30%-to-35% solids (resin / pigment / other additives), 3%-4% VOC, and the balance of the volatile portion as water (>60%). The composition of ink VOC is dominated by three compounds at the following approximate ratio: 80% monoethanolamine, 15% propylene glycol, and 5% diethylene glycol ethyl ether. The

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[44] U.S. EPA, OAQPS Control Cost Manual, 6th edition, EPA 452/B-02-001, July 2002. www.epa.gov/ttn/catc/dir1/c_allchs.pdf

estimated aggregate partial pressure of these VOC constituents in the aqueous ink volatiles mixture is presented in Section D.1 of Appendix D. The aggregate VOC partial pressure at ambient temperature outside of the press dryers is negligible (< 0.005 mmHg) and is approximately 0.1% of the value for the elevated temperature (> 280 ^{o}F) within the dryers. Moreover, given that the web is partially cured when exiting the printing decks and the length of web runs exposed to plant air, resulting in potential fugitive losses, is less than the web run length in the dryers. Accordingly, the VOC fugitive losses occurring outside of the press dryers are expected to be negligible.

The same analysis for the overprint varnish is presented in Section D.1 of Appendix D. The majority of the overprint varnish VOC consists of three compounds at the following approximate ratio: 60% residual monomer (assumed to be acrylic acid), 25% butoxyethanol, and 15% diethylaminoethanol. The estimated aggregate partial pressure of these varnish VOC constituents at ambient temperature outside of the press dryers is also negligible (< 0.004 mmHg) and is less than 4% of the aggregate VOC partial pressure for the elevated temperature within the dryers. The length of web run from the stack coater discharge to the first tunnel dryer is considerably less than the combined web run length in both stack coater tunnel dryers, and the dryer hot air velocities impinging on the web are far greater than air velocity outside the dryers. Given all of these factors, the potential surface evaporative losses for overprint varnish outside of the dryers (fugitive emissions) are also expected to be negligible. Accordingly, the BACT analysis for the flexographic printing press does not consider additional VOC capture devices (total enclosures or close capture hoods) beyond the substantial capture achieved by the press dryers.

5.5.2. Printing Plate Processor

VOC emissions from the printing plate processor are generated by evaporative losses from a low-vapor pressure solvent used in the process. Pre-formed photopolymer sheets are exposed to ultraviolet light by a digital laser to create a graphic image on the polymer. Once exposed to the UV light source, the plates are fed into the printing plate processor, where a low-vapor pressure solvent is flowed across the polymer surface and rotary brushes gently remove the dissolving polymer that was not exposed to the UV light. This process creates “relief” in the polymer layer on the plate, thus the recessed image. After the excess solvent/polymer solution is brushed away, the plate advances to a drying section to remove any residual solvent remaining on the surface or absorbed into the polymer.

The wash-out section of the plate processor operates at a slightly elevated temperature (30 ^{o}C) and is ventilated at approximately 350 scfm. The drying section operates at approximately 60 ^{o}C and is also ventilated at 350 scfm. These two ventilation sections carry away virtually all of the VOC emitted from the plate making process. The VOC constituents in the plate processor solvent are a relatively equal mix of benzyl alcohol, aliphatic esters, and synthetic hydrocarbons, with an estimated vapor pressure of 1.1 mmHg @ 110 ^{o}F, a maximum VOC outlet concentration of 184 ppmv, and an anticipated actual VOC outlet concentration of 75 ppmv. Section D.2 of Appendix D depicts the processor equipment.

The plate processor washout and drying section are totally enclosed, thus 100% capture of the VOC emission will be achieved by the planned ventilation system. No additional capture devices (hoods or enclosures) are considered in the BACT analysis.

5.5.3. Small Emission Sources

Certain equipment or activities that support this printing operation emit small to negligible quantities of VOC emissions. Such sources include the following:

- Ink kitchen: mixing of the final as-applied ink formulations the flexographic press[45]
- Distillation Unit: batch still that reclaims spent solvent from the plate processor
- Combustion devices: natural gas fired supply air heaters for the press dryers
- Overprint varnish aboveground storage tank (7,000 gallon capacity)
- Two storage tanks associated with the vapor recovery system of the plate processor

Given the negligible and trivial quantity of emissions from these sources, use of add-on controls would be deemed cost prohibitive, if any sort of control was even viable. Therefore, these small emission sources are excluded from the remainder of the BACT assessment.

5.6. BACT EVALUATION

5.6.1. Step 1: Identify all Available Control Technologies

Candidate control options identified from the RBLC search, permit review, and the literature review include those classified as pollution reduction techniques. VOC reduction options include:

- Thermal Oxidation
- Catalytic Oxidation
- Carbon Adsorption
- Biofiltration
- Condensation
- Wet Scrubbing
- Good Operating Practices

The control technologies are briefly discussed in the following sections.

5.6.1.1. Thermal Oxidation

Thermal oxidizers treat VOC by oxidizing the organic compounds to CO_2 and water vapor at a high temperature with a residence time between one-half second and one second. Thermal oxidizers can be designed as conventional thermal units, recuperative units, or regenerative thermal oxidizers (RTO). A conventional thermal oxidizer does not have heat recovery capability. Therefore, the fuel cost is extremely high and is not suitable for high volume flow applications. In a recuperative unit, the contaminated inlet air is preheated by the combustion exhaust gas stream through an air-to-air heat exchanger, with thermal efficiencies ranging up to 70% depending on the number of heat exchanger passes. An RTO can be designed with a thermal recovery efficiency approaching 98%, but are commonly designed for 95% heat recovery. Because of their robust thermal efficiencies, RTOs are often used to control relatively dilute VOC emissions in high volume gas streams.

An RTO generally consists of at least two chambers packed with ceramic media. The VOC-laden gas enters one hot ceramic bed where the gas is heated to the desired combustion temperature (typically 1,500^{o}F or higher). Auxiliary fuel may be required in this stage, depending on the heating value of the inlet gas. After reacting in the combustion zone, the gas then passes through the other ceramic bed, where the heat released from combustion

[45] The ink kitchen is not represented as a separate emission source in calculation estimates given the conservative assumption for the preprint press that all VOC in utilized materials volatilize. Therefore, inclusion of emissions from the ink kitchen would be double counting.

is recovered and stored in the bed. The process flow is then switched so that the polluted gas is preheated by the ceramic bed. The system is operated in an alternating cycle. RTOs normally can achieve 98% destruction efficiency, unless a vent stream with very low VOC concentrations is being treated.

5.6.1.2. Catalytic Oxidization

Like an RTO, a regenerative catalytic oxidizer (RCO) converts VOC to CO_2 and water vapor. The RCO design is similar to the RTO with the exception that catalyst is located above the ceramic media beds. The catalyst effectively lowers the activation energy required for the oxidation so that the oxidation can be accomplished at a lower temperature than in an RTO (typically a pre-heat temperature around 650^{o}F). As a result, the consumption of auxiliary fuel is lower than for an RTO. However, the additional catalyst layer increases the pressure drop through the unit which increases the electric power consumption of the system fan. Also, VOC destruction efficiency may be slightly lower (95-97%) in a catalytic unit than in an RTO (98%).

5.6.1.3. Carbon Adsorption

Carbon adsorption systems can potentially be used to remove VOC from exhaust gas streams. The core component of a carbon adsorption system is an activated carbon bed contained in a steel vessel. The VOC-laden gas passes through the carbon bed where the VOC is adsorbed on the activated carbon. The cleaned gas is discharged to the atmosphere. The spent carbon can be regenerated on site if the adsorber is configured as a regenerative unit (typically with multiple vessels allowing one or more to be off-line for steaming / drying / cooling). Less expensive one-trip carbon canisters can also be used where the spent carbon is regenerated off-site, typically by the activated carbon supplier. Spent carbon is regenerated by using steam or heat to displace adsorbed organic compounds at high temperatures. The VOC stripped from the carbon is either recovered or burned in a separate device.

The adsorption capacity for an adsorbent is defined on graphs that plot vapor concentration versus adsorption capacity at a constant temperature, and are referred to as “adsorption isotherms”. The adsorption isotherm defines the pounds of material that can be adsorbed per pound of adsorbent. The adsorption isotherm is different for each type of adsorbent and each type of pollutant, and is temperature specific. For this reason, a heat exchanger may be used in tandem with a carbon system to achieve a desired temperature for optimal adsorption.

5.6.1.4. Biofiltration

In biofiltration, off-gases containing biodegradable organic compounds are vented, under controlled temperature and humidity, through a biologically active material. The process uses a biofilm containing a population of microorganisms immobilized on a porous substrate such as peat, soil, sand, wood, compost, or numerous synthetic media. As an air stream passes through the biofilter, the contaminants in the air stream partition from the gaseous phase to the liquid phase of the biofilm. Once contaminants pass into the liquid phase, they become available for biodegradation by the microorganisms inhabiting the biofilm. The control efficiency of biofilters are reported to range from approximately 80% to 99%, depending on the specific pollutant evaluated (i.e., microorganisms prefer short chain hydrocarbons). Factors that affect the performance of the bioreactor include temperature, moisture, nutrients, acidity, and microbe population. Microbes can survive at temperatures between 60 to 105°F in a moist, neutral environment (pH=7) and need to be fed a diet of balanced nutrients.

U.S. EPA identifies three types of bioreactors: the basic biofilter, the biotrickling filter, and the bioscrubber. The basic biofilter consists of a large flat surface covered with bed media, such as peat, bark, coarse soil, or gravel.

Air moves through the bed and comes into contact with the liquid film containing the biomass, VOC are absorbed into the liquid film, and then the microbes biodegrade the pollutants. Basic biofilters have significant disadvantages, in that they require a very large footprint and do not provide a continuous liquid flow where pH adjustments or nutrient additions can be made. In a biotrickling filter, liquid is sprayed onto a plastic media, where a biofilm is formed. As the air passes through the media, pollutants are absorbed into the liquid phase and come into contact with the microbes. The continuous flow of liquid allows the operator to neutralize acid buildup and make nutrient additions, when required. The plastic bed can have a void space of up to 95%, which greatly reduces pressure drop across the packing, and the synthetic material is not consumed by the biomass. Bioscrubbers utilize a chemical scrubber and are more similar to chemical-processing equipment than other bioreactors. Discharge effluent is collected in a storage tank which allows additional time for the microbes to consume pollutants.

5.6.1.5. Condensation

Condensers operate by lowering the temperature of the exhaust gas streams containing condensable VOC to a temperature at which the target VOC's vapor pressure is lower than its entering partial pressure. This condition is commonly referred to as the saturation point. Before the VOC can condense, any sensible heat present in the exhaust gas above the saturation point must be removed. Cooling the exhaust stream to a temperature below the saturation point removes the latent heat from the exhaust and allows the VOC to condense on the surface of the condenser tubes for collection and recycle to the process or disposal to an appropriate location. The tubes located within the condenser contain re-circulating cooling liquid that provides a heat sink for rejecting both sensible and latent heat from the hot exhaust gas stream. Available cooling fluids (depending on the necessary outlet temperature of the exhaust stream to achieve high levels of recovery for the condensable VOC) include chilled water, brine, glycol solutions, or refrigerants. Once the cooling liquid is passed through the condenser, it is chilled to the required condenser inlet temperature and recycled back to the cooling liquid inlet of the condenser. [46]

The VOC removal efficiency achieved by a condenser, as a sole add-on control device, is a function of: 1) the heat capacity and temperature of the inlet exhaust stream, 2) the heat transfer characteristics of the condenser (including the heat transfer area and the heat transfer coefficient), and 3) the outlet temperature of the exhaust gas exiting the condenser. Condensers are most effective in single component systems involving emission streams with a high percentage of a condensable VOC, because less heat must be removed from the exhaust gas to reduce the sensible heat of non-condensable gases and the required condenser temperature to achieve high levels of recovery. Unlike other VOC control devices for which quantifying control efficiency can require emissions testing, only the outlet exhaust gas temperature is required to estimate the VOC control efficiency of a condenser if the temperature, VOC concentration, and flow rate of the non-condensables in the inlet exhaust stream are all known. Since the control efficiency of a condenser is dynamic based on the outlet temperature and inlet concentration of VOC in the exhaust stream, condensers exhibit a wide range of VOC control efficiency from as low as 50 percent to as high as 99 percent. [47,48]

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[46] U.S. EPA, Office of Air Quality Planning and Standards, Control of Volatile Organic compound Emissions from Batch Processes – Alternative Control Technique Information Document, EPA-450/R-94-020, February 1994.

[47] Ibid.

[48] U.S. EPA, Clean Air Technology Center, Technical Bulletin Refrigerated Condensers for Control of Organic Air Emissions, EPA 456/R-01-004, December 2001.

5.6.1.6. Wet Scrubbing

Wet scrubbing of VOC in a gas stream is a potential method for reducing VOC emissions. Wet scrubbing is an absorption process typically conducted with a packed column where pollutants are absorbed by a counter-current flow of scrubbing liquid. Packed-bed scrubbers consist of a chamber of variously-shaped packing material that provide a large surface area liquid-gas contact. Scrubbing liquid is evenly introduced above the packing and flows down through the bed.

There are several limiting factors with respect to controlling organic vapors with a wet scrubber. Scrubbing requires that the VOC that are in the exhaust gas stream are highly soluble in the scrubbing liquid. Typically, water is selected due to favorable economics and solubility for selected pollutants. For pollutants with little to no water solubility, another solvent such as hydrocarbon oils can be selected, although the availability of large quantities of solvents other than water is generally impractical. Since the design approach requires parameters specific to the pollutant(s), the availability of vapor/liquid equilibrium data is crucial. Another consideration in the application of a wet scrubber is the treatment or disposal of the VOC-laden scrubbing liquid, which must be cost effective to prove the viability of the technology.

Wet scrubbing technology also can remove particulate matter and moisture along with VOC without the temperature limitations that other technologies may exhibit. Removal efficiencies vary for each pollutant/solvent system and with the type of scrubber utilized, but are typically in excess of 90%.

5.6.1.7. Rotary Concentrator

Rotary concentrators are designed to take large volumes of air (typically 20,000 to 60,000 scfm) containing a very low concentration of VOC and adsorb these organic materials onto a zeolite adsorbent material. This adsorbent material is mounted in the "rim" of a continuously rotating zeolite "wheel". The VOC-laden air passes from the outside of the wheel, through the "rim" of the wheel (where the VOC are removed onto the adsorbent), and into the interior of the wheel, from which the now cleaned air can be discharged to the atmosphere. The adsorbed VOC is then stripped with a hot air source into a much more concentrated gas stream (typically at least 10 times higher VOC concentrations) for treatment in an integral oxidizer within the system.

The process starts by drawing the dilute VOC laden air stream through a close coupled pre-filtration system to prevent particulate buildup on the zeolite wheel. As the process exits the pre-filtration system, it enters the zeolite rotor, depositing the VOC onto the zeolite media, and then passes through an induced draft fan out to the exhaust stack. Under the appropriate operating conditions and for VOC constituents amenable to zeolite adsorption, the zeolite rotary concentrator can provide up to 95% VOC removal efficiency and thus may provide a viable technology for large volume-low concentration VOC stream abatement.

An area of about 15-20% of the "wheel" (rotor) is out of the adsorption flow path. This 15-20% area of the rotor is sealed from the balance of the rotor and is contacted with hot, clean air -- pre-heated to 350-400°F by recovering heat from the stack of the integral thermal oxidizer in the system. The hot, clean air desorbs the VOC from the adsorbent in the wheel and the adsorbent media is then cooled to below 100°F. The volume of the desorbing clean, hot air stream is typically 1/10 or less that of the original incoming air stream. This air stream which now contains almost all the VOC at about ten times their original concentration is sent for VOC destruction, generally to a recuperative thermal oxidizer. Typical overall removal / recovery efficiencies of the rotary concentrators is in the 96-99% range.

5.6.1.8. Low VOC Materials and Good Operating Practices

The use of low-VOC materials (waterborne inks / varnishes, aqueous cleaners, etc.) in lieu of traditional solvent-based technologies used on flexographic printing presses results in significant VOC emission reductions. U.S. EPA estimates that solvent based flexographic inks would typically contain approximately 75% VOC (as-applied)[49]. If waterborne inks containing less than 5% VOC are substituted for these solvent-based inks, an equivalent emission reduction of more than 90% is achieved. Similarly, the use of aqueous cleaners with very low VOC contents instead of general purpose solvent cleaners (e.g., isopropyl alcohol) that have been commonly used for press wash-up will also create significant VOC emission reductions.

Good operating practices are deemed BACT for equipment in which all other control technologies or techniques are eliminated as technically or economically infeasible. For the preprint flexographic press and printing plate processor, good operating practices include use of low VOC solvent and ink, water based ink, proper operation of equipment, and prompt clean-up of any substance spills.

5.6.2. Step 2: Eliminate Technically Infeasible Options

After the identification of control options, the second step in the BACT assessment is to eliminate any technically infeasible options. A control option is eliminated from consideration if there are process-specific conditions that would prohibit the implementation of the control or if the highest control efficiency of the option would result in an emission level that is higher than any applicable regulatory limits. The following sections evaluate the feasibility of the previously mentioned control technologies for reducing VOC emissions from the preprint press and printing plate processor.

5.6.2.1. Thermal or Catalytic Oxidation

Thermal oxidizers (principally RTOs, recuperative TOs, and catalytic oxidizers) have been widely in the printing industry for control of flexographic press emissions, but typically when the press is operating with solvent-based inks. Review of the RBLC reveals that approximately 50% of the BACT determinations for such printing processes relied on RTOs and approximately 10% relied on catalytic oxidizers, as shown in Section D.10 of Appendix D. However, the use of an RTO, or similar oxidation technology, to control VOC from water-based inks presents certain operational challenges. The combined dryer exhaust from the flexographic press is estimated to contain less than 18 ppmv of VOC, which is an extremely low level for this technology. For example, to achieve 95% destruction / removal efficiency (DRE), the unit would have to operate with an outlet concentration of less than 1 ppmv, whereas U.S. EPA indicates that the target outlet concentration for oxidizers approaches 20 ppm. [50] Similarly, catalytic oxidizers work best when the unit sees a significant VOC load to the catalyst bed. In this case, the estimated 7.9 lbs/hr load carried by approximately 43,500 scfm of air flow would only create a catalyst bed temperature rise of 1-to-2 ^{o}F. Accordingly, the DRE assigned to oxidation technologies for the flexographic printing press were reduced from the typical vendor guarantees to 90% DRE to account for the challenges associated with oxidizing such a low VOC concentration vent stream.

In addition to the DRE challenges, operation of an oxidation technology to control emissions from a flexographic press that uses only water-based inks and such low VOC cleanup materials would require a substantial amount of supplemental fuel. RTOs typically operate at 1,500^{o}F, which would require increasing the 220^{o}F press dryer exhaust by almost 1,300^{o}F. Considering 43,500 scfm of dryer exhaust flow, this would require a supplemental

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[49] U.S. EPA Publication AP-42, Compilation of Air Pollution Emission Factors, Section 4.9, Table 4.9.1-1, 1995

[50] U.S. EPA CATC Air Pollution Control Technology Fact Sheets for incinerators, EPA-452/F-03-020 and EPA-452/F-03-021. Available at: www.epa.gov/ttn/catc/dir1/frecup.pdf and www.epa.gov/ttn/catc/dir1/fregen.pdf.

heat input of more than 65 mmBTU/hr. Although a catalytic unit runs a much lower temperature (typically around 650°F pre-heat), this would also require a significant heat input (over 20 mmBTU/hr). This would also create a possible significant environmental impact, since the combustion of these levels of supplemental fuel would generate substantial levels of combustion-generated pollutants such as PM, NO_X, CO, SO_2, and CO_2.[51] To represent a viable control option for the flexographic press, these technologies must operate with heat recovery variants that achieve relatively high levels of thermal efficiency so as to avoid prohibitive supplemental fuel consumption and operating costs. Accordingly, the regenerative thermal and regenerative catalytic options (RTO and RCO) that achieve thermal recovery efficiencies in the 90% to 95% range were the only oxidation technologies carried forward to the full BACT analysis.

With regard to oxidation control for the plate processor, the air flow rate is much lower, so heat recovery is not as important for driving feasibility. This emission stream still has a relatively low projected VOC concentration, so a recuperative TO and RTO options were also carried forward to the complete BACT analysis and assumed to be able to achieve at least 95% DRE.[52] An RCO was not evaluated, as the added complexity and operating issues associated with the precious metal catalyst do not justify the small potential savings in supplemental fuel consumption.

5.6.2.2. Adsorption

Review of the RBLC reveals there are entries for carbon adsorbers or solvent recovery units that use activated carbon for VOC control of printing processes, as shown in Section D.10 of Appendix D. However, all of these carbon adsorber entries are associated with publication rotogravure presses that operate with much higher VOC loads than the WestRock flexographic press and with solvents amenable to carbon adsorption. The adsorption process is designed for typical inlet VOC concentrations of 400 to 2,000 ppm and will reduce the concentration to about 20 ppm.[53] U.S. EPA notes the "absorber becomes nearly useless when the inlet concentration gets so low that the VOC will not be effectively adsorbed." The estimated exhaust VOC concentration for the flexographic press is approximately 18 ppmv, which is below this practical treatability threshold.

The combined press dryer exhaust is at an elevated temperature (~ 220°F) and contains a substantial amount of water vapor (projected to be above 4% moisture content). Adsorption isotherms for the dominant press VOC constituent (monoethanolamine) indicate that the exhaust gas would need to be cooled to below to 120°F to create reasonable adsorption capacity (exceeding 10 lbs VOC/ 100 lbs carbon) for the expected low concentration. A copy of the monoethanolamine isotherm at 110°F is included in Section D.3 of Appendix D. Cooling the press dryer exhaust gas to this level would require a very large heat exchanger (sized for 43,500 scfm airflow) and a substantial amount of refrigeration capacity (over 420 tons), thus rendering this control option infeasible. Evaporative cooling with a spray tower is also not a viable option, because it would increase the relative humidity in the gas stream to a level that would significantly diminish the already marginal monoethanolamine adsorption capacity. Dropping the dryer vent stream to approximately 90°F (without addition of any additional spray cooling water) would increase the relative humidity to 70%, which is the maximum value for proper operation of activated carbon. Finally, the size of the carbon adsorber bed(s) would have to be substantial, as achieving the recommended gas face velocity to the adsorption bed would require over

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[51] Quantification of combustion-generated pollutant emission levels is presented in Step 4 of the BACT assessment where cost, energy, and environmental impacts of technically feasible control technologies arereviewed. Refer to Section 5.6.4.1.1 (Table 5-3. BACT Evaluation Parameters – Flexographic Press Add-on Control Devices) and Section 5.6.4.2.1 (Table 5-4. BACT Evaluation Parameters – Plate Processor Add-on Control Devices).

[52] On an average operational basis, inlet VOC is predicted at 75 ppmv, and maximum worst-case is 184 ppmv.

[53] U.S. EPA CATC Technical Bulletin, Choosing an Adsorption System for VOC: Carbon, Zeolite, or Polymers?, EPA 456/F-99-004. Available at: www.epa.gov/ttn/catc/dir1/fadsorb.pdf

900 square feet of adsorber bed flow area. Based on the combined impact of the multiple technical feasibility issues, carbon adsorption for the flexographic press was judged to be technically infeasible and is not carried forward to the full BACT analysis.

Carbon adsorption was also evaluated for treatment of the plate processor VOC emissions. The plate processor has a much lower air flow (700 scfm), lower temperature (~ 110°F), lower moisture content (< 2% by vol), and higher concentration of VOC (~75 ppmv) than the press. Because of these characteristics, cooling the gas stream to a more favorable level (75°F) could be accomplished with a heat exchanger (approximately 34 square feet of heat exchanger surface area and 2.2 tons of refrigeration) and would not increase the relative humidity to, or above, the 70% upper limit for good adsorption. Isotherms at 75°F for the principal compounds in the plate processor solvent are presented in Section D.3 of Appendix D and indicate that the activated carbon should be able to adsorb more than 20 lbs of plate solvent VOC per 100 lbs of carbon. Based on these factors, activated carbon adsorption was carried forward to the full BACT analysis for the plate processor emissions. However, because of the relatively low VOC concentration in the vent stream, a removal efficiency of 90% is assumed, which would require achieving a 7.5 ppmv outlet concentration that is well below the 20 ppmv treatability threshold cited by U.S. EPA.

5.6.2.3. Biofiltration

Searches of the RBLC database did not identify biofilters as a control technology selected for the printing industry, thus it would represent a technology transfer if applied as BACT on this project. Although bioreactors can readily decompose certain organic compounds, some are more recalcitrant and difficult to degrade. The dominant VOC constituent in the press dryer exhaust (monoethanolamine, which is approximately 80% of the VOC mass) has a relatively poor biorate, with a default first order biodegradation rate constant of 0.069 liters per gram of volatile suspended solids per hour (L/g-VSS-hr). To put this in perspective, the default biorate for ethanol (a relatively biodegradable compound) is 0.9 L/g-VSS-hr, or more than 10 times higher.

Biofilters are also prone to operating upsets, if any of the key parameters needed to maintain a healthy biomass are compromised. These include temperature, moisture, nutrients, acidity, and microorganism population. The microorganisms become stressed and biorates are inhibited when the temperatures exceed 105°F. This presents a significant challenge for the press exhaust that will enter the system at approximately 220°F. Even if this gas stream is cooled with a spray tower upstream of the biofilter, it may be difficult to maintain an acceptable temperature during the hottest months of the year. Finally, the very low VOC load to the biofilter (7.9 lbs/hr) would also create an unfavorable operating condition. The relative mass of microorganisms (biomass) in the bioreactor adapts to the food-to-microorganism (F/M) ratio at which the unit operates. Thus, a very low VOC (food) loading rate means that the biomass inventory in the unit would also be at a relatively low level. Any biomass stressors that occur could quickly decimate this rather small biomass inventory.

Given the complexities in maintaining a well operating biofiltration unit and the combined effect of the problematic operating issues noted herein, this unproven printing industry control technology was eliminated as technically infeasible and is not carried forward to the full BACT analysis for the flexographic press.

Even though there are issues with scaling a biofilter down to a very low air flow rate, the biofiltration technology was considered for the plate processor. It was eliminated, however, because the solvent used in the plate making process has very little water solubility. This condition would prevent, or at least severely impede, the vapor to liquid mass transfer that is essential for the technology to work.

5.6.2.4. Condensation

Searches of the RBLC database did not identify condensers as a control technology selected for the printing industry, thus it would represent a technology transfer if applied as BACT on this project. Condensing the flexographic press VOC emissions is not feasible due to the very low concentrations of the VOC components and the significant amount of water vapor in the press dryer exhaust stream. A preliminary condenser evaluation of the press dryer emissions is included in Section D.4 in Appendix D. In order to condense the dominant compound (monoethanolamine) at a removal efficiency of 50%, the exhaust gas would have to be cooled from 220°F to 16°F. An extremely large condenser that would consume a tremendous amount of energy to create this much cooling would be required for this application. Moreover, it would require a two stage condenser system to first condense as much of the vent stream moisture at a temperature just above freezing, and then reduce the temperature further to condense the monoethanolamine. A major operating problem would occur during this second condenser stage (dropping the gas temperature from 35°F down to 16°F), as almost 900 lbs/hr of water would be condensed and this would cause severe freeze ups on the heat exchange surfaces in the unit. Accordingly, the condensation technology was eliminated as technically infeasible for the press VOC emissions and was not carried forward to the full BACT analysis.

A similar condenser analysis was completed for the plate processor VOC emissions and is included in Section D.4 of Appendix D. In this case, the condenser size and required refrigeration input from the chiller are much more reasonable, but the low concentration of the vent stream will still require condenser operation at sub-zero temperatures. Modeling condensation of benzyl alcohol, which comprises up to 40% of the solvent blend, indicates that a vapor exit temperature below negative 60°F would be required to start condensing any of this compound. Aside from the fact that typical chillers could not achieve this very low temperature, the same freeze up issues would likely occur from the ambient humidity. Again, the condensation technology was eliminated as technically infeasible for the plate processor VOC emissions and was not carried forward to the full BACT analysis.

5.6.2.5. Wet Scrubbing

Searches of the RBLC database did not identify scrubbers as a control technology selected for the printing industry, thus it would represent a technology transfer if applied as BACT on this project. Although the primary constituents in the press dryer exhaust are water soluble, the use of a packed-bed water scrubber to achieve meaningful emission reductions is problematic because of the very low VOC concentration. With the total VOC vapor concentration predicted to be less than 18 ppmv, there is little driving force to achieve good mass transfer rates between the exhaust gas and the scrubbing water. A preliminary packed-bed scrubber evaluation for the primary compound in the press dryer emissions (monoethanolamine) is included as Section D.5 in Appendix D. This design simulation was set up to determine the packed bed column geometry that would be required to achieve nominal 50% monoethanolamine removal efficiency. In the first run, a 4 gpm / 1,000 scfm liquid-to-gas ratio was selected from the recommended design range and then used to compute the minimum column diameter. The results from this run specify an unrealistic column diameter of over 40 feet to achieve proper flooding of the packed column and would still require about 40 feet of packing height to achieve the modest 50% removal efficiency. A second run was conducted where a more reasonable column diameter (10 feet) was forced into the analysis, but it specified an unrealistic packing height of over 600 feet. This analysis confirms that a reasonably sized packed bed column will not achieve any meaningful reductions in the dilute VOC emission stream from the press dryers. Accordingly, the wet scrubbing technology was eliminated as technically infeasible for the press VOC emissions and was not carried forward to the full BACT analysis.

Wet scrubbing was ruled out as a feasible technology for the plate processor emissions because the solvent used in this process is essentially insoluble in water.

5.6.2.6. Rotary Concentrator

Searches of the RBLC database did not identify rotary concentrators as a control technology selected for the printing industry, and discussions with a vendor of the rotary concentrators, Catalytic Products International (CPI), also indicate that this technology has not been applied in the printing industry. Discussions with Chris Heikkila, CPI's printing sector account manager confirmed that CPI has never sold a rotary concentrator for a printing press application, and in the almost 20 years that Mr. Heikkila has worked with the printing sector, he was not aware of any other vendors placing the technology in this sector. There are a number of significant technology limitations that would prevent successful application of a zeolite wheel rotary concentrator for control of the WestRock flexographic press emissions. First, the primary constituent in the press dryer exhaust (monoethanolamine) is an alcohol that has poor zeolite adsorption characteristics. More importantly, the temperature of the press exhaust (220°F) is too high to allow for effective adsorption efficiency on the zeolite wheel; CPI recommends a maximum gas temperature of 150°F for successful application of the technology. Given the combined effect of these rotary concentrator operating concerns, as well as its projected substantial capital cost (equipment cost estimated at $2.1 million), this unproven printing industry control technology was eliminated as technically infeasible and is not carried forward to the full BACT analysis for the flexographic press.

The rotary concentrator technology was also eliminated for the plate processor, because it would not be practical or cost effective to scale down this technology (designed for large volume, dilute VOC gas streams) to less than 1,000 scfm for application on this low volume source.

5.6.2.7. Low VOC Materials and Good Operating Practices

The planned flexographic printing press operations will employ low VOC waterborne inks (VOC contents typically below 4% by weight) and a waterborne overprint varnish that has an even lower VOC content than the inks. The press will be washed via an automated cleaning system that uses an aqueous detergent solution that contains a small amount of VOC (approximately 2.2% by weight), thus minimizing VOC emissions from this activity. The facility will also pursue applicable pollution prevention and good operating practices, such as proper maintenance, keeping containers that hold materials with VOC sealed when they are not in use, using an enclosed and automated press wash system, thus minimizing VOC emissions from the preprint press and printing plate processor. Accordingly, low VOC materials and good operating practices will be carried forward in the full BACT analysis.

5.6.3. Step 3: Rank Remaining Control Technologies by Control Effectiveness

Table 5-1. Technically Feasible Control Technologies – Flexographic Press

Ranking	Control Technology	Typical Range of DRE[54]	Source	DRE Used in Analysis[55]
1	Regenerative T.O. (95% heat recovery)	95% - 98%	RBLC Search	90%
1	Regenerative T.O. (97% heat recovery)	95% - 98%	RBLC Search	90%
2	Regenerative Catalytic Oxidation	95% - 98%	RBLC Search	90%
5	Good Operating Practices	N/A	N/A	N/A

Table 5-2. Technically Feasible Control Technologies – Plate Processor

Ranking	Control Technology	Typical Range of DRE	Source	DRE Used in Analysis
1	Regenerative Thermal Oxidation	95% - 98%	RBLC Search	98%
2	Recuperative Thermal Oxidation	95% - 98%	RBLC Search	98%
3	Carbon Adsorption	88% to 98%	RBLC Search	90%
5	Good Operating Practices	N/A	N/A	N/A

5.6.4. Step 4: Evaluate the Most Effective Control Option

Following the "top-down" BACT approach, the highest ranked potentially applicable control option is evaluated first. If the evaluation concludes that this top option is technically and economically feasible, and the option does have acceptable energy demands and minimal adverse environmental impacts, the option is determined as BACT, and no further evaluation is necessary. Otherwise, the evaluation process proceeds to the next highest ranked option. This process continues until an option meets all requirements and is determined as BACT.

This BACT analysis is based on conservative cost estimates and the VOC potential-to-emit. Actual costs are expected to be higher and actual VOC emissions are expected to be lower resulting in a higher cost per ton of VOC removed.

Estimates of energy consumption and cost effectiveness were performed to evaluate the economic impact of each option in accordance with the procedures established in the EPA Air Pollution Control Cost Manual.[56] Cost analysis considers the initial capital expenditures and the annualized direct cost. Replacement costs due to the aging of capital are addressed using the amortization technique in the EPA Air Pollution Control Cost Manual. A discount rate of 7% and an assumed project life of 15 years were used to determine the capital recovery factor

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[54] Assuming 100% VOC capture efficiency, which is conservative given the expectation of minor VOC emission losses across the process.

[55] Low inlet VOC concentrations limit the efficacy of various control technologies, thus a lower value was assumed in the cost-effectiveness analysis.

[56] US EPA, Air Pollution Control Cost Manual, Section 3.1, Chapter 1 (Carbon Absorbers) and Section 3.2, Chapter 2, (Incinerators), January 2002.

that amortizes the total capital investment as an equivalent annual cost.[57] Utility expenses were calculated based on engineering assessments for supplemental fuel consumption (heat balance calculations) and electric power consumption required to operate the control devices multiplied by the projected average utility rates expected for the site. Secondary environmental impacts of each proposed control technology were based on multiple factors, including additional energy consumption and pollutant emissions for each control technology.

5.6.4.1. Flexographic Press Top-Down BACT

Technologically feasible add-on control options for the preprint press include three oxidation technologies.

5.6.4.1.1 Oxidation Technologies

All of the technologically feasible add-on control options for the flexographic press (two RTO variants and an RCO) have the same estimated control efficiency; therefore, this top-down BACT analysis evaluates all three technologies at the same time in this initial iteration. Since combustion of auxiliary fuel in an RTO increases other pollutant emissions (products of combustion), it is not an ideal option for this application. However, thermal oxidation must be further evaluated as an option since it has been judged to be technically feasible.

Theoretically, an RTO can oxidize up to 98% of the VOC in the gas streams, provided that the inlet loadings are sufficiently high. Otherwise, it can reduce VOC emissions to 20 ppm and achieve emissions reductions of 95% or below. Because the flexographic press dryer vent is projected to have a low VOC inlet loading (approximately 18 ppmv), a reduced theoretical DRE of 90% was used in the evaluation. Even at this reduced DRE, the RTO or RCO would still have to achieve an outlet concentration of less than 2 ppmv, which is one-tenth of the 20 ppmv feasibility threshold cited by U.S. EPA guidance documents.[58] Moreover, the cost effectiveness analysis also assumes 100% capture of the VOC by the press dryers. Because of the low vapor pressure of the ink and varnish VOC at ambient temperatures, and other operating factors, the actual VOC capture is likely close to this 100% capture efficiency assumption, but this still represents another conservative input to the analysis.

Section D.6.1 and D.6.2 of Appendix D summarize the cost analyses for controlling the press dryer emissions with two variants of a RTO at 97% and 95% heat recovery, respectively. Since many of the cost factors are tied to the purchased equipment cost of the oxidizer, actual vendor quotes were obtained as a starting point. Furthermore, since the supplemental fuel cost was a very important contributor to the total annual cost, a standard RTO (95% heat recovery) and an enhanced, slightly more expensive RTO variant (97% heat recovery) were both evaluated. A significant emission collection system would also be required to connect all of the separate dryer vents to an RTO installed on a large concrete foundation outside the building across the access road running adjacent to the press room. A schematic diagram of the duct work required for this control system is presented in Appendix D, Section D.6.4, Figures 1 and 2. The basis for sizing and costing the ductwork system is presented in Sections D.6.1 and D.6.2 of Appendix D. Costing was completed in accordance with procedures set forth in EPA's Air Pollution Control Cost Manual, and then adjusted from 1993 to 2016 dollars using a construction cost index.[59] The ductwork and RTO capital and operating cost were combined to determine the total annual cost to acquire, install, and operate the control technology. The results of the cost analysis indicate that the cost effectiveness of using an RTO for either of these variants is expected to exceed $20,000 per ton,

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[57] US EPA, Air Pollution Control Cost Manual, Section 1 (Introduction), Chapter 2 (Cost Estimation), Section 2.4.4.4, January 2002.

[58] U.S. EPA CATC Air Pollution Control Technology Fact Sheets for incinerators, EPA-452/F-03-020 and EPA-452/F-03-021. Available at: www.epa.gov/ttn/catc/dir1/frecup.pdf and www.epa.gov/ttn/catc/dir1/fregen.pdf

[59] EPA Publication EPA/452/B-02-001, "EPA Air Pollution Control Cost Manual", 6th Edition, Section 2, Chapter 1 , August 2002

with the 95% heat recovery unit being about 7% more costly to operate. Based on these cost effectiveness estimates, using an RTO to control VOC emission from the flexographic press is cost prohibitive.

Section D.6.3 of Appendix D summarizes the cost analysis for controlling the press dryer emissions with a RCO. Again, an actual vendor quote was obtained as the starting point of this analysis. Although the total capital cost for an RCO exceeded the RTO options, it operates at a much lower temperature, thus supplemental fuel consumption was about one-third of the rate projected for the standard RTO. However, the catalyst layer at the top of the heat exchange media would have to be periodically replaced and the precious metal catalyst is expensive (estimated at $225K total cost per replacement event). Based on conversions with the vendor, Anguil Environmental, a typical catalyst replacement frequency of 3 years was modeled. Therefore, the net present value for 4 separate replacement events over the 15 year life of the unit was calculated and then divided by 15 to estimate the equivalent annual cost for this special maintenance event. The results of the analysis predict RCO cost effectiveness consistent with the RTO options, with the value being marginally over $20,000 per ton. Based on these cost effectiveness estimates, employing an RCO to control VOC emissions from the flexographic press is cost prohibitive.

Relying on either of the oxidation technologies to control the flexographic press emissions also creates significant energy and environmental impacts The annual amount of supplemental fuel burned for the RTO and RCO control options ranges from approximately 13.2 to 35.2 million scf, as calculated in Sections D.6.1 through D.6.3 of Appendix D. Moreover, these technologies consume a significant amount of electric power, principally to drive the main blower that pushes 43,500 scfm of air flow through a significant pressure drop created by the heat exchange media and catalyst. The estimated annual electric power consumption for the RTO and RCO control options ranged from 1,387 to 1,716 MW-hrs. The secondary emissions (products of combustion) from the natural gas combustion in the oxidizers and from electric power generation (assuming a coal-fired electric generating station) were calculated for each of these three oxidation control options. Derivation of the cost effectiveness, energy consumption and secondary emissions are derived in Sections D.6.1 through D.6.3 of Appendix D, and are summarized in Table 5-3.

Table 5-3. BACT Evaluation Parameters – Flexographic Press Add-on Control Devices

Control Device	Cost Effectiveness $/Ton VOC	Natural Gas Combustion MMscf/yr	Electricity Consumption MWh/yr	SO_2 (Secondary Emissions, tons/yr)	NO_X (Secondary Emissions, tons/yr)	CO (Secondary Emissions, tons/yr)	CO_2 (Secondary Emissions, tons/yr)
RCO	$ 20,754	13.2	1,716	2.95	1.95	0.56	1,488
RTO, 95% TER	$ 22,396	35.2	1,387	2.38	2.8	1.48	2,674
RTO, 97% TER	$ 20,933	23.7	1,622	2.79	2.4	0.99	2,076

Because VOC is regulated as a pre-cursor to ozone, it is valid to consider the second component to ozone formation: NO_X. The formation of ozone generally requires a mixture of NO_X and VOC with the proper meteorological conditions. The chemical stoichiometry is not a one-to-one correlation, meaning it does not take one mole of NO_X to react with one mole of VOC to form one mole of ozone. Still a simple representation of this reaction is provided for evaluation:

$$VOC + NO_X + Sunlight = Ozone (O_3)$$

As seen in the above equation, both VOC and NO_X are required to form ozone in the presence of sunlight. If one reactant is in abundant supply, the reaction is "limited" by the other reactant. Based on 2011 national inventory (NEI) data, the natural background emissions of VOC are in abundant supply in Georgia, including Douglas County, which means that ozone formation is NO_X-limited.[60] While VOC addition would not necessarily increase ozone concentrations, NO_X addition would almost certainly have this impact. Due to the daily variations of ozone formation and the conditions under which the reactions occur, it is not possible to quantify the ambient concentration impact or the total tons of ozone that would be formed as a result of additional NO_X emissions. However, ambient concentrations of ozone would likely increase if an RTO is selected for the preprint flexographic press and printing plate processor given the magnitude of NO_X emissions.

Besides the additional criteria pollutant emissions and the potential increase in formation of ozone, an RTO or RCO would result in more annual emissions of CO_2. Each year, between 1,500-2,000 additional tons of CO_2 would be emitted from an RTO or RCO for the preprint flexographic press. This consequence is due to the natural gas combustion required of an incinerator, wherein methane (natural gas) is converted to CO_2 and water.

Considering that each oxidation technology costs more than $20,000 per ton of VOC removed, as well as the environmental and energy disadvantages associated with supplemental fuel and electric power consumption required to operate these control devices, none of these add-on control technologies (RTOs at 95% & 97% DRE, or RCO) meet the appropriate criteria to be considered as BACT. This conclusion is further supported via a letter, included in Section D.6 of Appendix D, from Bobst Bielefeld GmbH, a major worldwide supplier of flexographic printing presses and the manufacturer of the proposed preprint press, stating that none of the flexographic printing presses dedicated solely to printing with water-based inks have been required to install VOC controls, such as RTOs, catalytic oxidizers or similar equipment, to treat the exhaust air.

5.6.4.1.2 Good Operating Practices

Pollution prevention, implemented as the usage of low VOC solvent and water-based ink are largely used by similar printing processes as summarized in Appendix D. WestRock plans to use water-based inks and overprint varnish with a VOC content of less than 5 percent by weight. VOC emissions from other miscellaneous materials will be inherently limited by the total 34.5 tpy rolling 12-month emission limit proposed for BACT and the low VOC content of the inks, varnishes, and cleaning materials proposed for this project. Additionally, proper maintenance and housekeeping measures will be considered as pollution prevention practices. The use of low-VOC inks and varnishes (less than 5% by weight VOC content) will achieve a VOC emission rate that is equal to or better than those typically achieved by add-on controls on a solvent-based flexographic printing press. In the absence of a permanent total enclosure, even a modern central impression flexographic printing press would likely generate no more than 90% VOC capture. If these emissions were controlled by the very best technology (98% DRE from an oxidation control device), the overall VOC control efficiency would be approximately 88%. U.S. EPA estimates that a typical solvent-based flexographic printing press uses ink that contains inks with about 75% VOC content.[61] The use of inks and varnishes with less than 5% VOC content would represent a 93% or greater reduction in VOC emissions from the uncontrolled emissions of a flexographic printing press applying 75% VOC content inks. Even further emission reductions would be achieved by WestRock's proposed use of aqueous press wash cleaners instead of conventional cleaning solutions containing solvents. This verifies that

[60] 2011 NEI data: https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data

[61] U.S. EPA Publication AP-42, Compilation of Air Pollution Emission Factors, Section 4.9, Table 4.9.1-1, 1995

the use of low VOC materials creates a higher level of VOC emissions reduction than application of add-on control technology in the absence of 100% capture efficiency.

5.6.4.2. Plate Processor Top-Down BACT

Technologically feasible add-on control options for the plate processor include two oxidation technologies and carbon adsorption. Both of the oxidation technologies (recuperative and regenerative thermal oxidizers) have the same estimated control efficiency; thus are evaluated at the same time in this initial iteration.

5.6.4.2.1 Oxidation Technologies

The plate processor emission stream (approximately 75 ppmv VOC for average operations) is not as dilute as the flexographic press and represents a much lower gas flow requiring treatment. Therefore, the typical default DRE of 98% was used in the evaluation. The emission sources on the plate processor (solvent wash-out and dryer sections) are also completely enclosed, so the cost effectiveness analysis assumes 100% capture of its VOC emissions.

Section D.7 of Appendix D summarizes the cost analysis for controlling the plate processor emissions with a recuperative thermal oxidizer (TO). The purchased equipment cost for the TO was estimated in accordance with procedures set forth in EPA's Air Pollution Control Cost Manual, and then adjusted from 1999 to 2016 dollars using a construction cost index.[62] A TO with 50% heat recovery (double-pass air-to-air heat exchanger) was evaluated. This included the sizing and development of cost estimates for ductwork following the same procedure used for the flexographic press. The results of this analysis indicate that the cost effectiveness of a TO to control plate processor VOC emissions is expected to approach $40,000 per ton. Accordingly, this oxidation technology is judged to be cost prohibitive for plate processor.

Section D.7.2 of Appendix D summarizes the cost analysis for controlling the plate processor with an RTO. A prior vendor quote for a 1,500 scfm RTO was scaled to the appropriate size for this application using the 6/10ths rule. The RTO has superior heat recovery (95% thermal efficiency) characteristics relative to a recuperative TO, thus it reduces the supplemental fuel consumption to less than 15% of the rate projected for the recuperative TO. However, the RTO has a much higher pressure drop and consumes more electric power to operate. Its total capital investment is also more than double the total for the recuperative TO; therefore, the lower fuel cost advantage is completely off-set by the higher electric power and capital recovery cost items. The results of the analysis predict an RTO cost effectiveness value higher than the recuperative TO and above $50,000 per ton. Accordingly, the use of an RTO is judged to be cost prohibitive for the plate processor.

Consistent with the prior analysis for the flexographic press, oxidation technologies applied to the plate processor will create energy and environmental impacts, although not as significant because of the much lower air flow rate. The annual amount of supplemental fuel burned for the recuperative TO and RTO control options ranges from approximately 0.4 to 3.2 million scf, (see derivation in Sections D.7.1 and D.7.2 of Appendix D). The estimated annual electric power consumption for the TO an RTO control options ranged from 7 to 30 MW-hrs. Derivation of the cost effectiveness, energy consumption and secondary emissions are presented in Sections D.7.1 through D.7.2 of Appendix D, and are summarized in Table 5-4.

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[62] U.S. EPA Publication EPA/452/B-02-001, "EPA Air Pollution Control Cost Manual", 6th Edition, Section 3.2, Chapter 2, Figure 2.8, August 2002

Table 5-4. BACT Evaluation Parameters – Plate Processor Add-on Control Devices

Control Device	Cost Effectiveness $/Ton VOC	Natural Gas Combustion MMscf/yr	Electricity Consumption MWh/yr	SO_2 Secondary Emissions, tons/yr	NO_X	CO	CO_2
Recup. T.O.	$ 39,145	3.2	7	0.01	0.17	0.13	195
RTO	$ 46,128	0.4	11	0.02	0.03	0.02	28
Carbon Adsorption	$ 17,607	--	39	0.07	0.03	--	16

5.6.4.2.2 Carbon Adsorption

Given that the top-level BACT option (oxidation technologies) was cost prohibitive and has negative energy and environmental impacts, the next highest level of control (carbon adsorption), was evaluated. Because of the relatively low VOC emitted from the plate processor, a regenerative carbon system was not considered, as its substantial capital cost would drive the cost effectiveness metric into a range similar to the oxidation technologies. Instead, a lower capital cost carbon canister system, which requires off-site regeneration of the carbon, was evaluated.

The concept design for the adsorption system evaluated includes a two-step process of a heat exchanger to cool the gas stream to a more favorable level (75 ˚F), followed by 1,800 pound activated carbon canisters situated in a lead-lag configuration. The initial cooling to 75 ˚F and the ability to completely saturate the carbon (provided by the lead-lag operating configuration) minimizes the amount of carbon that is consumed. The carbon consumption rate is the most significant cost element in the analysis; therefore, the modest additional capital cost to minimize carbon consumption is easily justified. A budgetary cost estimate for the carbon canister system and to regenerate saturated canisters was obtained from Calgon Carbon Corp. This vendor also provided isotherms for the definable plate processor solvent constituent (benzyl alcohol) and surrogates for the remaining proprietary components (aliphatic esters and synthetic hydrocarbons). The isotherms and budgetary cost estimates are included in Section D.3 and D.7.3 of Appendix D, respectively.

Section D.7.3 of Appendix D also summarizes the cost analysis for controlling the plate processor with carbon canisters. The total capital investment for the system is relatively low (approximately $109,000), but the annual operating cost (primarily driven by the carbon replacement expense) was significant compared to the amount of VOC being controlled. Even at the reduced 75 ˚F design temperature, the activated carbon isotherms indicated adsorption capacities ranging from about 20 to 40 lbs VOC per 100 lbs of carbon. Because this technology application covers a multiple VOC component vent stream, the design adsorption capacity was set at the low end of the range of the individual components (the less favourable component will break through even when others have sufficient remaining capacity). This analysis indicates that the plate processor VOC emissions would consume approximately 32,000 lbs of carbon per year (approximately 18 1,800-lb canisters), which translates to an annual carbon replacement expense of almost $19,000 per year. The overall results of the analysis predict a cost effectiveness value above $17,000 per ton. Accordingly, the use of activated carbon adsorption is judged to be cost prohibitive for the plate processor.

5.6.4.2.3 Good Operating Practices

Spent solvent recycling through a solvent distillation system and reuse, with a total 3.15 tpy rolling 12-month emission limit is proposed as BACT for the plate processor. Additionally, proper maintenance and housekeeping measures will be considered as pollution prevention practices. These include a number of good operating practices designed to minimize evaporative losses.

5.6.5. Step 5 - Select BACT

For the preprint press, WestRock plans to use water-based inks and overprint varnish with a VOC content of less than 5 percent by weight. VOC emissions from other miscellaneous materials will be inherently limited by the total 34.5 tpy rolling 12-month emission limit proposed for BACT and the low VOC content of the inks, varnishes, and cleaning materials proposed. Additionally, proper maintenance and housekeeping measures will be considered as pollution prevention practices. These include a number of good operating practices designed to minimize evaporative losses from the already low-VOC materials proposed for the project.

For the plate processor, spent solvent recycling through a solvent distillation system and reuse, with a total 3.15 tpy rolling 12-month emission limit is proposed as BACT. Additionally, proper maintenance and housekeeping measures will be considered as pollution prevention practices. These include a number of good operating practices designed to minimize evaporative losses.

For compliance demonstration, WestRock will maintain usage records for the preprint press of all materials containing VOC. Records shall include the total gallons of material used, the density of each material, the VOC content (in weight percent), the solids content (in volume percentage of the material), the weight of any material disposed of as waste, and the VOC content (weight percentage) of any material disposed as waste. Such usage records will then be utilized to calculate monthly emissions from the preprint press.

Similar records of material usages and waste tracking will also be maintained for the plate processor.

6. AIR QUALITY ANALYSES

PSD review will not apply to this project as the facility will be a true minor source for all PSD pollutants. As such, elements such as NAAQS and Class II Increment modeling are not required. However, Class I impacts were considered as the proposed project is a major NSR permitting action.

TAP modeling is required for compliance with the state of Georgia regulations per Georgia's Guideline for *Ambient Impact Assessment of Toxic Air Pollutant Emissions*. This section of the application discusses the air quality analysis requirements, methodologies, and results. Supporting documentation may be found in Appendix E.

6.1. OZONE IMPACTS ANALYSIS

The proposed project will trigger NNSR review for VOC only. Under the provisions of 40 CFR 51.165, the offsetting of VOC emissions ensures that the sum total of the VOC from the proposed facility, less the sum total of the VOC being retired from existing facilities where the ERCs are obtained, represent reasonable further progress toward attaining the NAAQS for this non-attainment area. The net result is no increased impacts on the ozone concentrations in the area.

Ozone is formed when NO_X and VOC react in the presence of sunlight. In the Atlanta area, this reaction is NO_X limited due to the presence of high amounts of biogenic VOC. As such, VOC emissions, including those from the proposed project, have very little impact on ozone concentrations in this NO_X limited area. NO_X primarily is emitted from mobile sources and industrial sources. Therefore, ozone formation in the Atlanta area is directly impacted by NO_X emissions, which is a reflection of population density, vehicle miles travelled (VMT), and industrial NO_X emissions. These key indicators will not be impacted by the proposed project given the low magnitude of the industrial NO_X emissions proposed from the new operations.

6.2. CLASS I AREA IMPACTS

The proposed project may be evaluated for its potential impact on Air Quality Related Values (AQRV) at potentially-affected Class I areas. The Federal Land Managers (FLMs) for Class I areas have the responsibility to protect AQRV and to consider, in consultation with the permitting authority, whether a proposed major emitting facility will have an adverse impact on such values. AQRV typically considered include visibility (e.g., regional haze) and deposition of sulfur and nitrogen.

WestRock has qualitatively evaluated its impacts on federally-protected Class I areas by performing a Q/D screening analysis consistent with the FLM's AQRV Work Group (FLAG) 2010 guidance, which compares the ratio of visibility affecting pollutant emissions to the distance from the Class I area.[63] In the Q/D analysis, the combined annual emissions increase in tons per year (Q) of SO_2, NO_X, total PM_{10}, and H_2SO_4 is divided by the distance, in kilometers, from the facility to the Class I area (D). If Q/D is less than 10, then no Air Quality Related Values (AQRV) analysis is required. The results of the Q/D screening analysis for the FLAG 2010 Approach show all of the Class I areas within 300 km of the project (considering source-wide emissions) have a Q/D well

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[63] U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service. 2010. Federal land managers' air quality related values work group (FLAG): phase I report—revised (2010). Natural Resource Report NPS/NRPC/NRR—2010/232. National Park Service, Denver, Colorado.

below 10. The analysis suggests that the proposed project will have no adverse impacts to any AQRVs at near-by Class I areas; therefore, WestRock plans no AQRV analyses for the proposed project.

While there are no Class I areas within 100 km of the proposed project in Douglas County, Georgia, there are five (5) Class I areas located within 300 km of the proposed project. Four of the Class I areas within 300 km of the proposed facility, the Cohutta Wilderness, Joyce Kilmer, Shining Rock, and Sipsey Wilderness areas, are managed by the Forest Service (FS). The Great Smoky Mountains National Parks is managed by the National Park Service (NPS). The Class I areas within a 300 km radius of the WestRock facility, along with Q/D values, are listed in Table 6-1.

Table 6-1. Summary of Class I Areas within 300 km of the Proposed Project

Class I Area	Responsible FLM	Minimum Distance from Site (km)	Sum of Annualized VAP Emissions - Q (tpy)	FLAG 2010 Approach Q/D
Cohutta Wilderness	FS	123		0.05
Joyce Kilmer Slickrock Wilderness	FS	188		0.03
Great Smoky Mountains National Park	NPS	202	5.91	0.03
Shining Rock	FS	236		0.03
Sipsey Wilderness Area	FS	263		0.02

WestRock is submitting concurrent with this application, separate requests to the appropriate FLMs to obtain their agreement with the findings for the nearby Class I areas. Copies of the letters to the FLMs presenting the Q/D screening analysis are included in Appendix F.

6.3. TOXIC AIR POLLUTANTS IMPACT ASSESSMENT

This section details the assumptions used for completing the TAP modeling analysis (i.e., model setup) and the results of modeling analysis.

6.3.1. Georgia Air Toxics Modeling

Georgia EPD regulates the emissions of TAP through a program approved under the provisions of the GRAQC 391-3-1-.02(2)(a)3(ii). A TAP is defined as any substance that may have an adverse effect on public health, excluding any specific substance that is covered by a State or Federal ambient air quality standard. Procedures governing the Georgia EPD's review of toxic air pollutant emissions as part of air permit reviews are contained in the agency's *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions (Guideline)*.[64]

[64] *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions*. Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch, Revised, June 21, 1998.

6.3.2. Derivation of Acceptable Ambient Concentrations

According to the *Guideline*, dispersion modeling should be completed for each potentially toxic pollutant having quantifiable emission increases. The *Guideline* infers that a pollutant is identified as a toxic pollutant if any of the following toxicity-determined values have been established for that pollutant:

- EPA Integrated Risk Information System (IRIS) reference concentration (RfC) or unit risk;
- Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL);
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV);
- National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (REL); and
- Lethal Dose – 50% (LD50) Standards.

The *Guideline* specifies that the resources should be referenced in the priority listed above to determine long-term and short-term acceptable ambient concentrations (AACs) based on the exposure limits that are provided. For pollutants without any of the prescribed toxicity–determined values, the Workplace Environmental Exposure Levels (WEELs) established by the American Industrial Hygiene Association (AIHA) were used to determine the AAC. AIHA WEELs are occupational exposure limits reported as time-weighted averages (TWA).

To determine which product ingredients are considered toxic pollutants, the product data sheets for each ink and coating were thoroughly reviewed for volatile ingredients. Then, the databases above were searched for each possible air toxic. Chemicals with exposure limits were considered TAP, and chemicals without exposure limits were not considered further. Please note that a representative product data sheet is included in Appendix E for reference.

The AAC for each toxic pollutant is calculated from the toxicity data presented in the resources listed above. For any pollutant, both a long-term and short-term AAC might be calculated. If a pollutant has an RfC and/or unit risk, an annual average (long-term) AAC can be calculated as follows. The RfC is an estimate of daily inhalation exposure that is likely to be without an appreciable risk of deleterious effects during a lifetime. The unit risk is a quantitative assessment of cancer-causing potential per concentration of air inhaled. An annual average AAC is obtained by dividing the unit risk by a cancer risk factor based on the weight-of-evidence classification, i.e., 1:1,000,000 for known carcinogens (class A), 1:100,000 for probable carcinogens (class B), and 1:10,000 for suspected carcinogens (class C). The result is an annual average AAC in units of micrograms per cubic meter ($\mu g/m^3$). RfC values are given in units of milligrams per cubic meter (mg/m^3) and require no conversion.

If RfC and unit risk data are not available in the IRIS database, then an annual standard cannot be calculated and a 24-hour AAC must be derived. The bases for the 24-hour standards are the OSHA PEL given at 29 CFR Part 1910 Subpart Z, followed in priority by the ACGIH TLV, NIOSH REL, and LD50 databases. As with AIHA WEELs, these resources provide exposure limits as TWA in terms of occupational exposure duration (i.e., typically an 8-hour average). If a TWA value is provided for a given pollutant, the 24-hour average AAC is derived as follows. First, an adjustment factor (i.e., 40 divided by the total weekly emitting hours) is applied to the TWA to account for exposure in excess of occupational duration. This adjustment factor is assumed to be 168 hours per week for continuous operation. Second, the adjusted TWA is divided by a safety factor to account for human carcinogenicity: 100 for pollutants that are not known human carcinogens, 300 for pollutants that are known human carcinogens. The resultant value is adopted as a 24-hour AAC. Per the *Guideline*, if a toxic air pollutant has an annual AAC, then the derivation of and comparison to a 24-hour standard is not required.

An additional standard must be met if a given pollutant has listed a Short Term Exposure Limit (STEL) or Ceiling (C) in any one of the above-named resources. A STEL is a 15-minute weighted average concentration that should not be exceeded at any time during the workday. A C value is a concentration that should not be exceeded at any time during occupational exposure. These values have been established for pollutants that are acute sensory irritants and apply as a 15-minute standard, also adjusted by a safety factor of 10 as recommended by the *Guideline*. No other adjustment factor is applied to STEL or C values. A 15-minute average standard, if applicable, must be met in addition to an annual average and/or 24-hour average standard. The *Guideline* clearly states that each of annual, 24-hour, and 15-minute AAC should be derived if the appropriate toxicity information is provided in any of the listed resources.

AACs were derived for the following TAP:

➤ Diethylaminoethanol	➤ Acrylic acid
➤ Glutaraldehyde	➤ Trimethylamine
➤ Ethanolamine	➤ Propionaldehyde
➤ Propylene glycol	➤ Diethylene glycol
➤ Isopropanol	➤ Ethyl acrylate
➤ 1-propanol	➤ Ethyl benzene
➤ Styrene	➤ Maleic anhydride
➤ Diethylene glycol ethyl ether	➤ Benzyl alcohol

TAP from natural gas combustion were not included in the TAP assessment given the insignificant size of each burner, the magnitude of TAP emissions from natural gas combustion compared to emissions from the process, and EPD's traditional focus for such operations being the chemical usage-based pollutants. Details on the development of the emissions for the proposed project are presented in Appendix C of this application. WestRock has evaluated the available reference material to determine the applicable AAC standards for TAP identified as being emitted at the facility, as presented in Appendix E.

6.3.3. Determination of Toxic Air Pollution Impact

The WestRock completed the TAP assessment for the proposed Lithia Springs facility using the SCREEN3 dispersion model. As the facility is located within an urban area (Lithia Springs), the urban options were selected within the model. Building downwash was not evaluated within the modeling assessment, as allowed per the Georgia Guidelines. The primary facility sources of the air toxics of concern considered as part of this project are the newly planned preprint press and printing plate processor. For the preprint press, emissions were assumed to exhaust through stacks associated with each of the dryers, with varying temperature and airflow information. The printing plate processor was modeled based on one presumed stack. Each stack height was presumed to be 41 feet or 12.5 meters. Table 6-2 summarizes the modeled stack parameters for the Screen3 analyses.

Table 6-2. Screen3 Modeled Stack Parameters

Stack Description	Stack Height (m)	Stack Temp (K)	Airflow (m^3/s)	Stack Diameter (m)	Modeled Emissions (g/s)	Height of Nearest Building (m)	Min. Horizontal Building Dimension (m)	Max. Horizontal Building Dimension (m)
Between Color Dryer	12.50	359.82	7.50	0.46	1.0	N/A	N/A	N/A
Final Dryer 1	12.50	381.48	3.98	0.46	1.0	N/A	N/A	N/A
Final Dryer 2	12.50	388.71	7.30	0.46	1.0	N/A	N/A	N/A
Final Dryer 3	12.50	388.71	7.30	0.46	1.0	N/A	N/A	N/A
Printing Plate Processor	12.50	293.00	0.17	0.14	1.0	N/A	N/A	N/A

Note that the parameters for Final Dryer 2 and Final Dryer 3 are identical, so one SCREEN3 run was relied upon for those exhaust points. All SCREEN runs were conducted using a 1 g/s modeled emission rate to estimate the maximum predicted ambient impact from each individual stack. Predicted impacts from each SCREEN3 run are then multiplied by the corresponding stack TAP emission rate to estimate the specific pollutant impact from each individual stack. Emission rates for pollutants emitted from the press were divided proportionally based on the proportion of each individual stacks airflow to the total airflow from the press. To ascertain the total predicted impact, the resulting predicted impacts from each individual stack are then summed for comparison to the applicable AAC. This presents a highly conservative estimate of ambient impacts as it presumes the maximum impact from each individual source will occur at the same location. Table 6-3 summarizes the overall results of the TAP assessment and demonstrates that all modeled pollutants have impacts less than their respective AACs. Please see Appendix E for the detailed inputs and results of the toxic air pollutant impact assessment. In addition, a representative product data sheet was included in Appendix E for reference.

Table 6-3. Toxic Air Pollutants Impacts Analysis

Pollutant	Max. 1-hr Impact (μg/m^3)	Max. 15-min Average Impact[1] (μg/m^3)	15-min Average AAC (μg/m^3)	Max. 15-min Average Impact (% of AAC)	Max. 24-hour Average Impact[2] (μg/m^3)	24-hour Average AAC (μg/m^3)	Max. 24-hour Average Impact (% of AAC)	Max. Annual Impact[3] (μg/m^3)	Annual Average AAC (μg/m^3)	Max. Annual Impact (% of AAC)
Ethanolamine	3.67E+01	4.84E+01	1,499	3%	1.47E+01	17.8	82%	2.93E+00	None	-
Propylene Glycol	2.00E-01	2.65E-01	None	-	8.02E-02	74.1	0.11%	1.60E-02	None	-
Isopropanol	6.08E-02	8.03E-02	98,323	<0.01%	2.43E-02	2,341	<0.01%	4.86E-03	None	-
1-Propanol	9.51E-03	1.25E-02	61,447	<0.01%	3.80E-03	1,170	<0.01%	7.61E-04	None	-
Styrene	3.27E-02	4.32E-02	17,039	<0.01%	1.31E-02	None	-	2.62E-03	1,000	<0.01%
Diethylene Glycol Ethyl Ether	7.47E-01	9.87E-01	None	-	2.99E-01	327	0.09%	5.98E-02	None	-
Acrylic Acid	2.72E-01	3.59E-01	None	-	1.09E-01	None	-	2.18E-02	1.0	2%
Triethylamine	3.72E-04	4.91E-04	1,242	<0.01%	1.49E-04	None	-	2.98E-05	7.0	<0.01%
Propionaldehyde	9.54E-06	1.26E-05	None	-	3.81E-06	None	-	7.63E-07	8.0	<0.01%
Diethylene Glycol	4.38E-01	5.78E-01	None	-	1.75E-01	103	0.17%	3.50E-02	None	-
Ethyl Acrylate	4.60E-01	6.08E-01	6.14E+03	<0.01%	1.84E-01	244	0.08%	3.68E-02	None	-
Ethyl Benzene	4.60E-01	6.08E-01	None	-	1.84E-01	None	-	3.68E-02	1.00E+03	<0.01%
Maleic Anhydride	2.30E-01	3.04E-01	None	-	9.21E-02	2	3.86%	1.84E-02	None	-
Benzyl Alcohol	9.13E+01	1.21E+02	None	-	3.65E+01	105	34.7%	7.30E+00	None	-

1. 15-minute impacts equal the 1-hour impact times a factor of 1.32 per Georgia EPD's Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions, page 8.
2. 24-hour impacts equal the 1-hour impact times a factor of 0.4 per Georgia EPD's Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions, page 8.
3. Annual impacts equal the 1-hour impact times a factor 0.08 per Georgia EPD's Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions, page 8.

7. ADDITIONAL NNSR REQUIREMENTS

This section addresses additional impacts, the alternatives analysis, and various additional NNSR requirements.

7.1. ADDITIONAL IMPACTS

7.1.1. Growth Impacts

A growth analysis is intended to quantify the amount of new growth that is likely to occur in support of the facility and to estimate emissions resulting from that associated growth. Associated growth includes residential and commercial/industrial growth resulting from the new facility. Residential growth depends on the number of new employees and the availability of housing in the area, while associated commercial and industrial growth consists of new sources providing services to the new employees and the facility. WestRock anticipates that most personnel currently employed at a nearby WestRock Atlanta site will transfer employment to the new location in Lithia Springs without moving from their current residences. There will be minor impacts during the construction of this facility, as the operations will be located in an existing building within an industrial park that has already been constructed. Therefore, additional growth from this project is expected to be minimal.

7.1.2. Soils and Vegetation

WestRock has considered the project's potential to impact its surroundings based on the facility's emission rates and resulting ground level concentrations of ozone.

The effects of gaseous air pollutants on vegetation may be classified into three broad categories: acute, chronic, and long-term. Acute effects are those that result from relatively short (less than 1 month) exposures to high concentrations of pollutants. Chronic effects occur when organisms are exposed for months or even years to certain threshold levels of pollutants. Long-term effects include abnormal changes in ecosystems and subtle physiological alterations in organisms. Acute and chronic effects are caused by the gaseous pollutant acting directly on the organism, whereas long-term effects may be indirectly caused by secondary agents such as changes in soil pH.

VOC are regulated by the U.S. EPA as precursors to tropospheric ozone. Elevated ground-level ozone concentrations can damage plant life and reduce crop production. VOC interferes with the ability of plants to produce and store food, making them more susceptible to disease, insects, other pollutants, and harsh weather. Ozone is formed by the interaction of NO_X, VOC, and sunlight in the atmosphere.

The Lithia Springs facility will be located in Douglas County, which is currently designated as an ozone nonattainment area. Ozone formation in the metro Atlanta area is limited as it is primarily dependent upon NO_X emissions and proper atmospheric conditions. Because the NOx emissions from the new facility will be negligible, WestRock does not predict any significant negative impact on soil or vegetation.

7.1.3. Visibility Impairment

The project is not expected to produce any perceptible visibility impacts in the immediate vicinity of the plant. Given the state limitation of 40% opacity of emissions, no immediate visibility impairment is anticipated. As this project is not evaluating PSD for any criteria pollutants associated with visibility impacts, no Class II visibility evaluation is required.

7.2. ALTERNATIVES ANALYSIS

7.2.1. Alternative Siting

WestRock's site selection process incorporated both internal and external consultants' research and analysis of alternative locations for the facility. Factors considered paramount to the decision as to where to locate the plant included: transportation/logistics access and costs; proximity to customers/vendors; sufficient building and site requirements to accommodate new equipment;, and workforce retention and expansion.

Currently, WestRock's Graphic Solutions Business Unit encompasses seven printing machines housed at four locations in North America: four in Canada, and one each in Kentucky, Florida, and Georgia. Numerous challenges and limitations on the company's ability to expand its operations at these existing locations were identified during the alternative analysis. These limitations included:

- Lack of other suitable WestRock facilities within the right geographic area
- No space available to expand operations at existing locations
- Aging equipment/dated technology at existing plants that would limit the company's ability to meet rapidly evolving customer demands
- High cost labor base at various locations
- Freight costs and transportation time, including challenges of border crossing and customs issues with imports from Canada into the U.S.

The Lithia Springs facility will be centrally located in metro Atlanta primarily to serve customers across the southeastern and central United States. Locating the facility outside of metro Atlanta would have resulted in job losses for local employees, loss of state and local tax revenue, disruption to local vendors and service providers, and diminished ability for WestRock to serve its existing customers. Additionally, WestRock's home office is located in Norcross, Georgia.

The Lithia Springs location was ultimately selected based on an objective analysis and competitive state and local economic development site selection process. By retaining and expanding operations within the metro Atlanta area, WestRock is best positioned to serve existing clients and customers with minimal interruption. WestRock will retain the leadership talent and experienced local employees and avoid a lengthy startup from having to train a new workforce. This location also offers cost-competitive inbound and outbound freight lanes for efficient transportation from regional suppliers. The Lithia Springs location provides the most economical building costs, including ample room for future growth. In order for WestRock to maintain and grow its customer base, retain its existing talent, create new jobs with wages that exceed the county average, contribute new tax revenues, and enhance the economy of metro Atlanta, it must locate at the Lithia Springs site, proposed in this application.

7.2.2. Alternative Processes and Controls

The flexographic press and the processor are both state-of-the-art equipment. They will be more efficient and have lower air emissions, on a per production unit basis, than existing equipment currently in operation at other WestRock preprint locations, and within the printing industry as a whole. Alternate equipment manufacturers were considered in the design of this facility, but based on the customer base and the demand for the variety and type of products to be made, the selected equipment represents the best alternative.

The BACT review in Section 5 contains a detailed discussion on environmental and other impacts from the use of alternate control techniques. As described, the proposed BACT is considered the best alternative.

7.3. MAJOR SOURCE COMPLIANCE STATEMENT

WestRock has a full or partial ownership interest in three major stationary sources in the State of Georgia: (1) WestRock Southeast, LLC (Dublin, Georgia), (2) Green Power Solutions, LLC (Dublin, Georgia), and (3) WestRock Packaging Systems, LLC (Atlanta, Georgia). All of these facilities are in compliance, or on a schedule for compliance, with all applicable federal and state emission limitations and standards. The most recent Title V compliance reports were relied upon for this determination.

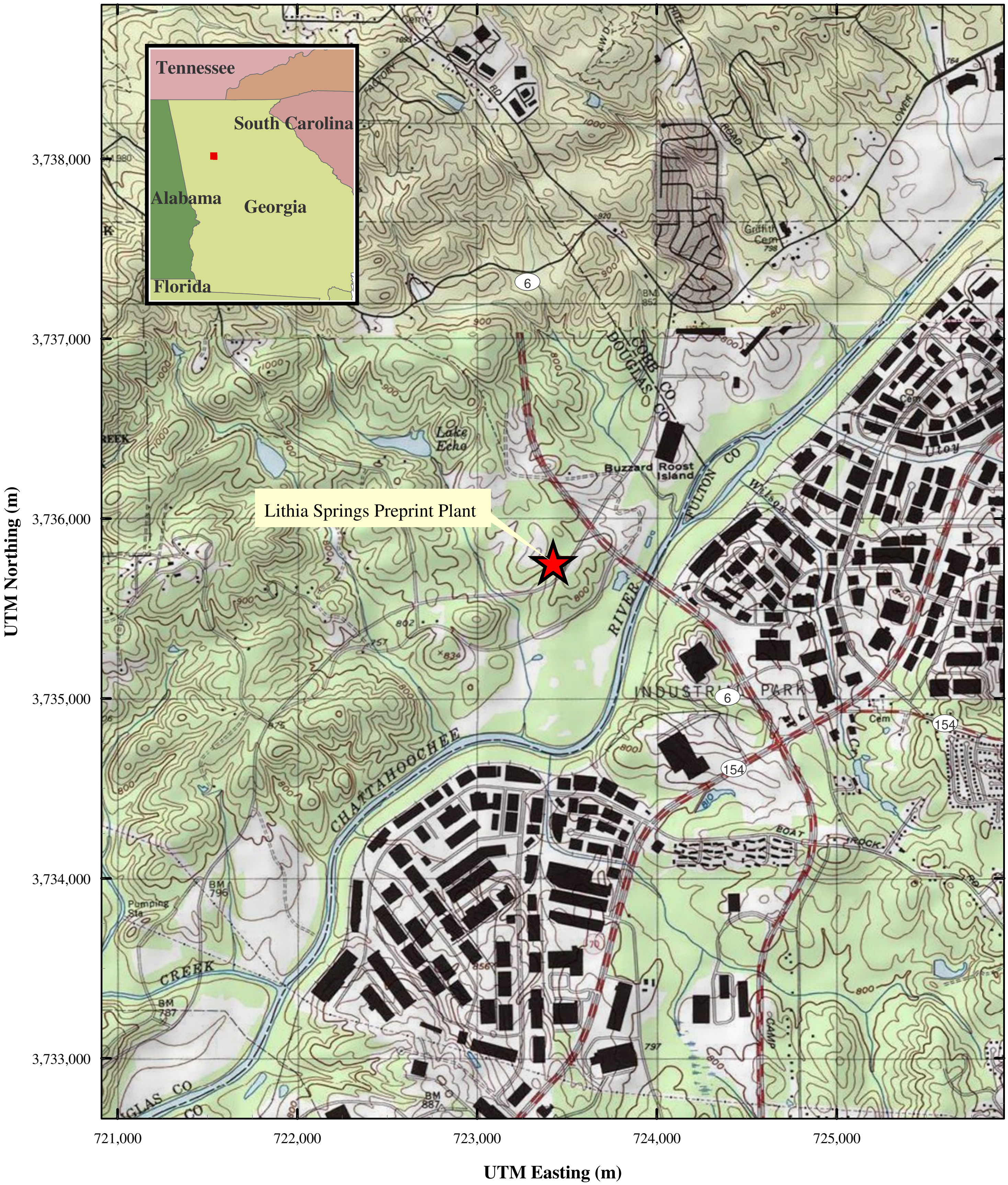
7.4. EMISSION REDUCTION CREDITS

Emission increases must be offset by the purchase of ERC. External offsets must be obtained at a ratio of 1.3 to 1. For this project, WestRock will be acquiring approximately 49.4 tpy VOC ERCs.

The ERC acquisition process, including transferring and retiring ERCs from the present credit holders, will be completed per the steps outlined in GRAQC Chapter 391-3-1-.03(8)(c)12. For a project in Douglas County, ERCs must be obtained from within the same non-attainment area, which includes the following 20-counties: Barrow, Bartow, Carroll, Cherokee, Clayton, Cobb, Coweta, Dekalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Newton, Paulding, Spalding, Rockdale and Walton counties. At least 30 days prior to commencement of operation of the new source, WestRock will provide documentation as to the possession of sufficient offsets, depending on whether the offsets were obtained though ERC Banking Program or, if obtained outside of the ERC Banking Program, the submittal of information as detailed in suparagrpah 12(iv) of this regulation. As allowed in this rule, when multiple emission units are permitted at the same time but commence operation on different dates (i.e., if the press or the processor were to startup at different dates), the above documentation can be submitted separately.

APPENDIX A: FACILITY INFORMATION

Figure A-1. Area Map
WestRock Lithia Springs, Douglas County, Georgia



Coordinates reflect UTM projection Zone 16, NAD83.

Trinity Consultants

WestRock Lithia Springs Preprint Plant
Lithia Springs, Georgia

Figure A-2. Site Layout

161101.0117
July 2016
Trinity Consultants

APPENDIX B: GEORGIA EPD PERMIT APPLICATION FORMS

State of Georgia
Department of Natural Resources
Environmental Protection Division
Air Protection Branch

Stationary Source Permitting Program
4244 International Parkway, Suite 120
Atlanta, Georgia 30354
404/363-7000
Fax: 404/363-7100

EXPEDITED PERMITTING PROGRAM – APPLICATION FOR ENTRY TO PROGRAM FOR AIR PERMITS

EPD Use Only

Date Received: ____________ Application No. ____________

To be eligible for expedited review, this application form must be accompanied by the complete permit application for the type of air permit being requested.

1. Contact Information

Facility Name: WestRock Lithia Springs Preprint Plant

AIRS No. (if known): 04-13- -

Contact Person: Rachel Davis Title: Environmental Service Manager

Telephone No.: 770-326-8141 Alternate Phone No.: ____________

Email Address: rachel.g.davis@westrock.com

If EPD is unable to contact me, please contact the alternate contact person:

Contact Person: Nina Butler Title: Chief Sustainability Officer

Telephone No.: 770-326-8130 Alternate Phone No.: ____________

Email Address: nina.butler@westrock.com

On Page 2 of this form, please check the appropriate box for which type of air permit you are requesting expedited review.

I have read the Expedited Review Program Standard Operating Procedures and accept all of the terms and conditions within. I have participated in the required pre-application meeting with EPD. I understand that it is my responsibility to ensure an application of the highest quality is submitted and to address any requests for additional information by the deadline specified. I understand that submittal of this request form is not a guarantee that expedited review will be granted.

Signature: ____________ Date: ____________

2. **Applying For Which Type Of Permit: (Please Check Appropriate Box)**

Expedited Review Fees for Air Permits	
Permit Type – Please Check One	**Expedited Review Fee***
☐ Generic Permit: Concrete Batch Plant – Minor Source	$1,000
☐ Generic Permit: Concrete Batch Plant – Synthetic Minor Source	$1,500
☐ Generic Permit: Hot Mix Asphalt Plant – Synthetic Minor Source	$2,000
☐ Minor Source Permit (or Amendment)	$3,000
☐ Synthetic Minor Permit (or Amendment)	$4,000
☐ Major Source SIP Permit not subject to PSD or 112(g)	$6,000
☐ Title V 502(b)(10) Permit Amendment	$4,000
☐ Title V Minor Modification with Construction	$4,000
☐ Title V Significant Modification	$6,000
☐ Major Source SIP Permit subject to 112(g) but not subject to PSD	$15,000
☐ PSD Permit (or Amendment) not subject to NAAQS and/or PSD Increment Modeling	$15,000
☐ PSD Permit (or Amendment) subject to NAAQS and/or PSD Increment Modeling but not subject to Modeling for $PM_{2.5}$, NO_2, or SO_2	$20,000
☐ PSD Permit (or Amendment) subject to NAAQS and/or PSD Increment Modeling for $PM_{2.5}$, NO_2, or SO_2	$25,000
☐ PSD Permit (or Amendment) subject to NAAQS and/or PSD Increment Modeling for $PM_{2.5}$, NO_2, or SO_2 and also impacting a Class I Area	$30,000
☑ Nonattainment NSR Review Permit (or Amendment)	$40,000
* Do not send fee payment with this form. Upon acceptance of application for the expedited permit program, EPD will notify you by phone. Fees must be paid via check to "Georgia Department of Natural Resources" within ten (10) business days of acceptance.	

3. **Comments.**

This section is optional. Applicants may use this field to include specific comments or requests for EPD consideration. For example, the applicant may use this field to request a public hearing or to remind EPD of review time needs and/or expectations that may differ from the time frames in the procedures.

State of Georgia
Department of Natural Resources
Environmental Protection Division
Air Protection Branch

Stationary Source Permitting Program
4244 International Parkway, Suite 120
Atlanta, Georgia 30354
404/363-7000
Fax: 404/363-7100

SIP AIR PERMIT APPLICATION

EPD Use Only

Date Received: ____________________ Application No. ____________________

FORM 1.00: GENERAL INFORMATION

1. Facility Information

Facility Name: WestRock Lithia Springs Preprint Plant

AIRS No. (if known): 04-13- -

Facility Location: Street: 600 Riverside Parkway, Building A

City: Lithia Springs Georgia Zip: 30122 County: Douglas

Is this facility a "small business" as defined in the instructions? Yes: ☐ No: ☒

2. Facility Coordinates

Latitude: 33° 44' 18" **NORTH** Longitude: 84° 35' 18" **WEST**

UTM Coordinates: 723420.89 **EAST** 3735760.29 **NORTH** **ZONE** 16 S

3. Facility Owner

Name of Owner: WestRock CP, LLC.

Owner Address Street: 504 Thrasher Street

City: Norcross State: GA Zip: 30071

4. Permitting Contact and Mailing Address

Contact Person: Rachel Davis Title: Environmental Services Manager

Telephone No.: (770) 326-8141 Ext. ______ Fax No.: (770) 326-8159

Email Address: rachel.g.davis@westrock.com

Mailing Address: Same as: Facility Location: ☐ Owner Address: ☐ Other: ☒

If Other: Street Address: 3950 Shackleford Road

City: Duluth State: GA Zip: 30096

5. Authorized Official

Name: Wayne Coltrane Title: General Manager

Address of Official Street: 55 Enterprise Blvd

City: Atlanta State: GA Zip: 30336

This application is submitted in accordance with the provisions of the Georgia Rules for Air Quality Control and, to the best of my knowledge, is complete and correct.

Signature: ______________________________ Date: ____________________

6. Reason for Application: (Check all that apply)

- ☒ New Facility (to be constructed)
- ☐ Existing Facility (initial or modification application)
- ☒ Permit to Construct
- ☒ Permit to Operate
- ☐ Change of Location
- ☐ Permit to Modify Existing Equipment: Affected Permit No.: ____

☐ Revision of Data Submitted in an Earlier Application

Application No.: ____

Date of Original Submittal: ____

7. Permitting Exemption Activities (for permitted facilities only):

Have any exempt modifications based on emission level per Georgia Rule 391-3-1-.03(6)(i)(3) been performed at the facility that have not been previously incorporated in a permit?

☒ **No** ☐ **Yes, please fill out the SIP Exemption Attachment** (See Instructions for the attachment download)

8. Has assistance been provided to you for any part of this application?

☐ **No** ☐ **Yes, SBAP** ☒ **Yes, a consultant has been employed or will be employed.**

If yes, please provide the following information:

Name of Consulting Company: Trinity Consultants

Name of Contact: Deanna L. Duram, PE, CM

Telephone No.: 678-441-9977, ext. 236 Fax No.: 678-441-9978

Email Address: Dduram@trinityconsultants.com

Mailing Address: Street: 3495 Piedmont Road, Building 10, Suite 905

City: Atlanta State: Georgia Zip: 30305

Describe the Consultant's Involvement:

Assistance in preparing the application

9. Submitted Application Forms: Select only the necessary forms for the facility application that will be submitted.

No. of Forms	Form
1	2.00 Emission Unit List
1	2.01 Boilers and Fuel Burning Equipment
1	2.02 Storage Tank Physical Data
1	2.03 Printing Operations
	2.04 Surface Coating Operations
	2.05 Waste Incinerators (solid/liquid waste destruction)
1	2.06 Manufacturing and Operational Data
	3.00 Air Pollution Control Devices (APCD)
	3.01 Scrubbers
	3.02 Baghouses & Other Filter Collectors
	3.03 Electrostatic Precipitators
1	4.00 Emissions Data
	5.00 Monitoring Information
	6.00 Fugitive Emission Sources
1	7.00 Air Modeling Information

10. Construction or Modification Date

Estimated Start Date: October 2016

11. **If confidential information is being submitted in this application, were the guidelines followed in the "Procedures for Requesting that Submitted Information be treated as Confidential"?**

☒ No ☐ Yes

12. New Facility Emissions Summary

Criteria Pollutant	New Facility	
	Potential (tpy)	Actual (tpy)
Carbon monoxide (CO)	4.58	<4.58
Nitrogen oxides (NOx)	5.46	<5.46
Particulate Matter (PM) (filterable only)	0.41	<0.41
PM <10 microns (PM10)	0.41	<0.41
PM <2.5 microns (PM2.5)	0.41	<0.41
Sulfur dioxide (SO_2)	0.03	<0.03
Volatile Organic Compounds (VOC)	37.94	<37.94
Greenhouse Gases (GHGs) (in CO2e)	6,514	<6,514
Total Hazardous Air Pollutants (HAPs)	1.31	<1.31
Individual HAPs Listed Below:		

13. Existing Facility Emissions Summary

Criteria Pollutant	Current Facility		After Modification	
	Potential (tpy)	Actual (tpy)	Potential (tpy)	Actual (tpy)
Carbon monoxide (CO)				
Nitrogen oxides (NOx)				
Particulate Matter (PM) (filterable only)				
PM <10 microns (PM10)				
PM <2.5 microns (PM2.5)				
Sulfur dioxide (SO_2)				
Volatile Organic Compounds (VOC)				
Greenhouse Gases (GHGs) (in CO2e)				
Total Hazardous Air Pollutants (HAPs)				
Individual HAPs Listed Below:				

14. 4-Digit Facility Identification Code:

SIC Code:	2679	SIC Description:	Converted Paper and Paperboard Products, Not Elsewhere Classified
NAICS Code:	322219	NAICS Description:	Other Paperboard Box Manufacuring

15. Description of general production process and operation for which a permit is being requested. If necessary, attach additional sheets to give an adequate description. Include layout drawings, as necessary, to describe each process. References should be made to source codes used in the application.

Please see process description and process flow diagram in Section 2 of the application.

16. Additional information provided in attachments as listed below:

Attachment A - Facility Information

Attachment B - Georgia EPD Pemit Application Forms

Attachment C - Emission Calculations

Attachment D - BACT Supporting Documents and Calculations

Attachment E - Air Quality Analysis Supporting Documents

Attachment F - Letters to FLM

17. Additional Information: Unless previously submitted, include the following two items:

☒ Plot plan/map of facility location or date of previous submittal: Provided in Attachment A

☒ Flow Diagram or date of previous submittal: Provided in Section 2.1 of the Application

18. Other Environmental Permitting Needs:

Will this facility/modification trigger the need for environmental permits/approvals (other than air) such as Hazardous Waste Generation, Solid Waste Handling, Water withdrawal, water discharge, SWPPP, mining, landfill, etc.?

☒ **No** ☐ **Yes, please list below:**

19. List requested permit limits including synthetic minor (SM) limits.

Facility-wide VOC emission limit of 38 tons per year.

Facility Name: WestRock Lithia Springs Preprint Plant **Date of Application:** July 2016

FORM 2.00 – EMISSION UNIT LIST

Emission Unit ID	Name	Manufacturer and Model Number	Description
1	Preprint Flexo Press	Bobst-North America, Model 90SIX	110'' Flexographic 9-color water-based preprint press
Included in 1	Preprint Gas Dryers (4)	Maxo Valupak Burners	Gas fired dryer to heat air and dry inks and coatings from press
2	Printing Plate Processor	Vianord, Model Evo5 VP-1	Printing plate manufacturing using solvents & photopolymer
3	Overprint Varnish Storage Tank	TBD	7,000 gallons storage tank
4	Solvent Recovery System	PRI Plate-Vac, Model PV 300	Includes two (2) 300 gallons storage tanks with distillation system.

Facility Name: WestRock Lithia Springs Preprint Plant **Date of Application:** July 2016

FORM 2.01 – BOILERS AND FUEL BURNING EQUIPMENT

Emission Unit ID	Type of Burner	Type of Draft[1]	Design Capacity of Unit (MMBtu/hr Input)	Percent Excess Air	Dates		Date & Description of Last Modification
					Construction	Installation	
Included in 1	Maxon Valupak	NA	12.7	20	October 2016	October 2016	Listed burners are fuel burning sources within the press; not regulated as fuel burning equipment.

[1] This column does not have to be completed for natural gas only fired equipment.

Facility Name: WestRock Lithia Springs Preprint Plant **Date of Application:** July 2016

FUEL DATA

Emission Unit ID	Fuel Type	Potential Annual Consumption				Hourly Consumption		Heat Content		Percent Sulfur		Percent Ash in Solid Fuel	
		Total Quantity		Percent Use by Season									
		Amount	Units	Ozone Season May 1 - Sept 30	Non-ozone Season Oct 1 - Apr 30	Max.	Avg.	Min.	Avg.	Max.	Avg.	Max.	Avg.
Included in 1	**Natural Gas**	**109.16**	**MM cubic feet**	**41.67%**	**58.33%**	**0.0125 MMcf**	**0.0125 MMcf**	**NA**	**1020 Btu/scf**	**NA**	**NA**	**NA**	**NA**

Fuel Supplier Information

Fuel Type	Name of Supplier	Phone Number	Supplier Location			
			Address	City	State	Zip
Natural Gas	**Austell Gas System**	**770-948-1841**	**2838 Joe Jerkins Blvd.**	**Austell**	**GA**	**30168**

Facility Name: WestRock Lithia Springs Preprint Plant **Date of Application:** July 2016

FORM 2.02 – ORGANIC COMPOUND STORAGE TANK

Emission Unit ID	Emission Unit Name	Capacity (gal)	Material Stored	Maximum True Vapor Pressure (psi @ ºF)	Storage Temp. (ºF)	Filling Method	Construction/ Modification Date	Roof Type	Seal Type
3	Overprint Varnish Storage Tank	7,000	Water-Based Overprint Varnish	0.19 @ 88 °F	Ambient	Submerged	October 2016	Fixed Roof	N/A
4	Solvent Recovery System Tank 1	300	Cylosol	0.009 @ 88 °F	Ambient	Submerged	October 2016	Fixed Roof	N/A
4	Solvent Recovery System Tank 2	300	Cylosol	0.009 @ 88 °F	Ambient	Submerged	October 2016	Fixed Roof	N/A

Facility Name: WestRock Lithia Springs Preprint Plant **Date of Application:** July 2016

FORM 2.03 – PRINTING OPERATIONS

Emission Unit ID	Emission Unit Name	Construction Date	Type of Operation[1]	Substrate	Potential To Emit	
					VOC (Tons per year)	Total HAP (Tons per year)
1	Preprint Flexo Press	October 2016	A	Linerboard	34.80	1.31
2	Printing Plate Processor	October 2016	O	Photopolymer sheets	3.15	0

Individual HAP	CAS Number	Potential to Emit (Tons per year)	Actual Emission (Tons per Year)
Glycol Ethers	N/A	0.41	<0.41
Ethyl Acrylate	140-88-5	0.25	<0.25
Ethyl Benzene	100-41-4	0.25	<0.25
Acrylic Acid	79-10-7	0.15	<0.15
Maleic Anhydride	108-31-6	0.13	<0.13
Styrene	100-42-5	0.018	<0.018
Triethylamine	121-44-8	2.04E-4	<2.04E-4
Propionaldehyde	123-38-6	5.23E-6	<5.23E-6

[1] Indicate the type of operation using the appropriate letter code from below:

A - Flexography
B – Packaging Rotogravure
C – Publication Rotogravure
D – Screen Printing
E – Heatset Offset Lithography
F – Lithography (not heat set)
O – Other (include a description of the operation type)

Facility Name: WestRock Lithia Springs Preprint Plant **Date of Application:** July 2016

FORM 2.06 – MANUFACTURING AND OPERATIONAL DATA

Normal Operating Schedule: 24 hours/day 7 days/week 52 weeks/yr

Additional Data Attached? ☒ - No ☐ - Yes, please include the attachment in list on Form 1.00, Item 16.

Seasonal and/or Peak Operating Periods: None

Dates of Annually Occurring Shutdowns: Maintenance shutdowns occur periodically throughout the year

PRODUCTION INPUT FACTORS

Emission Unit ID	Emission Unit Name	Const. Date	Input Raw Material(s)	Annual Input	Hourly Process Input Rate		
					Design	Normal	Maximum
1	Preprint Flexo. Press	October 2016	Linerboard Rolls	15,000 rolls/yr	1.7 rolls/hr	<1.7 rolls/hr	1.7 rolls/hr
1	Preprint Flexo. Press	October 2016	Flexographic Inks and Overprint Varnish (OPV)	4,113,472 lbs/yr	470 lbs/hr	<470 lbs/hr	470 lbs/hr
2	Printing Plate Processor	October 2016	Printing Plate	288,000 ft^2/yr	33 ft^2/hr	<33 ft^2/hr	33 ft^2/hr

PRODUCTS OF MANUFACTURING

Emission Unit ID	Description of Product	Production Schedule		Hourly Production Rate (Give units: e.g. lb/hr, ton/hr)			
		Tons/yr	Hr/yr	Design	Normal	Maximum	Units
1	**Printed linerboard rolls**	**15,000 rolls**	**8,760**	**1.7**	**1.7**	**1.7**	**rolls/hr**
2	**Printing Plates**	**288,000 ft^2/yr**	**8,760**	**33**	**33**	**33**	**ft^2/hr**

Facility Name: WestRock Lithia Springs Preprint Plant **Date of Application:** July 2016

FORM 4.00 – EMISSION INFORMATION

Emission Unit ID	Air Pollution Control Device ID	Stack ID	Pollutant Emitted	Emission Rates				
				Hourly Actual Emissions (lb/hr)	Hourly Potential Emissions (lb/hr)	Actual Annual Emission (tpy)	Potential Annual Emission (tpy)	Method of Determination
1	N/A	BCD, FD1-3	NO_X	N/A	1.25	N/A	5.46	AP-42
1	N/A	BCD, FD1-3	CO	N/A	1.05	N/A	4.58	AP-42
1	N/A	BCD, FD1-3	VOC	N/A	7.94	N/A	34.80	AP-42, Mass Balance
1	N/A	BCD, FD1-3	Total PM/PM_{10}/$PM_{2.5}$	N/A	0.09	N/A	0.41	AP-42
1	N/A	BCD, FD1-3	SO_2	N/A	7.48E-03	N/A	0.03	AP-42
1	N/A	BCD, FD1-3	Lead	N/A	6.23E-06	N/A	2.73E-05	AP-42
1	N/A	BCD, FD1-3	Total HAP	N/A	0.30	N/A	1.31	AP-42, Mass Balance
1	N/A	BCD, FD1-3	CO_2e	N/A	1,487	N/A	6,514	AP-42
2	N/A	P1-4	VOC	N/A	2.65	N/A	3.15	Mass Balance
3	N/A	N/A	VOC	N/A	1.94E-06	N/A	8.49E-06	AP-42
3	N/A	N/A	HAP	N/A	2.42E-06	N/A	1.06E-05	AP-42
4	N/A	N/A	VOC	N/A	4.73E-05	N/A	2.07E-04	AP-42

Facility Name: WestRock Lithia Springs Preprint Plant **Date of Application:** July 2016

FORM 7.00 – AIR MODELING INFORMATION: Stack Data

Stack ID	**Emission Unit ID(s)**	**Stack Information**			**Dimensions of largest Structure Near Stack**		**Exit Gas Conditions at Maximum Emission Rate**			
									Flow Rate (acfm)	
		Height Above Grade (ft)	**Inside Diameter** (ft)	**Exhaust Direction**	**Height** (ft)	**Longest Side** (ft)	**Velocity** (ft/sec)	**Temperature** (°F)	**Average**	**Maximum**
BCD	1	41	1.5	Vertical	N/A	N/A	153	188	<16,177	16,177
FD1	1	41	1.5	Vertical	N/A	N/A	81	227	<8,576	8,576
FD2	1	41	1.5	Vertical	N/A	N/A	148	240	<15,731	15,731
FD3	1	41	1.5	Vertical	N/A	N/A	148	240	<15,731	15,731
P1-4	2	41	0.47	Vertical	N/A	N/A	34	68*	<350	350

NOTE: If emissions are not vented through a stack, describe point of discharge below and, if necessary, include an attachment. List the attachment in Form 1.00 *General Information*, Item 16.

*P1-4 temperature is conservatively modeled at ambient temperature.

Facility Name: WestRock Lithia Springs Preprint Plant **Date of Application:** July 2016

FORM 7.00 AIR MODELING INFORMATION: Chemicals Data

Chemical	Potential Emission Rate (lb/hr)	Toxicity	Reference	MSDS Attached
Refer to Appendix E				☐
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APPENDIX C: EMISSION CALCULATIONS

Table C-1. Potential Emissions Summary (tpy)

Emission Unit ID	Emission Unit Name	NO_X	CO	VOC	Total PM_{10}	Total $PM_{2.5}$	SO_2	Lead	Total HAP[3]	Total CO_2e[2]
1	Preprint Flexo. Press	--	--	34.50	--	--	--	--	1.21	--
	Preprint Dryers	5.46	4.58	0.30	0.41	0.41	0.03	2.73E-05	0.10	6,514
2	Printing Plate Processor	--	--	3.15	--	--	--	--	--	--
3	Overprint Varnish Storage Tank	--	--	8.49E-06	--	--	--	--	1.06E-05	--
4	Solvent Recovery Tank No. 1 & Solvent Recovery Tank No. 2	--	--	2.07E-04	--	--	--	--	--	--
Total Emissions		5.46	4.58	37.94	0.41	0.41	0.03	2.73E-05	1.31	6,514
NSR Major Source Threshold[1]		25	250	25	250	100	100	250	N/A	75,000
Above Threshold?		No	No	Yes	No	No	No	No	--	No

1. The Lithia Springs plant will be a major source located in an existing 8-hour ozone nonattainment area which is also one of the original thirteen Atlanta 1 -hour ozone nonattainment counties with a VOC and NO_X major source threshold of 25 tpy. While Douglas County has been redesignated as a $PM_{2.5}$ attainment area, pursuant to Georgia Rules for Air Quality Control (GRAQC) 391-3-1-.03(8)(c)16(i), sources located in Douglas County retain a major source threshold of 100 tpy of $PM_{2.5}$ and SO_2.

2. Greenhouse gas emissions should only be compared to the 75,000 tpy threshold for CO_2e if NNSR or PSD is triggered for another regulated pollutant.

3. Single HAP is assumed same as the total HAP.

Table C-2. Manufacturing and Operational Data of Preprint Press

Emission Unit ID	Input Material/Output Product	Potential Operating Hours	Maximum Throughput[1]	Units
1	Linerboard Rolls	8,760	15,000	rolls/yr
	Flexographic Ink	8,760	1,588,472	lb/yr
	Overprint Varnish	8,760	2,525,000	lb/yr
	Diethylene Glycol	8,760	480	lb/yr
	Detergent	8,760	16,500	gal/yr
	pH Adjuster	8,760	7,200	lb/yr

1. All material usages are based on existing preprint plants operated by WestRock, scaled according to the anticipated production at Lithia Springs.

Table C-3. Potential Emissions from Preprint Press

Emission Unit Name	Product Number	Description	VOC Content (%)	HAP Content (%)	Potential VOC Emissions[1] (lb/hr)	Potential VOC Emissions[1] (tpy)	Potential HAP Emissions[1,2] (lb/hr)	Potential HAP Emissions[1,2] (tpy)
Flexographic Ink	Various[3]	Water-Based Ink	3.15%	0.07%	5.72	25.04	0.13	0.58
Overprint Varnish	Various[4]	Hi Gloss Preprint OPV	0.60%	0.05%	1.72	7.55	0.14	0.63
Diethylene Glycol	PI-10101	--	100%	--	0.05	0.24	--	--
Detergent	YM-UV953	Yellow Magic Cleaner	0.18 lbs/gal	--	0.34	1.49	--	--
pH Adjuster	PI-2865	pH Adjuster	5%	--	0.04	0.18	--	--
	Total				**7.88**	**34.50**	**0.28**	**1.21**

1. Potential emissions are based on a mix of inks, overprint varnish, and other materials planned for use at the Lithia Springs facility.
Emissions (lbs/hr) = [VOC or HAP Content (%) or (lb/gal)] * [Material Throughput (lb/yr) or (gal/yr)]/ Operating Hours (hr/yr)
Emissions (tpy) = Emissions (lb/hr) * Operating Hours (hr/yr) /2,000 lbs/ton
2. Metal is present in some inks in small amounts; however the metal is assumed to remain on the substrate.
3. VOC/HAP content is based on the weighted average of applicable inks used at a similar WestRock facility.
4. The Lithia Springs plant will utilize a new overprint varnish, in addition to those used at a similar WestRock facility; therefore, VOC/HAP content is based on the maximum VOC/HAP content of all potential overprint varnish products.

Table C-4. Emission Factors for Natural Gas Combustion from Preprint Press Dryers

Pollutant	Emission Factors[1,2] (lb/MMscf)	(lb/MMBtu)
NO_X	100	9.80E-02
CO	84	8.24E-02
VOC	5.5	5.39E-03
Total PM	7.6	7.45E-03
Total PM_{10}[3]	--	7.45E-03
Total $PM_{2.5}$[3]	--	7.45E-03
Filterable PM	1.9	1.86E-03
SO_2	0.6	5.88E-04
Lead	0.0005	4.90E-07
Total HAP	1.89	1.85E-03
CO_2[4]	--	116.89
CH_4[4]	--	2.20E-03
N_2O[4]	--	2.20E-04
Total CO_2e[4]	--	117.01

1. Emission factors for natural gas combustion per AP-42 Section 1.4, Table 1.4-1 and Table 1.4-2 (July 1998). HAP emission factors are detailed in Table 7.
2. Emission factor in lb/MMscf is converted to lb/MMBtu using natural gas heating valu 1,020 Btu/scf
3. It is conservatively assumed that total PM equals total PM_{10} and total $PM_{2.5}$.
4. Emission factors per 40 CFR 98, Subpart C, Table C-1 and C-2 (converted to lb/MMBtu).

CO_2e factor calculated based on the emission factors for CO_2, CH_4, and N_2O and the global warming potential (GWP) for each pollutant per 40 CFR 98, Subpart A, Table A-1 (rule effective January 1, 2014), as follows:

CO_2 = 1
CH_4 = 25
N_2O = 298

Table C-5. Operational Data of Preprint Press Dryers

Emission Unit ID	Emission Unit Name	Maximum Heat Input Capacity (MMBtu/hr)	Potential Operating Hours (hr/yr)
1	Between Color Dryer	3.19	8,760
	Final Dryer 1	1.97	8,760
	Final Dryer 2	3.77	8,760
	Final Dryer 3	3.77	8,760

1. Capacity based on manufacturer specifications.

Table C-6. Potential Emissions from Preprint Press Dryers[1]

Pollutant	Between Color Dryer (lb/hr)	Between Color Dryer (tpy)	Final Dryer 1 (lb/hr)	Final Dryer 1 (tpy)	Final Dryer 2 (lb/hr)	Final Dryer 2 (tpy)	Final Dryer 3 (lb/hr)	Final Dryer 3 (tpy)	Total (lb/hr)	Total (tpy)
NOx	0.31	1.37	0.19	0.85	0.37	1.62	0.37	1.62	1.25	5.46
CO	0.26	1.15	0.16	0.71	0.31	1.36	0.31	1.36	1.05	4.58
VOC	0.02	0.08	0.01	0.05	0.02	0.09	0.02	0.09	0.07	0.30
Total PM	0.02	0.10	0.01	0.06	0.03	0.12	0.03	0.12	0.09	0.41
Total PM_{10} [2]	0.02	0.10	0.01	0.06	0.03	0.12	0.03	0.12	0.09	0.41
Total $PM_{2.5}$ [2]	0.02	0.10	0.01	0.06	0.03	0.12	0.03	0.12	0.09	0.41
Filterable PM	5.95E-03	0.03	3.67E-03	0.02	7.03E-03	0.03	7.03E-03	0.03	0.02	0.10
SO_2	1.88E-03	8.23E-03	1.16E-03	5.08E-03	2.22E-03	9.72E-03	2.22E-03	9.72E-03	7.48E-03	0.03
Lead	1.57E-06	6.86E-06	9.66E-07	4.23E-06	1.85E-06	8.10E-06	1.85E-06	8.10E-06	6.23E-06	2.73E-05
Total HAP	5.91E-03	0.03	3.65E-03	0.02	6.98E-03	0.03	6.98E-03	0.03	0.02	0.10
CO_2	373.32	1,635	230.32	1,009	441.04	1,932	441.04	1,932	1,486	6,508
CH_4	7.04E-03	0.03	4.34E-03	0.02	8.32E-03	0.04	8.32E-03	0.04	0.03	0.12
N_2O	7.04E-04	3.08E-03	4.34E-04	1.90E-03	8.32E-04	3.64E-03	8.32E-04	3.64E-03	2.80E-03	0.01
Total CO_2e	373.71	1,637	230.56	1,010	441.50	1,934	441.50	1,934	1,487	6,514

1. Potential Emissions (lb/hr) = Emission Factor (lb/MMBtu) * Dryer Heat Input Capacity (MMBtu/hr)
   Potential Emissions (tpy) = Potential Emissions (lb/hr) * Operating Hours (hr/yr) / 2,000 lbs/ton
2. It is conservatively assumed that total PM equals total PM_{10} and total $PM_{2.5}$.

Table C-7. Factors for HAP Emissions from Preprint Press Dryers

Pollutant	Emission Factor[1,2] (lb/MMscf)
2-Methylnaphthalene*	2.40E-05
3-Methylchloranthrene*	1.80E-06
7,12-Dimethylbenz(a) anthracene*	1.60E-05
Acenaphthene*	1.80E-06
Acenaphthylene*	1.80E-06
Anthracene*	2.40E-06
Benz(a)anthracene*	1.80E-06
Benzene	2.10E-03
Benzo(a)pyrene*	1.20E-06
Benzo(b)fluoranthene*	1.80E-06
Benzo(g,h,i)perylene*	1.20E-06
Benzo(k)fluoranthene*	1.80E-06
Chrysene*	1.80E-06
Dibenzo(a,h)anthracene*	1.20E-06
Dichlorobenzene	1.20E-03
Fluoranthene*	3.00E-06
Fluorene*	2.80E-06
Formaldehyde	7.50E-02
Hexane	1.80E+00
Indeno(1,2,3-cd)pyrene*	1.80E-06
Naphthalene	6.10E-04
Phenanathrene*	1.70E-05
Pyrene*	5.00E-06
Toluene	3.40E-03
Arsenic	2.00E-04
Beryllium	1.20E-05
Cadmium	1.10E-03
Chromium	1.40E-03
Cobalt	8.40E-05
Manganese	3.80E-04
Mercury	2.60E-04
Nickel	2.10E-03
Selenium	2.40E-05

1. Emission factors for natural gas combustion per AP-42 Section 1.4, Table 1.4-3 and Table 1.4-4 (July 1998).

2. The starred compounds are polycyclic organic matter (POM).

Table C-8. Potential Emissions from Printing Plate Processor Wash-Out Section

Component	% Total Weight	Molecular Weight	Vapor Pressure[1,2] (Vp)	Liquid Mole Fraction[3] (Xi)	Emissions: (Assume 100% Saturation) Partial Pressure[3] (Xi*Vp)		Flow Rate[4,5] F_{sat}	Emissions[3,6]	Emissions: (with Saturation Factors) K_i[7]	K_i* A[8]	Saturation Factor - Iteration 1	Saturation Factor[9] - Iteration 2	Saturation Factor[9] - Iteration 3	Saturation Factor[9] - Iteration 4	Emissions[10]	
	%	lb/lb-mol	(mm Hg)	(%)	(mm Hg)	(psia)	(ft³/min)	(lbs/hr)	(ft/min)	(ft³/min)	(%)	(%)	(%)	(%)	(lbs/hr)	(tpy)
Benzyl Alcohol	40	108	0.14	0.49	0.069	0.0013	0.03	0.51	0.90	25.13	100%	6.70%	6.70%	6.70%	0.03	0.10
Synthetic hydrocarbons	30	140	1.00	0.28	0.282	0.0055	0.13	2.74	0.83	23.06	100%	6.18%	6.18%	6.18%	0.17	0.51
Aliphatic Esters	30	172	0.50	0.23	0.115	0.0022	0.05	1.37	0.78	21.55	100%	5.80%	5.80%	5.80%	0.08	0.24
Total	100			1.00	0.47	0.01		4.63							0.28	0.85

1. Vapor pressure of benzyl alcohol is based on Antoine equation
2. Operating temperature of the washout system at 30 °C. System pressure is 14.7 psia. 1 psia = 760 mm Hg
3. Liquid mole fraction = (% Total Weight of component i / Molecular Weight of component i) / ∑(% Total Weight of component i/ Molecular Weight of component i)
4. Per EPA Emission Inventory Improvement Program (EIIP), Volume II, Chapter 16 - Methods for Estimating Air Emissions from Chemical Manufacturing Facilities, Equation 3-11 (August 2007).
F_{sat}, Saturated Flow Rate of Volatile Component (cfm) = Purge Flow Rate (scfm) * Partial Pressure of Volatile Component i (mmHg) /Partial Pressure of Non-condensable Gas [System Pressure (Ambient Pressure, 760 mmHg) - Total Partial Pressure of VOC (mmHg)], assuming 100% saturation.
5. Purge flow rate is 350 scfm
6. Emissions at 100% Saturation are calculated based on EPA EIIP, Volume II, Chapter 16, Equation 3-15 (August 2007). Emissions (lbs/hr) = Molecular Weight (lb/lb-mol) * System Operating Pressure (psia) / [Universal Gas Constant (psia ft^3/lb-mol °R) * Operating System Temperature (°R)] * Fsat (ft^3/min)/ 60 seconds/min
Universal Gas Constant 10.73 psia ft^3/lb-mole °R
7. Mass transfer coefficient is calculated based on EPA EIIP, Volume II, Chapter 16, Equation 3-10 (August 2007). Ki = K_{water} , 0.83 cm/s (M_{water}, 18 lb/lb-mol/ $M_i)^{1/3}$ * 0.03281 ft/cm * 60 seconds/min
8. Single Plate Area, which is 27.78 ft^2
9. Iterative trial and errors result are based on EPA EIIP, Volume II, Chapter 16, Equation 3-14 (August 2007). Saturation Factor at Iteration Level i+1 (%) = K_iA /(K_iA + Purge Flow Rate + F_{sat} * Saturation Factor at Iteration Level i)
10. While short -term emissions are based on the maximum capacity for this unit, the processor can not sustain this level of production continuously. These calculations are to predict the maximum anticipated VOC emissions on both a short and long term basis; however, as WestRock is proposing to limit annual emissions, and track emissions using a mass balance approach, no restriction should be placed on actual operating hours.
Short-term emissions were annualized using a capacity factor of 68%

Table C-9. Potential Emissions from Printing Plate Processor Solvent Drying

Potential Surface Area of Plates Dried[1]		Max Polymer Thickness Swell[2]		Void area from Recessed Image[2]	Solvent Volume Creating Swell[3]		Solvent Density		Potential Emissions	
(ft²/hr)	(ft²/yr)	(mils)	(ft)	--	(ft³/hr)	(ft³/yr)	(lb/gal)	(lb/ft³)	(lb/hr)[4]	(tpy)[5]
148	288,000	5	4.17E-04	30%	0.04	84	7.3	54.7	2.36	2.30

1. Hourly capacity based on the area of 8 single plates, requiring a total drying time of 90 minutes.
2. Values based on WestRock engineering knowledge of this process. Assuming all solvent in swell of the non-voided image will be emitted.
3. Solvent Volume Creating Swell = Surface Area of Plates Dried (ft^2/hr or ft^2/yr) * Max Polymer Thickness Swell (ft) * (100%-Void Area from Recessed Image)
4. Potential Hourly Emissions (lb/hr) = Solvent Volume Creating Swell (ft^3/hr) * Solvent Density (lb/ft^3).
5. Potential Annual Emissions (tpy) = Solvent Volume Creating Swell (ft^3/yr) * Solvent Density (lb/ft^3)/2,000 lbs/ton

Table C-10. Potential Emissions from Printing Plate Processor Summary

Emission Unit ID	Emission Unit Name	Potential VOC (lb/hr)	(tpy)
2	Printing Plate Processor	2.65	3.15

Table C-11. Potential Emissions of Storage Tanks

Emission Unit ID	Emission Unit Name	VOC Content (%)	HAP Content (%)	Density (lb/gal)	Maximum Throughput (lb/yr)	Maximum Throughput (gal/yr)	Tank Capacity (gal)	Total Vapor Loss[1] (tpy)	VOC Emissions[2] (tpy)	HAP Emissions[2] (tpy)
3	Overprint Varnish Storage Tank	0.04%	0.05%	8.34	2,525,000	302,758	7,000	0.021	8.49E-06	1.06E-05
4	Solvent Recovery Tank No. 1	100%	0.00%	6.94	--	6,480	300	1.03E-04	1.03E-04	0.00E+00
	Solvent Recovery Tank No. 2	100%	0.00%	6.94	--	6,480	300	1.03E-04	1.03E-04	0.00E+00

1. Calculated based on Trinity Tank Calculation Tools developed using methods and equations from AP-42, November 2006, Chapter 7. Assume 100% water for overprint varnish storage tank as the VOC concentration is very low. Assume that solvent in Solvent Recovery Tanks will have characteristics similar to diesel for estimation purposes. The use of diesel factors with AP-42 equations results in an overall emission rate, which is then used as the basis for the VOC constituents of the solvent.

2. VOC and HAP Emissions (tpy) = Total Vapor Losses (tpy)* VOC or HAP Content

Table C-12. Potential TAP/HAP Emissions

Pollutant	Pollutant Class --	CAS No. --	Product --	Maximum Throughput (lb/yr)	TAP/HAP Content (%)	Maximum TAP/HAP Usage Rate (lb/yr)	Potential TAP/HAP Emissions (lbs/hr)[1]	(tpy)[2]
Preprint Flexo. Press								
Ethanolamine	TAP	141-43-5	Ink pH Adjuster	1,588,472 7,200	2.53% 5.00%	40,214 360	4.59	20.11
Diethylene Glycol	TAP	111-46-6	Diethylene Glycol	480	100.0%	480	0.05	0.24
Propylene Glycol	TAP	57-55-6	Ink	1,588,472	0.014%	220	0.03	0.11
Isopropanol	TAP	67-63-0	Ink	1,588,472	0.0042%	67	7.61E-03	0.03
1-Propanol	TAP	71-23-8	Ink	1,588,472	0.00066%	10	1.19E-03	5.21E-03
Styrene	HAP/TAP	100-42-5	Ink	1,588,472	0.0023%	36	4.09E-03	0.018
Diethylene Glycol Ethyl Ether	HAP/TAP	111-90-0	Ink	1,588,472	0.0516%	820	0.09	0.41
Acrylic Acid	HAP/TAP	79-10-7	Ink	1,588,472	0.0188%	298	0.034	0.15
Triethylamine	HAP/TAP	121-44-8	Ink	1,588,472	0.000026%	0.408	4.66E-05	2.04E-04
Propionaldehyde	HAP/TAP	123-38-6	Ink	1,588,472	0.00000066%	0.010	1.19E-06	5.23E-06
Ethyl Acrylate	HAP/TAP	140-88-5	OPV	2,525,000	0.02%	505	0.06	0.25
Ethyl Benzene	HAP/TAP	100-41-4	OPV	2,525,000	0.02%	505	0.06	0.25
Maleic Anhydride	HAP/TAP	108-31-6	OPV	2,525,000	0.01%	253	0.03	0.13
Printing Plate Processor								
Benzyl Alcohol	TAP	100-51-6	Plate Processor	2.6 lb/hr	40.00%	--	1.06	4.64

1. It was conservatively assumed that 100% of HAP and TAP are emitted.
Potential TAP/HAP Emissions (lb/hr) = (Maximum TAP/HAP Usage Rate, lb/yr) / (8,760 hr/yr)

2. Potential TAP/HAP Emissions (tpy) = (Potential TAP/HAP Emissions, lb/hr) *(8,760 hr/year) / (2,000 lb/ton)

Fixed-Roof Tank Emissions - Monthly

Reporting Year	2016

Based on AP-42, November 2006, Section 7.1.3.1.

Tool Last Updated: 12/14/15 Click Here to Go Back to Cover Page

Tank Reference Parameters				
Parameter Title	**Notes**	**Parameter Symbol**	**Units**	**Value**
Tank ID	Enter only Tank ID in this tab.			TK01
Tank Name	Text Description of Tank Name	TK_{name}		Vertical Fixed Roof Tank
Actual Location		Loc_{Act}		Atlanta
Location for Calculation Purposes		Loc_{Calc}		Atlanta, Georgia
Tank/Roof Type		TK_{roof}		VFR - Cone
Normal Capacity		Cap	gal	7,000
Diameter		D	ft	8.414
Shell Height or Length		H_S	ft	16.83
Effective Diameter	$= ((H_S * D) / (\pi/4))^{0.5}$ {horiz. tanks only, Eqn. 1-13} = D {all other fixed roof tanks}	D_E	ft	8.4
Effective Height	$= \pi/4 * D$ {horiz. tanks only, Eqn. 1-14} $= H_S$ {all other fixed roof tanks}	H_E	ft	16.8
External Shell Color		SC_{ext}		White
External Shell Paint Condition		PC_{Shell}		Good
Roof Color/Shade		RC		White
Roof Paint Condition		PC_{Roof}		Good
Tank Shell Solar Absorbance		α_{Shell}		0.17
Tank Roof Paint Solar Absorbance		α_{Roof}		0.17
Total Tank Paint Solar Absorbance	$= (\alpha_{Shell} + \alpha_{Roof}) / 2$ {Note A, Table 7.1-6}	α_{Tot}		0.17
Ideal Gas Constant,		R	psia ft^3 / lbmole °R	10.731
Ambient Pressure		P_A	psia	14.225

Tank Reference Parameters				
Parameter Title	**Notes**	**Parameter Symbol**	**Units**	**Value**
Underground Tank?		UT		Aboveground
Heated Tank?		HT		No
Liquid Bulk Temperature	Heated Tanks Only	T_B	Degrees F	--
Insulated Tank?		IT		No
Pressure Tank?		PT		Atmospheric
Normal Operating Pressure	Only for Pressure Tanks	P_I	psig	0.0
Vapor Tight Roof		VTR		Yes
Control Device	*= None {No vapor tight roof}* *= User Specified*	CD		None
Control Device Efficiency		CD_{Eff}	%	--
Maximum Liquid Height		H_{LX}	ft	16.8
Dome Tank Roof Height	$= R_R - (R_R^2 - (D / 2)^2)^{0.5}$ {dome roof with D = 2 * R_S, Eqn. 1-19}	H_R	ft	--
Roof Outage	$= S_R * (D / 2) / 3$ {cone roof, Eqn. 1-16 and 1-17} $= H_R * (^1/_2 + {^1/_6}*(H_R / (D / 2))^2)$ {dome roof, Eqn. 1-18}	H_{RO}	ft	0.1
Breather Vent Pressure Setting	= 0 {No vapor tight roof, AP-42 Pg. 7.1-13 Note 3} = User Specified = Default +/-0.03 psig if unknown	P_{BP}	psig	0.03
Breather Vent Vacuum Setting		P_{BV}	psig	-0.03
Breather Vent Pressure Setting Range	*= 0 {No vapor tight roof}* $= P_{BP} - P_{BV}$ *{Eqn. 1-11}*	ΔP_B	psig	0.06
Dome Roof Radius	Dome Roofs Only = user input between 0.8 to 1.2 * D {AP-42 7.1-15} = 1.0 * D {default if blank}	R_R	ft	--
Cone Roof Slope	Cone Roofs Only Default = 0.0625 ft/ft	S_R	ft/ft	0.0625
Tank Maximum Liquid Volume	$= \pi/4 * D_E^2 * H_{LX}$ {Eqn. 1-31} Though not stated in AP-42, use DE in place of D for hor. tanks.	V_{LX}	ft^3	936
Days per Year	For leap years, days = 366	t_{yr}	days/yr	366

Emission Summary			
Annual Throughput, gal	302,758	**Annual Emissions**	0.02
Annual Turnovers	43.25		
Month	**Emissions, lbs**	**Emissions, tons**	
Jan	1.53	0.001	
Feb	1.71	0.001	
Mar	2.54	0.001	
Apr	3.35	0.002	
May	4.43	0.002	
Jun	5.32	0.003	
Jul	5.88	0.003	
Aug	5.66	0.003	
Sep	4.60	0.002	
Oct	3.37	0.002	
Nov	2.33	0.001	
Dec	1.73	0.001	

Note: The emission summary table is pulled into the Tank Emissions tab using cell references A31:B42. The emission summary must remain at this cell reference to function properly.

Calculations						1	2	3	4	5	6	7	8	9	10	11	12
Parameter Title	Notes	Parameter Symbol	Units	Reference or Equation		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Service						Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service
Type of Substance	Select Organic Liquid, Petroleum Distillate, or Crude Oil					Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other
Contents of Tank	Select from list (add new compounds in 'VOLs' tab):			= User specified		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Speciation Profile	Select from list (add new in 'Speciation Input' tab):			= User specified		--	--	--	--	--	--	--	--	--	--	--	--
Speciation Profile Type				= User specified		None	None	None	None	None	None	None	None	None	None	None	None
Monthly Throughput		Q	gal/month	= User specified		25,230	25,230	25,230	25,230	25,230	25,230	25,230	25,230	25,230	25,230	25,230	25,230
Days-In-Service	Total days per month minus the days tank has a service change, is out of service, or for non-routine events.	t_{IS}	days			31	29	31	30	31	30	31	31	30	31	30	31
Constant in the vapor pressure equation	Used in ΔP_V only for petroleum liquids. If full speciation profile specified, leave blank.	B	°R	= Not Applicable {Organic liquids and full speciation profiles}		--	--	--	--	--	--	--	--	--	--	--	--
Average Liquid Height	Leave blank if unknown. Not applicable for horizontal Tanks. Fill out for tanks operating on level control.	H_L	ft	= User specified if known = H_{LX} / 2 {default}		8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Vapor Space Outage		H_{VO}	ft	= (H_E / 2) {horizontal tanks only, Eqn. 1-14} = H_S - H_L + H_{RO} {all other fixed roof tanks, Eqn. 1-15}		8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Daily Total Solar Insolation Factor		I	Btu / ft^2 day			823	1,087	1,426	1,794	1,970	2,045	1,956	1,815	1,538	1,287	929	758
Vent Setting Correction Factor		K_B		= 1 {(P_{BP} ≤ 0.03 or P_{BV} ≥ -0.03 psig) and (K_N * (P_{BP} + P_A) / (P_I + P_A)) ≤ 1.0, Eqn. 1-36} = (((P_I + P_A) / K_N) - $P_{VA,Tla}$) / (P_{BP} + P_A - $P_{VA,Tla}$) {Eqn. 1-37}		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Vapor Space Expansion Factor	Per AP-42 7.1-12, use Eqn. 1-6 if PVA,Tb < 0.1 psia. Tank location is always known for this tool. True vapor pressure based on liquid stock. If KE < 0, no standing losses occur. Per API MPMS Ch. 19.1.2.1.4.2, K_E ≥ 0.	K_E		= (ΔT_V / (T_{LA} + 459.67 °R)) + ((ΔP_V - ΔP_B) / (P_A - $P_{VA,Tla}$)) ≥ 0 {$P_{VA,Tla}$ ≥ 0.1 psia or P_{BP} > 0.03 psig or P_{BV} < -0.03 psig, Eqn. 1-7} = (0.0018 $°R^{-1}$) * ΔT_V {$P_{VA,Tla}$ < 0.1 psia, Eqn. 1-5}		0.0353	0.0393	0.0458	0.0520	0.0532	0.0540	0.0518	0.0492	0.0446	0.0438	0.0385	0.0334
Working Loss Turnover (Saturation) Factor	Per Eqn. 1-29, annual threshold for turnovers is 36. Equation modified to a monthly form by converting the monthly turnovers to a theoretical annual turnover equivalent.	K_N		= (180 + (N * t_{yr} / t_{IS})) / (6 * (N * t_{yr} / t_{IS})) {(N * t_{yr} / t_{IS}) > 36, Eqn. 1-29} = 1 {(N * t_{yr} / t_{IS}) ≤ 36, Eqn. 1-29}		0.87	0.83	0.87	0.85	0.87	0.85	0.87	0.87	0.85	0.87	0.85	0.87
Working Loss Product Factor		K_P		= 0.75 {crude oils, Eqn. 1-29} = 1 {all other organic liquids}		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Vented Vapor Saturation Factor	Constant 0.053 has units of 1/(psia-ft). True vapor pressure based on liquid surface.	K_S		= 1 / (1 + 0.053 * $P_{VA,Tla}$ * H_{VO}) {Eqn. 1-20}		0.943	0.934	0.910	0.882	0.851	0.819	0.806	0.811	0.837	0.881	0.913	0.936
Vapor Molecular Weight	When using full speciation profiles, calculated as the weighted average of the M_V of each component.	M_V	lb/lb-mole	= VOL data of tank contents {partial speciation} M_V = Σ (M_{Vi} * ($P_{VA,Tla,i}$/$P_{VA,Tla}$)) M_L = 1 / Σ (Z_{Li} / M_{Li}) {full speciation, Eqn. 1-22}		18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Liquid Molecular Weight		M_L	lb/lb-mole			18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Number of Turnovers per Month	Constant 5.614 has units of ft^3/bbl.	N		= 5.614 * Q * (bbl / 42 gal) / V_{LX} {Eqn. 1-30}		3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60
Average Daily Minimum Ambient Temperature		T_{AN}	°F			31.50	34.50	42.50	50.20	58.70	66.20	69.50	69.00	63.50	51.90	42.80	35.00
Average Daily Maximum Ambient Temperature		T_{AX}	°F			50.40	55.00	64.30	72.70	79.60	85.80	88.00	87.10	81.80	72.70	63.40	54.00
Daily Average Ambient Temperature		T_{AA}	°F	= (T_{AX} + T_{AN}) / 2 {Eqn. 1-27}		40.95	44.75	53.40	61.45	69.15	76.00	78.75	78.05	72.65	62.30	53.10	44.50
Daily Minimum Liquid Surf. Temperature, F		T_{LN}	°F	= T_{LA} - 0.25 * ΔT_V {Fig. 7.1-17}		37.69	41.24	49.71	57.69	65.70	72.80	75.73	75.08	69.60	58.76	49.55	41.21
Daily Maximum Liquid Surf. Temperature, F		T_{LX}	°F	= T_{LA} + 0.25 * ΔT_V {Fig. 7.1-17}		46.45	51.20	60.95	70.06	77.91	84.72	87.04	85.92	79.85	69.31	59.17	49.85
Daily Vapor Temperature Range	Constant 0.028 has units of (°R-ft^2-day/Btu)	ΔT_V	°R	= 0 {heated and fully insulated tanks only} = 0.72 * (T_{AX} - T_{AN}) + 0.028 * α_{Tot} * I {Eqn. 1-8}		17.53	19.93	22.48	24.74	24.43	23.85	22.63	21.67	20.50	21.10	19.26	17.29

Calculations						2	3	4	5	6	7	8	9	10	11	12	13
Parameter Title	Notes	Parameter Symbol	Units	Reference or Equation		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Service						Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service
Daily Average Liquid Surf. Temperature	Constant 0.0079 has units of (°R-ft^2-day/btu).	T_{LA}	°F	= T_B {heated and/or fully insulated tanks only} = (0.44 * T_{AA}) + (0.56 * T_B) + (0.0079 * α_{Tot} * I) {Eqn. 1-26}		42.07	46.22	55.33	63.87	71.81	78.76	81.39	80.50	74.73	64.04	54.36	45.53
Liquid Bulk Temperature	If T_{LA} is unknown, see AP-42 7.1-23 Note 3. Not included here as T_B is always calculated. α_{TOT} is not applicable for fully insulated tanks.	T_B	°F	= specified by user {heated tanks only} = T_{AA} {fully insulated but not heated tanks only} = T_{AA} + (6 * α_{Tot} - 1) {Eqn. 1-28}		40.97	44.77	53.42	61.47	69.17	76.02	78.77	78.07	72.67	62.32	53.12	44.52
Vapor Pressure at Daily Av. Liquid Surf. Temp.	Used for speciated emissions and most vapor pressures. $P_{VA,Tla}$ uses T_{LA}.	$P_{VA,Tla}$	psia	*{full speciation profiles, Eqn. 1-22}:* Sum of partial true vapor pressures components. *{partial/no speciation profiles}:* Vapor pressures at T (°F) based on P_{VA} values in VOLs tab at ΔT (°F) increments by interpolating between the P_{VA} values at the next highest/lowest T. $P_{VA,T}$ = (T - T_{Low}) / (T_{High} - T_{Low}) * ($P_{VA,T,High}$ - $P_{VA,T,Low}$) + $P_{VA,T,Low}$		0.1334	0.1568	0.2198	0.2976	0.3891	0.4890	0.5334	0.5164	0.4311	0.2994	0.2122	0.1529
Vapor Pressure at Daily Min. Liquid Surf. Temp.	Used for ΔP_V. Per AP-42 7.1-13 Note 5, P_{VN} uses T_{LN}.	P_{VN}	psia			0.0935	0.1287	0.1764	0.2382	0.3172	0.4033	0.4455	0.4362	0.3589	0.2466	0.1755	0.1285
Vapor Pressure at Daily Max. Liquid Surf. Temp.	Used for ΔP_V. Per AP-42 7.1-13 Note 5, P_{VX} uses T_{LX}.	P_{VX}	psia			0.1581	0.1875	0.2664	0.3641	0.4769	0.5970	0.6415	0.6199	0.5048	0.3558	0.2498	0.1773
Daily Vapor Pressure Range	Eqn. 1-10 is alt. method per AP-42 7.1-13. Used as primary method for Petroleum Distillates & Crude. True vapor pressure based on liquid surface.	ΔP_V	psia	= P_{VX} - P_{VN} {Eqn. 1-9} = (0.50 * B * $P_{VA,Tla}$ * ΔT_V) / (T_{LA} + 459.67 °R)^2 {petroleum liquids if B is known, Eqn. 1-10}		0.065	0.059	0.090	0.126	0.160	0.194	0.196	0.184	0.146	0.109	0.074	0.049
Vapor Density		W_V	lb/ft^3	= (M_V * $P_{VA,Tla}$) / (R * (T_{LA} + 459.67 °R)) {Eqn. 1-21}		0.00045	0.00052	0.00072	0.00095	0.00123	0.00153	0.00166	0.00161	0.00135	0.00096	0.00069	0.00051
Vapor Space Volume		V_V	ft^3	= (π/4 * D_E^2) * H_{VO} {Eqn. 1-3}		473	473	473	473	473	473	473	473	473	473	473	473
Standing Storage Loss	Uncontrolled emissions. No standing or breathing losses occur for underground tanks per AP-42 7.1-14.	L_S	lbs/month	= 0 {underground tanks only} = t_{lS} * V_V * W_V * K_E * K_S {Eqn. 1-2 and 1-4}		0.22	0.26	0.44	0.62	0.82	0.96	1.01	0.94	0.72	0.54	0.35	0.23
Working Loss	Uncontrolled emissions. True vapor pressure based on liquid surface. Constant 0.0010 derived from Eqn. 1-32, 1-33, and 1-35 assuming T_{LA} = 63 °F.	L_W	lbs/month	= Q * (5.614 ft^3/bbl) * (bbl / 42 gal) * (M_V * $P_{VA,Tla}$) / (R * (T_{LA} + 459.67 °R)) * K_N * K_P * K_B {Eqn. 1-29}		1.31	1.45	2.11	2.73	3.61	4.37	4.87	4.72	3.88	2.82	1.98	1.49
Total Losses	**Uncontrolled emissions.**	L_T	**lbs/month**	**= (L_S + L_W) {Eqn. 1-1}**		**1.53**	**1.71**	**2.54**	**3.35**	**4.43**	**5.32**	**5.88**	**5.66**	**4.60**	**3.37**	**2.33**	**1.73**
Total Losses	**Controlled emissions, if applicable. Note: some species have 0% efficiencies with activated carbon.**	$L_{T,CD}$	**lbs/month**	**= Not Applicable {no CD} = L_T * (1 - CD_{Eff}) {CD}**		**1.53**	**1.71**	**2.54**	**3.35**	**4.43**	**5.32**	**5.88**	**5.66**	**4.60**	**3.37**	**2.33**	**1.73**

Fixed-Roof Tank Emissions - Monthly

Reporting Year	2016

Based on AP-42, November 2006, Section 7.1.3.1.

Tool Last Updated: 12/14/15 Click Here to Go Back to Cover Page

Tank Reference Parameters

Parameter Title	Notes	Parameter Symbol	Units	Value
Tank ID	Enter only Tank ID in this tab.			TK02
Tank Name	Text Description of Tank Name	TK_{name}		Vertical Fixed Roof Tank
Actual Location		Loc_{Act}		Atlanta
Location for Calculation Purposes		Loc_{Calc}		Atlanta, Georgia
Tank/Roof Type		TK_{roof}		VFR - Cone
Normal Capacity		Cap	gal	300
Diameter		D	ft	2.945
Shell Height or Length		H_S	ft	5.89
Effective Diameter	= $((H_S * D) / (\pi/4))^{0.5}$ {horiz. tanks only, Eqn. 1-13} = D {all other fixed roof tanks}	D_E	ft	2.9
Effective Height	= π/4 * D {horiz. tanks only, Eqn. 1-14} = H_S {all other fixed roof tanks}	H_E	ft	5.9
External Shell Color		SC_{ext}		White
External Shell Paint Condition		PC_{Shell}		Good
Roof Color/Shade		RC		White
Roof Paint Condition		PC_{Roof}		Good
Tank Shell Solar Absorbance		α_{Shell}		0.17
Tank Roof Paint Solar Absorbance		α_{Roof}		0.17
Total Tank Paint Solar Absorbance	= $(\alpha_{Shell} + \alpha_{Roof}) / 2$ {Note A, Table 7.1-6}	α_{Tot}		0.17
Ideal Gas Constant,		R	psia ft^3 / lbmole °R	10.731
Ambient Pressure		P_A	psia	14.225

Tank Reference Parameters

Parameter Title	Notes	Parameter Symbol	Units	Value
Underground Tank?		UT		Aboveground
Heated Tank?		HT		No
Liquid Bulk Temperature	Heated Tanks Only	T_B	Degrees F	--
Insulated Tank?		IT		No
Pressure Tank?		PT		Atmospheric
Normal Operating Pressure	Only for Pressure Tanks	P_I	psig	0.0
Vapor Tight Roof		VTR		Yes
Control Device	*= None {No vapor tight roof}* *= User Specified*	CD		None
Control Device Efficiency		CD_{Eff}	%	--
Maximum Liquid Height		H_{LX}	ft	5.9
Dome Tank Roof Height	= $R_R - (R_R^2 - (D / 2)^2)^{0.5}$ {dome roof with D = 2 * R_S, Eqn. 1-19}	H_R	ft	--
Roof Outage	= S_R * (D / 2) / 3 {cone roof, Eqn. 1-16 and 1-17} = $H_R * (^1/_2 + ^1/_6 * (H_R / (D / 2))^2)$ {dome roof, Eqn. 1-18}	H_{RO}	ft	0.0
Breather Vent Pressure Setting	= 0 {No vapor tight roof, AP-42 Pg. 7.1-13 Note 3}	P_{BP}	psig	0.03
Breather Vent Vacuum Setting	= User Specified = Default +/-0.03 psig if unknown	P_{BV}	psig	-0.03
Breather Vent Pressure Setting Range	*= 0 {No vapor tight roof}* *= $P_{BP} - P_{BV}$ {Eqn. 1-11}*	ΔP_B	psig	0.06
Dome Roof Radius	Dome Roofs Only = user input between 0.8 to 1.2 * D {AP-42 7.1-15} = 1.0 * D {default if blank}	R_R	ft	--
Cone Roof Slope	Cone Roofs Only Default = 0.0625 ft/ft	S_R	ft/ft	0.0625
Tank Maximum Liquid Volume	= $\pi/4 * D_E^2 * H_{LX}$ {Eqn. 1-31} Though not stated in AP-42, use DE in place of D for hor. tanks.	V_{LX}	ft^3	40
Days per Year	For leap years, days = 366	t_{yr}	days/yr	366

Emission Summary

Annual Throughput, gal	6,480	**Annual Emissions**	1.03E-04
Annual Turnovers	21.60		
Month	**Emissions, lbs**	**Emissions, tons**	
Jan	0.01	3.76E-06	
Feb	0.01	4.43E-06	
Mar	0.01	6.39E-06	
Apr	0.02	8.57E-06	
May	0.02	1.09E-05	
Jun	0.03	1.29E-05	
Jul	0.03	1.37E-05	
Aug	0.03	1.32E-05	
Sep	0.02	1.12E-05	
Oct	0.02	8.34E-06	
Nov	0.01	5.90E-06	
Dec	0.01	4.26E-06	

Note: The emission summary table is pulled into the Tank Emissions tab using cell references A31:B42. The emission summary must remain at this cell reference to function properly.

Calculations					1	2	3	4	5	6	7	8	9	10	11	12
Parameter Title	Notes	Parameter Symbol	Units	Reference or Equation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Service					Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service	Main Service
Type of Substance	Select Organic Liquid, Petroleum Distillate, or Crude Oil				Petroleum Distillate	Petroleum Distillate	Petroleum Distillate	Petroleum Distillate	Petroleum Distillate	Petroleum Distillate	Petroleum Distillate	Petroleum Distillate	Petroleum Distillate	Petroleum Distillate	Petroleum Distillate	Petroleum Distillate
Contents of Tank	Select from list (add new compounds in 'VOLs' tab):			= User specified	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2	Distillate fuel oil no. 2
Speciation Profile	Select from list (add new in 'Speciation Input' tab):			= User specified	--	--	--	--	--	--	--	--	--	--	--	--
Speciation Profile Type				= User specified	None	None	None	None	None	None	None	None	None	None	None	None
Monthly Throughput		Q	gal/month	= User specified	540	540	540	540	540	540	540	540	540	540	540	540
Days-In-Service	Total days per month minus the days tank has a service change, is out of service, or for non-routine events.	t_{IS}	days		31	29	31	30	31	30	31	31	30	31	30	31
Constant in the vapor pressure equation	Used in ΔP_V only for petroleum liquids. If full speciation profile specified, leave blank.	B	°R	= Not Applicable {Organic liquids and full speciation profiles}	8,907	8,907	8,907	8,907	8,907	8,907	8,907	8,907	8,907	8,907	8,907	8,907
Average Liquid Height	Leave blank if unknown. Not applicable for horizontal Tanks. Fill out for tanks operating on level control.	H_L	ft	= User specified if known = H_{LX} / 2 {default}	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Vapor Space Outage		H_{VO}	ft	= (H_E / 2) {horizontal tanks only, Eqn. 1-14} = H_S - H_L + H_{RO} {all other fixed roof tanks, Eqn. 1-15}	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Daily Total Solar Insolation Factor		I	Btu / ft^2 day		823	1,087	1,426	1,794	1,970	2,045	1,956	1,815	1,538	1,287	929	758
Vent Setting Correction Factor		K_B		= 1 {(P_{BP} ≤ 0.03 or P_{BV} ≥ -0.03 psig) and (K_N * (P_{BP} + P_A) / (P_I + P_A)) ≤ 1.0, Eqn. 1-36} = (((P_I + P_A) / K_N) - $P_{VA,Tla}$) / (P_{BP} + P_A - $P_{VA,Tla}$) {Eqn. 1-37}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Vapor Space Expansion Factor	Per AP-42 7.1-12, use Eqn. 1-6 if PVA,Tb < 0.1 psia. Tank location is always known for this tool. True vapor pressure based on liquid stock. If KE < 0, no standing losses occur. Per API MPMS Ch. 19.1.2.1.4.2, K_E ≥ 0.	K_E		= (ΔT_V / (T_{LA} + 459.67 °R)) + ((ΔP_V - ΔP_B) / (P_A - $P_{VA,Tla}$)) ≥ 0 {$P_{VA,Tla}$ ≥ 0.1 psia or P_{BP} > 0.03 psig or P_{BV} < -0.03 psig, Eqn. 1-7} = (0.0018 $°R^{-1}$) * ΔT_V {$P_{VA,Tla}$ < 0.1 psia, Eqn. 1-5}	0.0315	0.0359	0.0405	0.0445	0.0440	0.0429	0.0407	0.0390	0.0369	0.0380	0.0347	0.0311
Working Loss Turnover (Saturation) Factor	Per Eqn. 1-29, annual threshold for turnovers is 36. Equation modified to a monthly form by converting the monthly turnovers to a theoretical annual turnover equivalent.	K_N		= (180 + (N * t_{yr} / t_{IS})) / (6 * (N * t_{yr} / t_{IS})) {(N * t_{yr} / t_{IS}) > 36, Eqn. 1-29} = 1 {(N * t_{yr} / t_{IS}) ≤ 36, Eqn. 1-29}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Working Loss Product Factor		K_P		= 0.75 {crude oils, Eqn. 1-29} = 1 {all other organic liquids}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Vented Vapor Saturation Factor	Constant 0.053 has units of 1/(psia-ft). True vapor pressure based on liquid surface.	K_S		= 1 / (1 + 0.053 * $P_{VA,Tla}$ * H_{VO}) {Eqn. 1-20}	0.999	0.999	0.999	0.999	0.998	0.998	0.998	0.998	0.998	0.999	0.999	0.999
Vapor Molecular Weight	When using full speciation profiles, calculated as the weighted average of the M_V of each component.	M_V	lb/lb-mole	= VOL data of tank contents {partial speciation} M_V = Σ (M_{Vi} * ($P_{VA,Tla,i}$/$P_{VA,Tla}$))	130.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0
Liquid Molecular Weight		M_L	lb/lb-mole	M_L = 1 / Σ (Z_{Li} / M_{Li}) {full speciation, Eqn. 1-22}	188.0	188.0	188.0	188.0	188.0	188.0	188.0	188.0	188.0	188.0	188.0	188.0
Number of Turnovers per Month	Constant 5.614 has units of ft^3/bbl.	N		= 5.614 * Q * (bbl / 42 gal) / V_{LX} {Eqn. 1-30}	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Average Daily Minimum Ambient Temperature		T_{AN}	°F		31.50	34.50	42.50	50.20	58.70	66.20	69.50	69.00	63.50	51.90	42.80	35.00
Average Daily Maximum Ambient Temperature		T_{AX}	°F		50.40	55.00	64.30	72.70	79.60	85.80	88.00	87.10	81.80	72.70	63.40	54.00
Daily Average Ambient Temperature		T_{AA}	°F	= (T_{AX} + T_{AN}) / 2 {Eqn. 1-27}	40.95	44.75	53.40	61.45	69.15	76.00	78.75	78.05	72.65	62.30	53.10	44.50
Daily Minimum Liquid Surf. Temperature, F		T_{LN}	°F	= T_{LA} - 0.25 * ΔT_V {Fig. 7.1-17}	37.69	41.24	49.71	57.69	65.70	72.80	75.73	75.08	69.60	58.76	49.55	41.21
Daily Maximum Liquid Surf. Temperature, F		T_{LX}	°F	= T_{LA} + 0.25 * ΔT_V {Fig. 7.1-17}	46.45	51.20	60.95	70.06	77.91	84.72	87.04	85.92	79.85	69.31	59.17	49.85
Daily Vapor Temperature Range	Constant 0.028 has units of (°R-ft^2-day/Btu)	ΔT_V	°R	= 0 {heated and fully insulated tanks only} = 0.72 * (T_{AX} - T_{AN}) + 0.028 * α_{Tot} * I {Eqn. 1-8}	17.53	19.93	22.48	24.74	24.43	23.85	22.63	21.67	20.50	21.10	19.26	17.29

Calculations						2	3	4	5	6	7	8	9	10	11	12	13
Parameter Title	**Notes**	**Parameter Symbol**	**Units**	**Reference or Equation**		**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Service						**Main Service**	**Main Service**	**Main Service**	**Main Service**	**Main Service**	**Main Service**	**Main Service**	**Main Service**	**Main Service**	**Main Service**	**Main Service**	**Main Service**
Daily Average Liquid Surf. Temperature	Constant 0.0079 has units of (°R-ft^2-day/btu).	T_{LA}	°F	= T_B {heated and/or fully insulated tanks only} = (0.44 * T_{AA}) + (0.56 * T_B) + (0.0079 * α_{Tot} * I) {Eqn. 1-26}		42.07	46.22	55.33	63.87	71.81	78.76	81.39	80.50	74.73	64.04	54.36	45.53
Liquid Bulk Temperature	If T_{LA} is unknown, see AP-42 7.1-23 Note 3. Not included here as T_B is always calculated. α_{TOT} is not applicable for fully insulated tanks.	T_B	°F	= specified by user {heated tanks only} = T_{AA} {fully insulated but not heated tanks only} = T_{AA} + (6 * α_{Tot} - 1) {Eqn. 1-28}		40.97	44.77	53.42	61.47	69.17	76.02	78.77	78.07	72.67	62.32	53.12	44.52
Vapor Pressure at Daily Av. Liquid Surf. Temp.	Used for speciated emissions and most vapor pressures. $P_{VA,Tla}$ uses T_{LA}.	$P_{VA,Tla}$	psia	*{full speciation profiles, Eqn. 1-22}:* Sum of partial true vapor pressures components. *{partial/no speciation profiles}:* Vapor pressures at T (°F) based on P_{VA} values in VOLs tab at ΔT (°F) increments by interpolating between the P_{VA} values at the next highest/lowest T. $P_{VA,T}$ = (T - T_{Low}) / (T_{High} - T_{Low}) * ($P_{VA,T,High}$ - $P_{VA,T,Low}$) + $P_{VA,T,Low}$		0.0034	0.0040	0.0056	0.0075	0.0095	0.0116	0.0126	0.0122	0.0104	0.0075	0.0054	0.0039
Vapor Pressure at Daily Min. Liquid Surf. Temp.	Used for ΔP_V. Per AP-42 7.1-13 Note 5, P_{VN} uses T_{LN}.	P_{VN}	psia			0.0031	0.0033	0.0045	0.0060	0.0079	0.0098	0.0107	0.0105	0.0089	0.0063	0.0044	0.0033
Vapor Pressure at Daily Max. Liquid Surf. Temp.	Used for ΔP_V. Per AP-42 7.1-13 Note 5, P_{VX} uses T_{LX}.	P_{VX}	psia			0.0040	0.0047	0.0067	0.0090	0.0114	0.0139	0.0148	0.0144	0.0120	0.0088	0.0063	0.0045
Daily Vapor Pressure Range	Eqn. 1-10 is alt. method per AP-42 7.1-13. Used as primary method for Petroleum Distillates & Crude. True vapor pressure based on liquid surface.	ΔP_V	psia	= P_{VX} - P_{VN} {Eqn. 1-9} = (0.50 * B * $P_{VA,Tla}$ * ΔT_V) / (T_{LA} + 459.67 °R)^2 {petroleum liquids if B is known, Eqn. 1-10}		0.001	0.001	0.002	0.003	0.004	0.004	0.004	0.004	0.003	0.003	0.002	0.001
Vapor Density		W_V	lb/ft^3	= (M_V * $P_{VA,Tla}$) / (R * (T_{LA} + 459.67 °R)) {Eqn. 1-21}		0.00008	0.00010	0.00013	0.00017	0.00022	0.00026	0.00028	0.00027	0.00024	0.00017	0.00013	0.00009
Vapor Space Volume		V_V	ft^3	= (π/4 * D_E^2) * H_{VO} {Eqn. 1-3}		20	20	20	20	20	20	20	20	20	20	20	20
Standing Storage Loss	Uncontrolled emissions. No standing or breathing losses occur for underground tanks per AP-42 7.1-14.	L_S	lbs/month	= 0 {underground tanks only} = t_{IS} * V_V * W_V * K_E * K_S {Eqn. 1-2 and 1-4}		0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
Working Loss	Uncontrolled emissions. True vapor pressure based on liquid surface. Constant 0.0010 derived from Eqn. 1-32, 1-33, and 1-35 assuming T_{LA} = 63 °F.	L_W	lbs/month	= Q * (5.614 ft^3/bbl) * (bbl / 42 gal) * (M_V * $P_{VA,Tla}$) / (R * (T_{LA} + 459.67 °R)) * K_N * K_P * K_B {Eqn. 1-29}		0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Total Losses	**Uncontrolled emissions.**	**L_T**	**lbs/month**	**= (L_S + L_W) {Eqn. 1-1}**		**0.01**	**0.01**	**0.01**	**0.02**	**0.02**	**0.03**	**0.03**	**0.03**	**0.02**	**0.02**	**0.01**	**0.01**
Total Losses	**Controlled emissions, if applicable. Note: some species have 0% efficiencies with activated carbon.**	**$L_{T,CD}$**	**lbs/month**	**= Not Applicable {no CD} = L_T * (1 - CD_{Eff}) {CD}**		**0.01**	**0.01**	**0.01**	**0.02**	**0.02**	**0.03**	**0.03**	**0.03**	**0.02**	**0.02**	**0.01**	**0.01**

APPENDIX D: BACT SUPPORTING DOCUMENTS AND CALCULATIONS

Table of Contents

D.1. Flexographic Printing Press Specifications

D.1.1. Estimated Weighted Average VOC Partial Pressure - Flexo Press Inks

VOCs in Ink

CAS	VOC	VOC Consumed @ JAX (lbs/yr)	Lithia Springs Est Wt'd Avg Compostion (% of VOC)	Projected Lithia Springs Emissions (lbs/hr)	Est Dryer Exhaust Vapor Conc (ppmv)	Volatiles Composition (wt% of vol)	Moles	Mole Fraction	VOC Partial Pressure: Dryer Temp (mmHg)	VOC Partial Pressure: Ambient Temp (mmHg)
111-90-0	Diethylene Glycol Ethyl Ether	578	5%	0.39	0.4	0.17%	0.000012	0.0002	0.019	0.000012
141-43-5	Ethanolamine	13,445	80%	6.20	15.0	3.87%	0.000634	0.012	3.12	0.0038
57-55-6	Propylene Glycol	2,770	15%	1.16	2.3	0.80%	0.000105	0.002	0.27	0.0002
	Water	----	----	----	----	95.16%	0.053	0.986		
	Totals		100%	7.75	17.7		0.054	1	**3.41**	**0.0040**

Total VOC in Ink (JAX Data)	17,171	lbs
Total Ink Used (JAX Data)	508,311	lbs
Avg VOC Content	3.4%	
Est Lithia Springs VOC Emissions	7.75	lbs/hr
Combined Dryer Air Flow	43,500	scfm

D.1.2. Estimated Weighted Average VOC Partial Pressure - Flexo Press Overprint Varnish

VOCs in Overprint Varnish

CAS	VOC	VOC Consumed @ JAX (lbs/yr)	Lithia Springs Est Wt'd Avg Compostion (% of VOC)	Projected Lithia Springs Emissions (lbs/hr)	Est Dryer Exhaust Vapor Conc (ppmv)	Volatiles Composition (wt% of vol)	Moles	Mole Fraction	VOC Partial Pressure: Dryer Temp (mmHg)	VOC Partial Pressure: Ambient Temp (mmHg)
111-76-2	2-Butoxyethanol	4.1	26%	0.01	0.02	0.0058%	4.89E-07	8.80E-06	0.0026	6.31E-06
100-37-8	Diethylaminoethanol	1.9	12%	0.01	0.01	0.0027%	2.31E-07	4.16E-06	0.0016	3.64E-06
79-10-7	Acrylic Acid	9.5	61%	0.03	0.06	0.0133%	1.85E-06	3.33E-05	0.094	3.67E-03
	Water					99.98%	0.056	0.99995		
	Totals		100%	0.05	0.09		0.056	1.00	**0.10**	**0.0037**

Total VOC in Varnish (JAX Data)	19.5	
Total Varnish Used (JAX Data)	98,964	lbs
Avg VOC Content	0.020%	
Est Lithia Springs VOC Emissions	0.05	lbs/hr
Combined Dryer Air Flow	43,500	scfm

D.2. Printing Plate Processor Specifications

D.2.1. Plate Processor and Carbon Canister Diagram

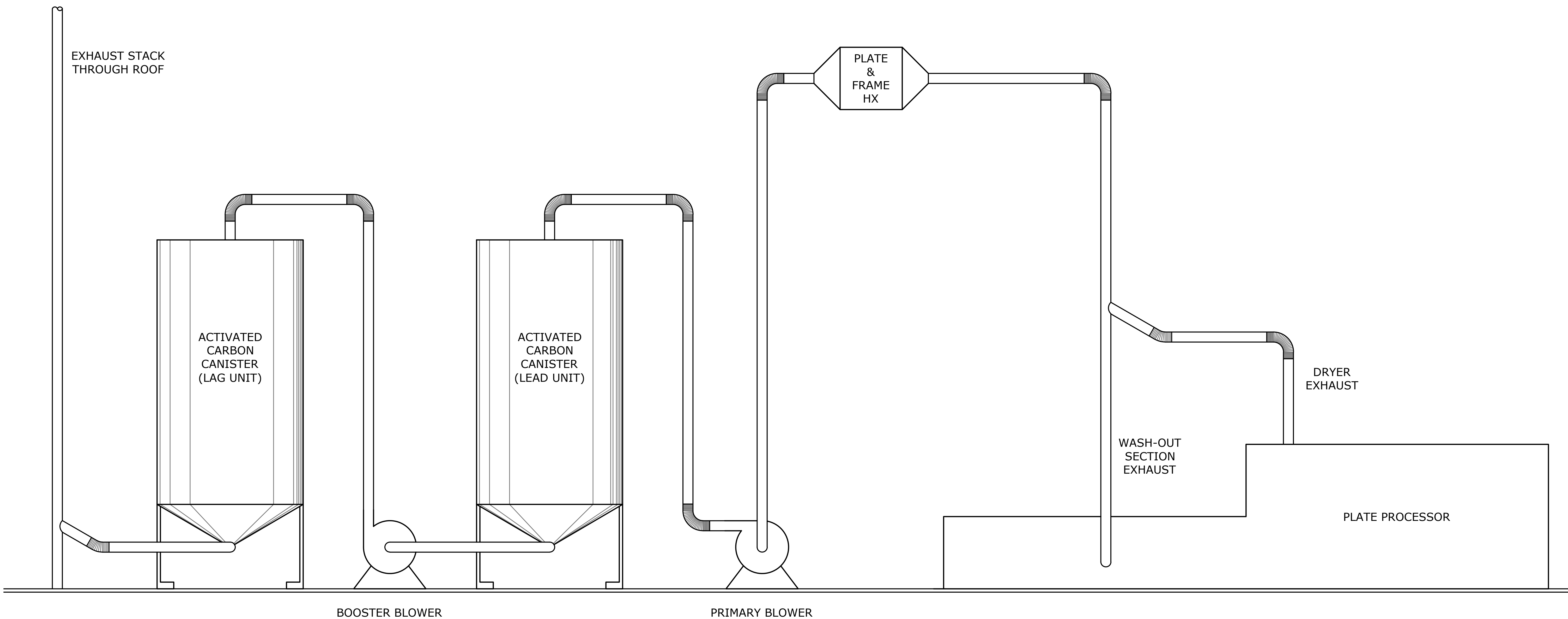


PLATE PROCESSOR APC CONCEPT ACTIVATED CARBON CANISTER CONTROL
TOLEDO, OHIO

RAMBOLL ENVIRON

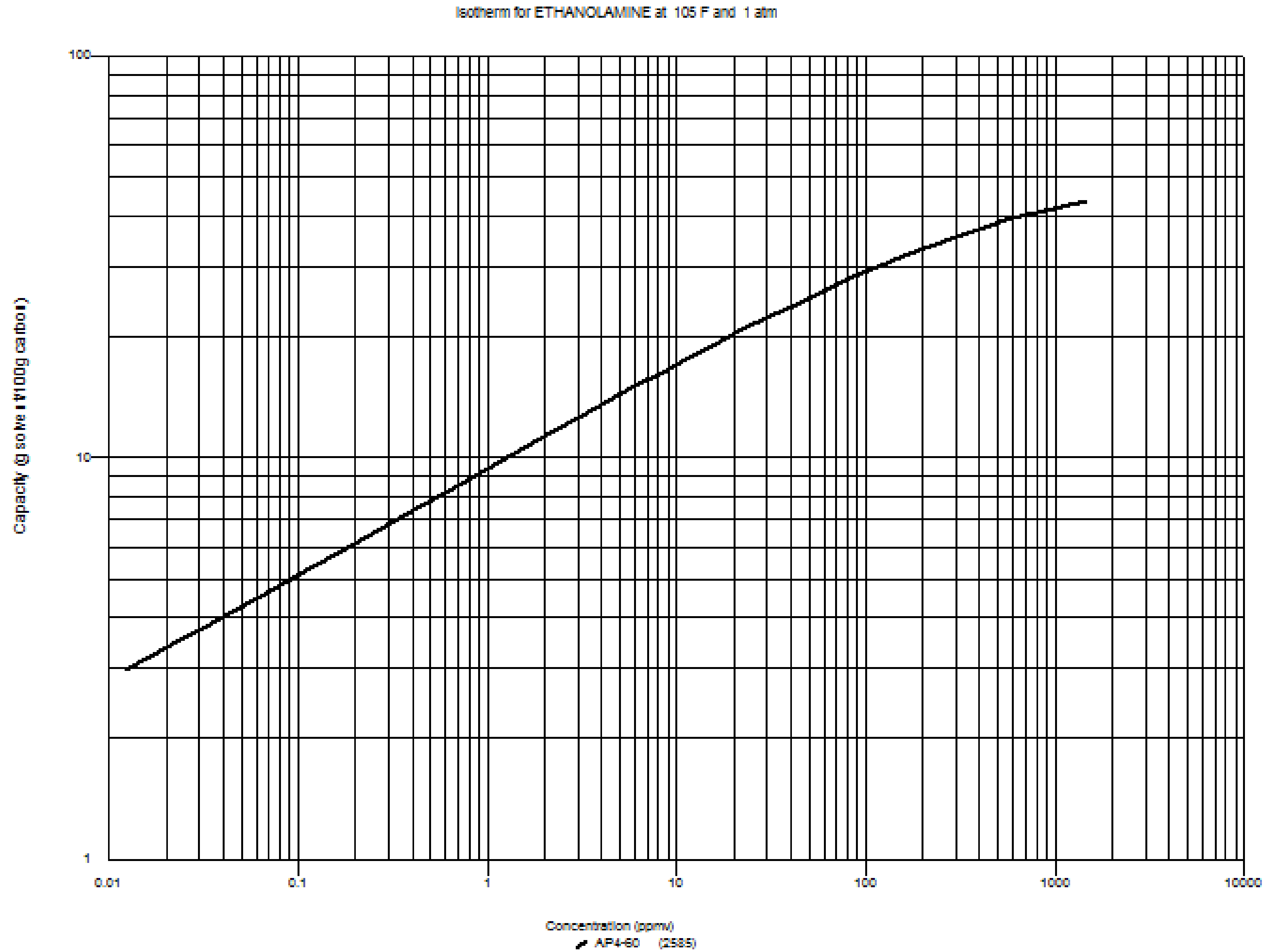
FIGURE **2**

DRAFTED BY: ELS | DATE: 6/29/16 | 1937660A

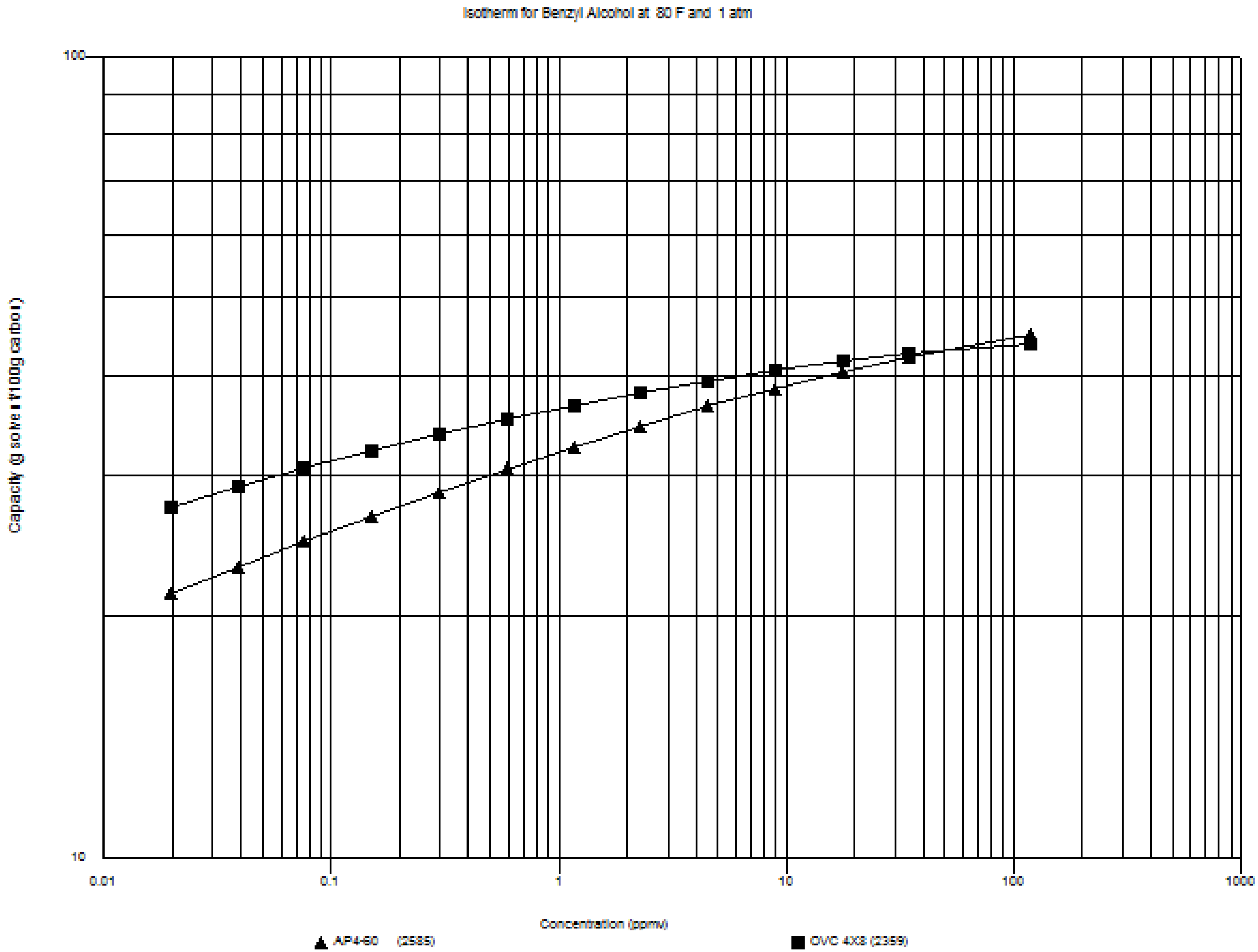
L:\Loop Project Files\00_CAD FILES\19\WestRock_Toledo Catalytic Oxidizer 1937660A\02_Plate Processor APC Concept ACCC.dwg

D.3. Carbon Adsorption

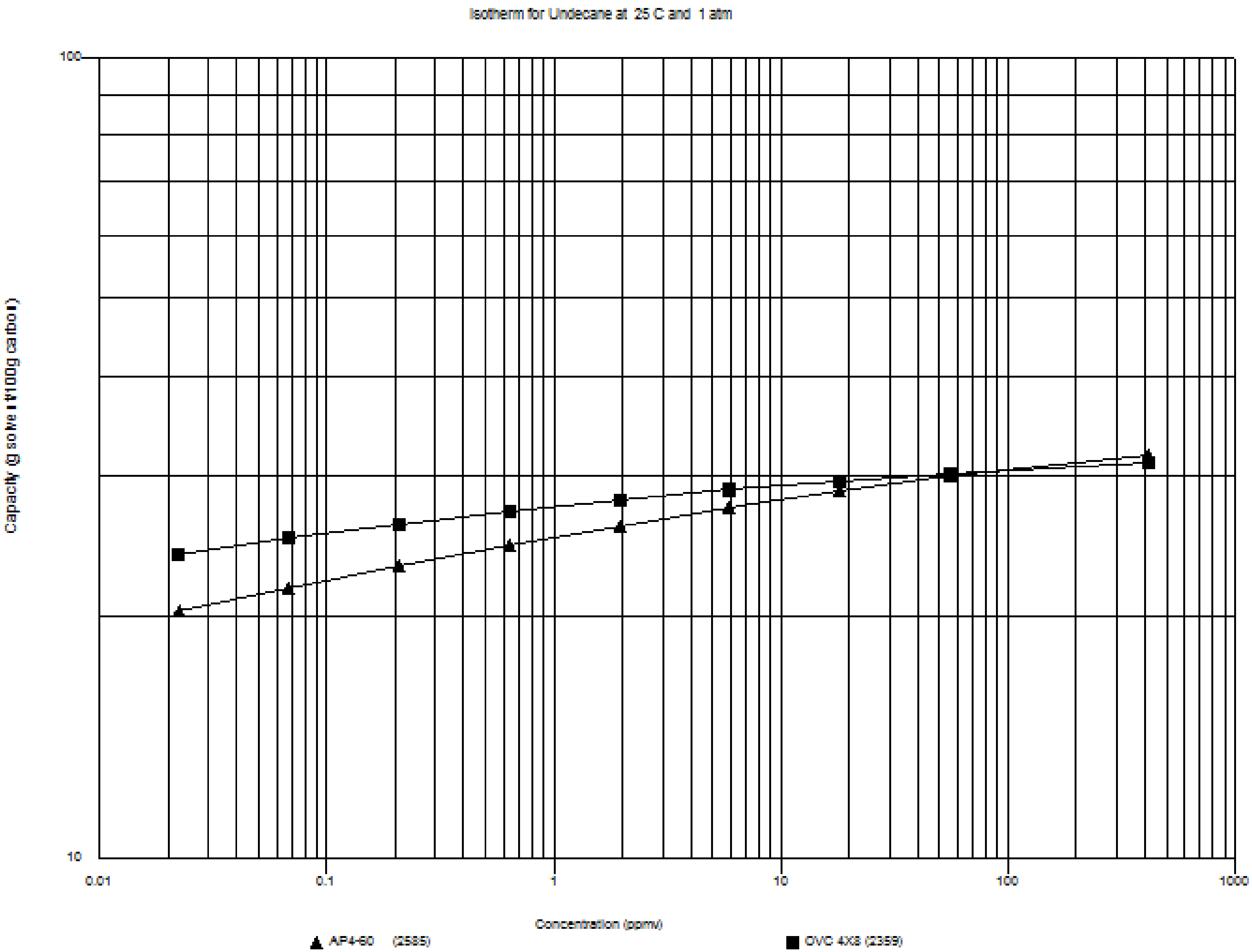
D.3.1. Monoethanolamine Isotherm



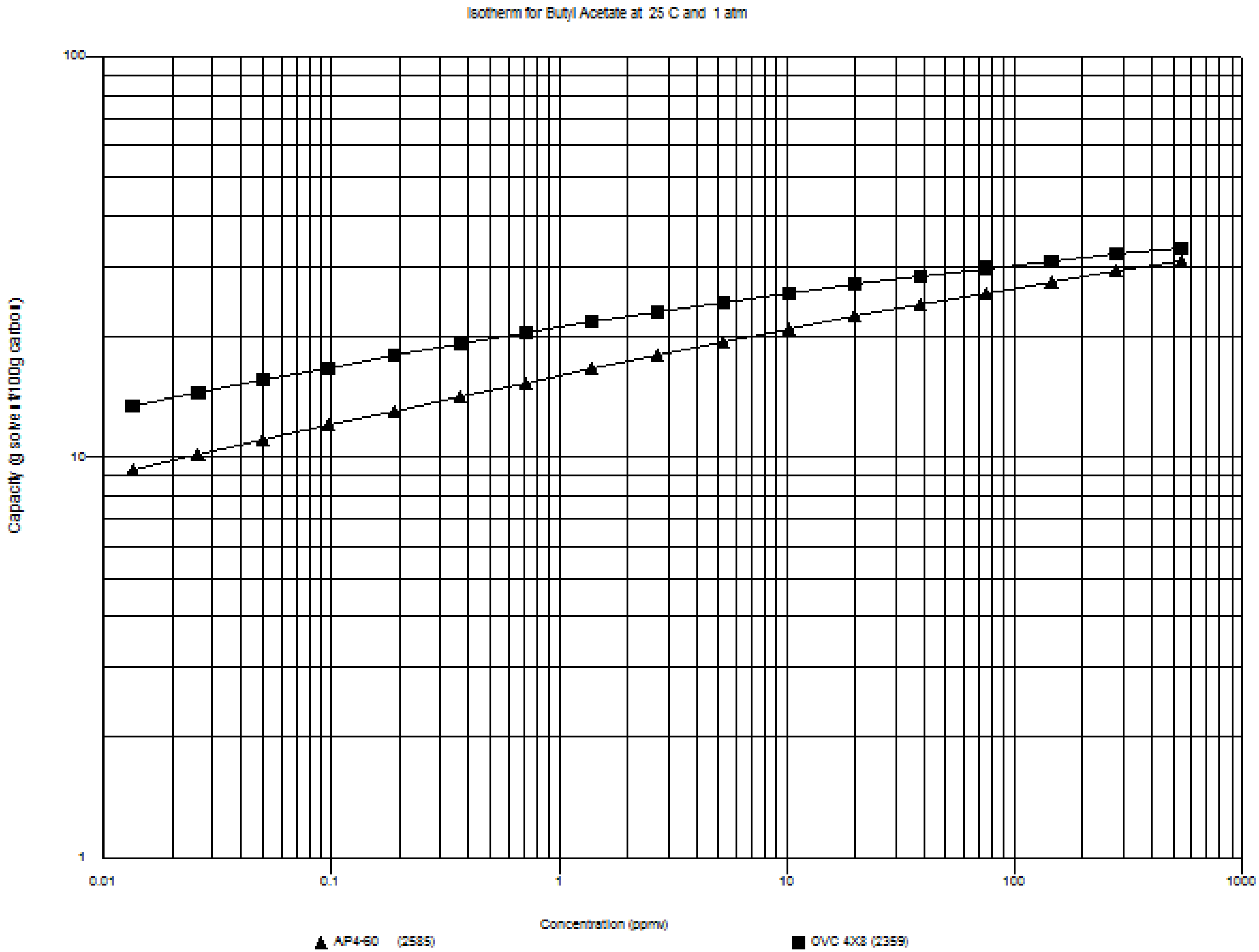
D.3.2-1 Benzyl Alcohol Isotherm



D.3.2-2 Undecane Isotherm



D.3.2-3 Butyl Acetate Isotherm



D.4. Condensation

D.4.1. Flexographic Printing Press Condenser Evaluation
WestRock - Lithia Springs, GA
BACT Analysis - Lithographic Press
Condenser Simulation

VOC Parameters:

			Antoine	mmHg = 10^(A-(B/(T+C))	
VOC	MW	SG	A	B	C
Ethanolamine	61	1.02	7.456	1577.67	173.37
Water	18	1	8.140	1810.94	244.49

Simulation:

Step 1: Condense the water dryer exhaust - cool to 35°F

Component	MW	Volume Flow scfm	Mass Flow lb/hr	Molar Flow lb-mol/hr
air	29	41652	188245	108
water vapor	18	1856	5202	289.01
VOC (assume pure EtAm)	61	0.820	7.8	0.1279
Total		**43509**	**193455**	**397**

inlet water, ppm	42658.0	inlet EtAm conc., ppm	18.9
temperature to achieve target, °F	35	temperature to achieve target, °F	35
temperature to achieve target, °C	2	temperature to achieve target, °C	2
water partial P at target, mm Hg	6.07	EtAm partial P at target, mm Hg	0.028
exit water conc., ppm	7987	EtAm conc., ppm	36.5
efficiency	82%	efficiency	0%

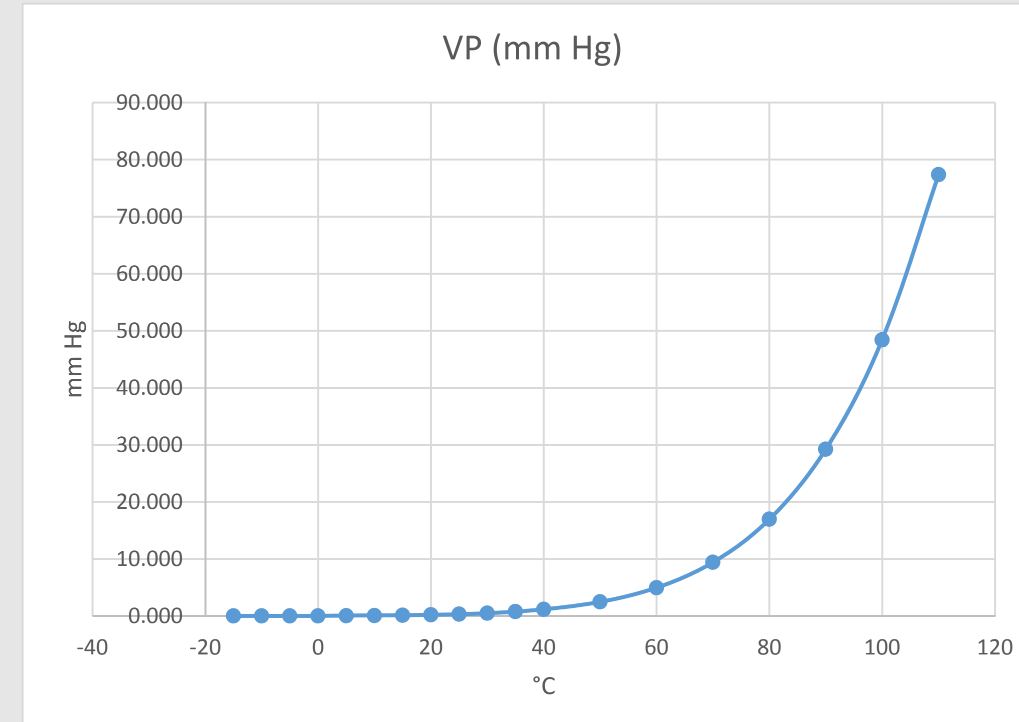
Step 2: Condense the EtAm - cool to °F

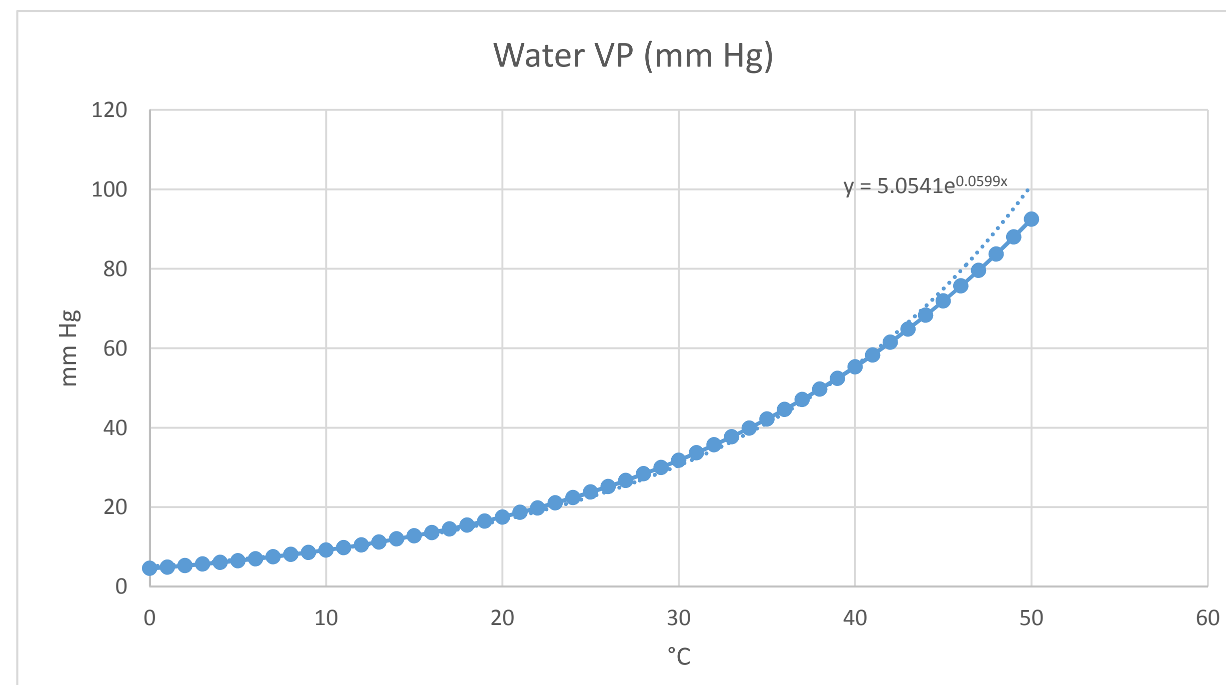
inlet EtAm conc., ppm	18.9	inlet water, ppm	5174.1
temperature to achieve target, °F	16	temperature to achieve target, °F	16
temperature to achieve target, °C	-9	temperature to achieve target, °C	-9
EtAm partial P at target, mm Hg	0.00731	water partial P at target, mm Hg	2.84
EtAm conc., ppm	9.6	exit water conc., ppm	3739
Efficiency	49%	Efficiency	92%
Inlet water, lb/hr	974	Outlet Water, lb/hr	82
		Condensed water, lb/hr	892

The large amount of water would freeze in a condenser operating at this temperature.

Ethanolamine VP Curve

T (°C)	VP (mm Hg)
-15	0.003
-10	0.006
-5	0.012
0	0.023
5	0.041
10	0.071
15	0.120
20	0.198
25	0.318
30	0.499
35	0.767
40	1.153
50	2.472
60	4.962
70	9.406
80	16.953
90	29.220
100	48.396
110	77.352





D.4.2. Printing Plate Processor Condenser Evaluation

WestRock - Lithia Springs, GA

BACT Analysis - Plate Manufacturing

Condenser Simulation

VOC Parameters:

Antoine mmHg = 10^(A-(B/(T+C))

VOC	MW	SG	A	B	C
Benzyl Alcohol (BnOH)	108	1.04	7.19817	1632.59	172.79
Water	18	1	8.140	1810.94	244.49

Simulation:

Step 1: Cool exhaust from 45°C to __°F

Component	MW	Volume Flow scfm	Mass Flow lb/hr	Molar Flow lb-mol/hr
air	29	350	1582	1
water vapor	18	9	25	1.40
BnOH	108	0.025	0.42	0.0039
Synthetic Hydrocarbons	140	0.017	0.3675	0.0026
Aliphatic Esters				
Total		**359**	**1607**	**2**

inlet water, ppm	25042
temperature to achieve target, °F	39
temperature to achieve target, °C	4
water partial P at target, mm Hg	7.12
exit water conc., ppm	9364
efficiency	63%

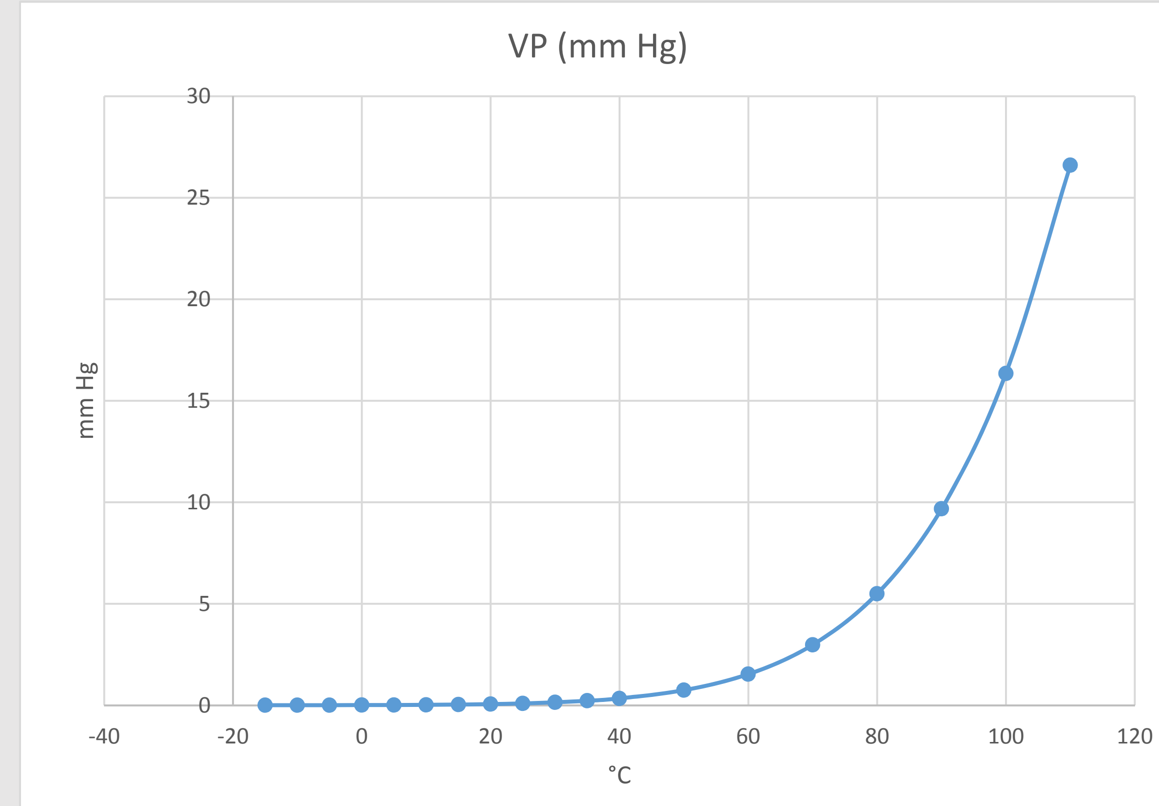
Moisture Estimate		
Dew Point, °F	70	
Humidity Ratio	112	gr /lb dry air
Moisture in air	25	lbs/hr water
	9	scfm

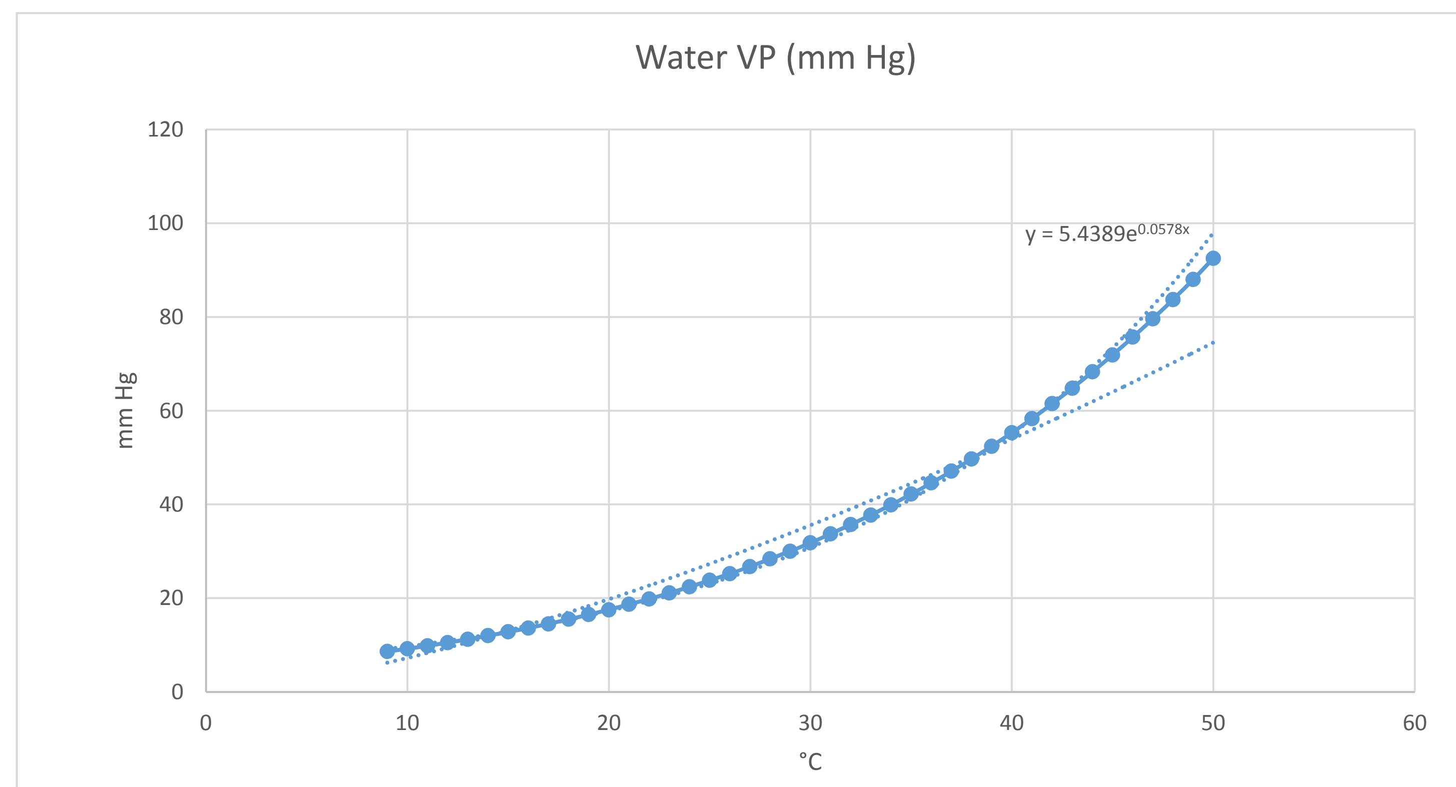
inlet BnOH conc., ppm	69.5
temperature to achieve target, °F	-62
temperature to achieve target, °C	-52
BnOH partial P at target, mm Hg	0.05
BnOH conc., ppm	71.0
efficiency	-2%

Extremely low condension temperature required to reach dew point of benzyl alcohol; condensing is not feasible

Benzyl Alcohol VP Curve

T (°C)	VP (mm Hg)
-15	0.001
-10	0.001
-5	0.003
0	0.006
5	0.010
10	0.018
15	0.032
20	0.054
25	0.088
30	0.140
35	0.219
40	0.336
50	0.742
60	1.531
70	2.978
80	5.494
90	9.675
100	16.345
110	26.608





D.5. Wet Scrubbing

D.5.1. Scrubber Evaluation

WestRock - Lithia Springs, GA
BACT Analysis - Flexographic Press
Scrubber Applicability Evaluation

#	Assumption
1	Iterative solution for the efficiency at a predetermined packing height
2	Assumed once-through water and no chemical treatment
3	Loading assumed to be pure ethanolamine

Design Inputs		
Efficiency	**50.0%**	
Diameter	470.0	in
Gas Inlet Volumetric Flow Rate	43508	scfm
Liquid Inlet EtAm concentration (0 if once-thru)	0	mg/L
VOC Loading (assume pure ethanolamine)	7.8	lbs/hr
Liquid Inlet Volumetric Flow Rate	174	gpm

Design Outputs		
Column Height	40.3	ft
Scrubber Flow	174.03	gpm
EtAm exit concentration	0.00000	mol frac
Instantaneous emission rate	3.90	lb/h

Properties		
Vapor Flow	196634	lbmol/h
Packing Type	1" Intalox Saddles, Plastic	
column CSA	1204.21	ft2

Molecular Weight, EtAm	61	
Molecular Weight, Air	29	
Molecular Weight, Water	18	
Air at 77F	0.024	m3/g-mol air

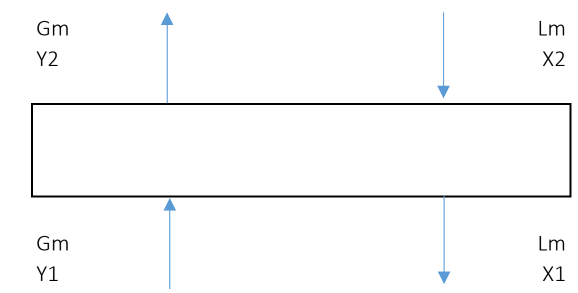
Conversion Factors			
35.31	m^3	to	ft^3
60	min	to	hr
10.76	m^2	to	ft^2
0.0624	kg/m^3	to	lb/ft^3
3.785	gal	to	L
0.4536	lb	to	kg
385	scf	to	lb-mol

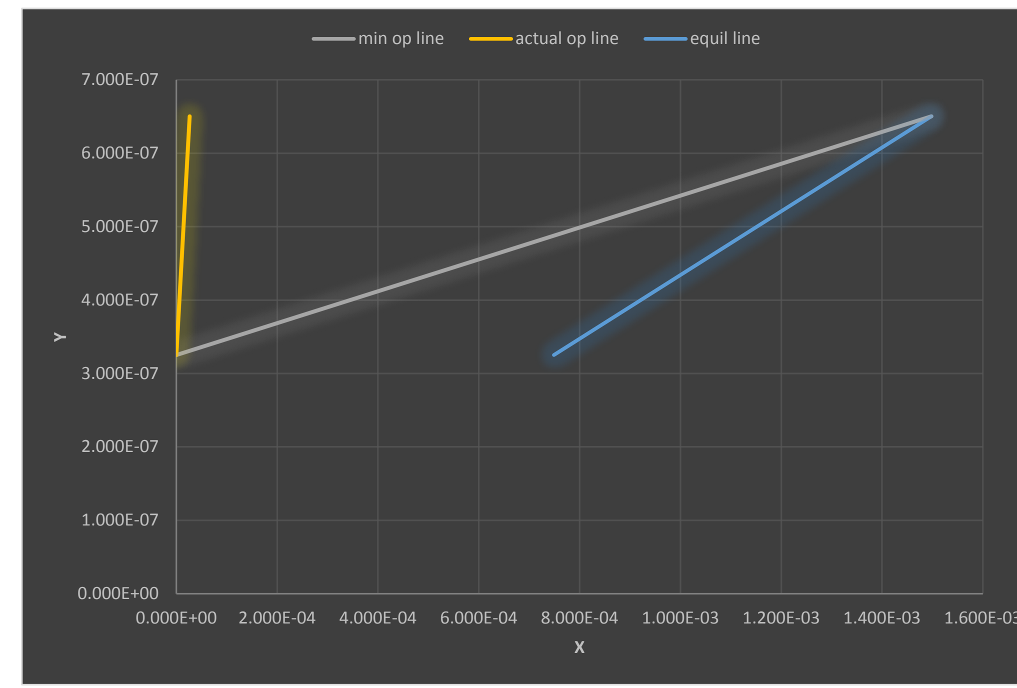
equil line	[Y = H"X]	
slope, m = H"	0.00043	
	Y1	0.000001
	Y2	0.0000003
	X1	0.001497913
	X2	0.000748956

min op line	[Y1-Y2 = Lm/Gm * (X1-X2)]	
(L/G) min	0.00043	lb-mol/lb-mol
G min	196634	lb-mol air/h
L min	85	lb-mol water/h
	1537	lb/h
	3.07	gpm
	Y1	0.000001
	Y2	0.000000
	X1	0.001498
	X2	0.000000

actual op line		
L/G	0.024604598	
Gm	196634	lb-mol/h
Lm	4838	lb-mol/h
	87086	lb/h
4 gpm per 1000 scf design spec	174.03	gpm
	Y1	0.000001
	Y2	0.000000
	X1	0.000026
	X2	0.000000

flooding calcs	=(L/G)*(rhoG/rhol)^0.5			
abscissa	0.00053			
L	87086	lb/h	39501.77483	kg/h
G	5702373	lb/h	12571451.95	kg/h
rhog	0.075	lb/ft3	1.204	kg/m3
rhol	62.5	lb/ft3	1000	kg/m3
ordinate (from graph)	0.15	ε		
F	30			
deltaPflood	**1.24**	in H2O/ft packing		
ϕ	1			
mu	0.00065	lbm/ft*s		
G*	1.81	lb/ft2*sec		
f, flooding factor	75%	ft2/ft3		
G* operate	1.35	lb/ft3*sec		
area	1169.2	ft2		
diameter	38.6	ft		
	463.1	in		
design diameter	470.0	in		





D.5.1. Scrubber Evaluation

WestRock - Lithia Springs, GA
BACT Analysis - Flexographic Press
Scrubber Applicability Evaluation

#	Assumption
1	Iterative solution for the efficiency at a predetermined packing height
2	Assumed once-through water and no chemical treatment
3	Loading assumed to be pure ethanolamine

Design Inputs		
Efficiency	**50.0%**	
Diameter	120.0	in
Gas Inlet Volumetric Flow Rate	43508	scfm
Liquid Inlet EtAm concentration (0 if once-thru)	0	mg/L
VOC Loading (assume pure ethanolamine)	7.8	lbs/hr
Liquid Inlet Volumetric Flow Rate	174	gpm

Design Outputs		
Column Height	618.4	ft
Scrubber Flow	174.03	gpm
EtAm exit concentration	0.00000	mol frac
Instantaneous emission rate	3.90	lb/h

Properties		
Vapor Flow	196634	lbmol/h
Packing Type	1" Intalox Saddles, Plastic	
column CSA	78.50	ft2

Molecular Weight, EtAm	61	
Molecular Weight, Air	29	
Molecular Weight, Water	18	
Air at 77F	0.024	m3/g-mol air

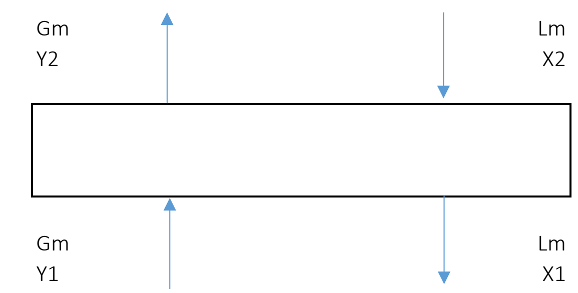
Conversion Factors			
35.31	m^3	to	ft^3
60	min	to	hr
10.76	m^2	to	ft^2
0.0624	kg/m^3	to	lb/ft^3
3.785	gal	to	L
0.4536	lb	to	kg
385	scf	to	lb-mol

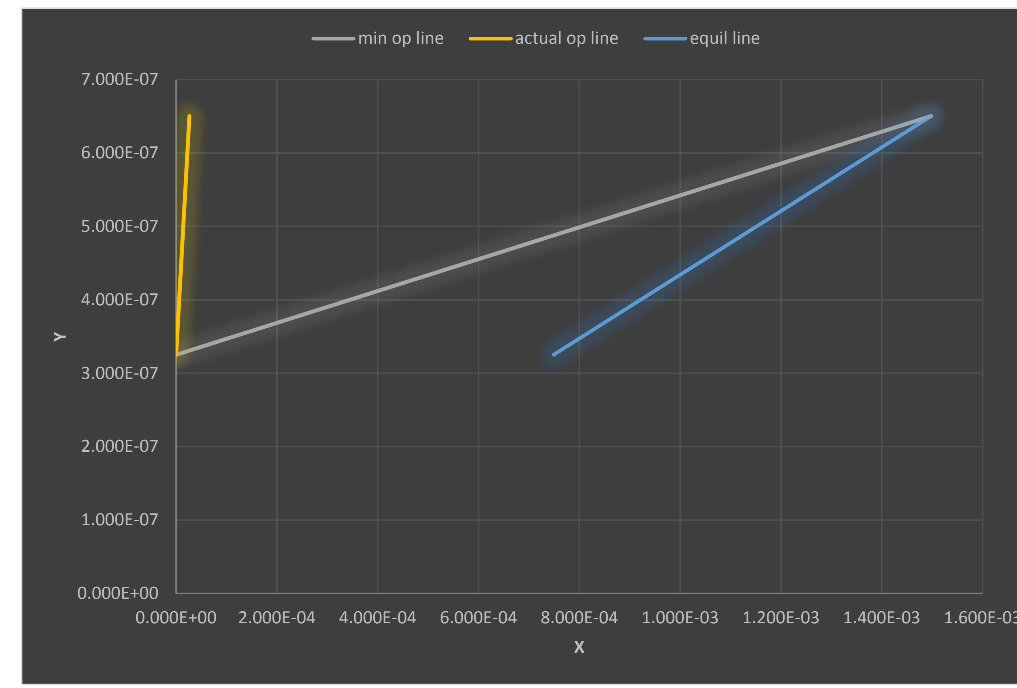
equil line	[Y = H''X]	
slope, m = H''	0.00043	
	Y1	0.000001
	Y2	0.0000003
	X1	0.001497913
	X2	0.000748956

min op line	[Y1-Y2 = Lm/Gm * (X1-X2)]	
(L/G) min	0.00043	lb-mol/lb-mol
G min	196634	lb-mol air/h
L min	85	lb-mol water/h
	1537	lb/h
	3.07	gpm
	Y1	0.000001
	Y2	0.000000
	X1	0.001498
	X2	0.000000

actual op line		
L/G	0.024604598	
Gm	196634	lb-mol/h
Lm	4838	lb-mol/h
	87086	lb/h
4 gpm per 1000 scf design spec	174.03	gpm
	Y1	0.000001
	Y2	0.000000
	X1	0.000026
	X2	0.000000

flooding calcs	=(L/G)*(rhoG/rhol)^0.5			
abscissa	0.00053			
L	87086	lb/h	39501.77483	kg/h
G	5702373	lb/h	12571451.95	kg/h
rhog	0.075	lb/ft3	1.204	kg/m3
rhol	62.5	lb/ft3	1000	kg/m3
ordinate (from graph)	0.15	ε		
F	30			
deltaPflood	**1.24**	in H2O/ft packing		
ϕ	1			
mu	0.00065	lbm/ft*s		
G*	1.81	lb/ft2*sec		
f, flooding factor	75%	ft2/ft3		
G* operate	1.35	lb/ft3*sec		
area	1169.2	ft2		
diameter	38.6	ft		
	463.1	in		
design diameter	470.0	in	huge diameter required to flood	





D.6. Flexographic Printing Press Cost Estimates

BOBST

Bobst Bielefeld GmbH
Management Board

Bielefeld, 07.06.2016

WestRock
1400 W. Tradeport Drive
Jacksonville, FL 32218
USA

TO WHOM IT MAY CONCERN

DECLARATION

Dear Sirs,

We, Bobst Bielefeld GmbH, as a major worldwide supplier of CI-Flexographic Printing Presses would like to state that so far none of our flexographic printing presses dedicated solely to printing with water-based inks have been required to install VOC controls, such as RTOs, catalytic oxidizers and similar equipment, to treat the exhaust air.

For any further questions you may have in this relation, please do not hesitate to contact us.

Best regards,
Bobst Bielefeld GmbH

ppa. Jürgen Dieterich
Head of SPL

ppa. Markus Trachternach
CFO

D.6.1. RTO 97% TER Cost Analysis

D.6.1-1 Summary Table

Cost Summary
Regenerative Thermal Oxidizer (RTO), 97% TER
Lithographic Press
WestRock - Lithia Springs, GA

	Value	Notes / Basis for Estimates
Total Capital Investment		
RTO System	$1,388,000	Vendor budgetary quotes with OAQPS Cost Manual factors for ancillary equip
Ductwork	$277,000	Concept design sizing (Figure 5.5-1) w/ OAQPS ductwork cost factors
Subtotal (TCI)	**$1,665,000**	
Annual Costs		
Direct Annual Cost		
Labor	$25,900	WestRock Labor Rats w/ OAQPS factors forO&M hours required
Maintenance Supplies	$35,000	OAQPS assumption - 100% of maintenance labor cost
Natural Gas Consumption	$173,900	RTO Heat balance w/ WetRock estimate for nat gas unit cost
Electricity	$141,100	OAQPS formula (ΔP, Q, Eff, etc.) w/ WestRock est for elec power rate
Indirect Annual Cost		
Overhead	$24,482	OAQPS Cost Manual Factor
Administrative	$33,300	OAQPS Cost Manual Factor
Property Tax	$16,650	OAQPS Cost Manual Factor
Insurance	$16,650	OAQPS Cost Manual Factor
Capital Recovery (*i* % @ N yr project life)	**$183,000**	
i, interest rate per period	7%	WestRock estimate for weighted average cost of captial
N, project life (no. of years)	15	
A/P	0.1098	
Total Annual Cost	**$649,982**	
Total VOC Removed (tons/yr)	**31.1**	Max Press VOC emission estimate time 90% DRE for RTO
Cost Effectiveness ($/ton)	**$20,933**	

D.6.1-2 Duct Design and TCI

Ductwork Design
Regenerative Thermal Oxidizer (RTO), 97% TER
Lithographic Press
WestRock - Lithia Springs, GA

Installation Cost = 50% PEC
1993 Material Cost from OAQPS

Summary

Duct Segment	Description	Duct Material	Gas Flow (scfm)	Gas Flow (acfm)	Temp (°F)	Target Vel. (fpm) *	Duct Area (ft2)	Calculated Duct Dia. (in)	Nominal Duct Dia (in)	Total Length (ft)	Enlargers	No. of Elbows	No. of Branch Tees	No. of Vol Control Dampers	Duct $/ft	Enlarger $/each	Elbow $/each	Tee $/each	Damper $/each	Total Cost ($)
1	Dryer 1 (Between Deck Dryer) Header	Sheet-galv CS	13,184	16,000	188	**2,801**	5.7	32.4	34.0	48	0	2	0	1	$143.68	$229.07	$229.07	$229.07	$3,384.26	**10,739**
2	Dryer 2 (Press Tunnel Dryer) Header	Sheet-galv CS	6,592	9,000	227	**2,884**	3.1	23.9	24.0	10	0	1	0	1	$96.26	$126.47	$126.47	$126.47	$2,569.27	**3,658**
3	Dryer 3 (Varnish Tunnel Dryer) Header	Sheet-galv CS	11,866	16,000	240	**2,912**	5.5	31.7	32.0	12	0	1	0	1	$134.01	$203.41	$203.41	$203.41	$3,225.80	**5,037**
4	Dryer 4 (Varnish Tunnel Dryer) Header	Sheet-galv CS	11,866	16,000	240	**2,912**	5.5	31.7	32.0	56	0	2	0	1	$134.01	$203.41	$203.41	$203.41	$3,225.80	**11,137**
5	2 & 3 Combined Header	Sheet-galv CS	18,458	24,000	235	**2,902**	8.3	38.9	40.0	9	1	2	2	0	$173.21	$327.16	$327.16	$327.16	$3,848.51	**3,195**
6	1-4 Combined Header to RTO	Sheet-galv CS	43,508	56,000	222	**2,874**	19.5	59.8	60.0	179	1	2	2	0	$276.10	$1,073.25	$1,073.25	$1,073.25	$5,303.72	**54,789**

* Target Velocity calculated to velocity pressure of: 0.40 in. W.C.

Purchase and Installation Cost Summary

1993$ Purchased Equipment Cost	$88,555
Construction Cost Escalation Factor[1], 1993$ to 2016$	2.11
Equipment Cost	$186,736

[1] from Turner Construction Company Cost Index, 2016.

Segment Measurements from Site Layout Map

Scale	cm	ft	ft/cm	
	2.85	9.51	3.34	
Segment*	**cm**	**Long. Ft**	**Vert. Ft**	**Total Ft**
1	14.1	48	0	48
2	2.8	10	0	10
3	3.3	12	0	12
4	16.7	56	0	56
5	2.4	9	0	9
6	11.7	147	32	179

*scale for segment 6 is 4 cm = 50 ft

Detail

Duct Segment	Description	Flow (scfm)	Air Temp (degF)	Flow (acfm)	Design Duct Velocity (fpm)	Req'd Area (ft2)	Calc'd Duct Dia (in)	Nominal Duct Diameter (in)	Calc'd Duct Velocity (fpm)	Approx VP (in w.g.)	Duct Length Rise (ft)	Duct Length Run (ft)	Duct Length Total (ft)	Friction Loss per ft (in. w.g. / ft)	Straight Run Press Drop (in w.g.)	No. of Elbows	Loss Factor Coeff	Elbow Press Drop (in w.g.)	No of Branch Entries	Loss Factor Coeff	Entry Press Drop (in w.g.)	Total Press Drop thru Leg (in w.g.)
1	Dryer 1 (Between Deck Dryer) Header	13,184	188	16,000	2,801	5.712	32.4	34.0	2,540	0.33	0	48	48	0.0014	0.0669	2	0.39	0.256	0	0.28	0.000	0.3225
2	Dryer 2 (Press Tunnel Dryer) Header	6,592	227	9,000	2,884	3.120	23.9	24.0	2,860	0.39	0	10	10	0.0024	0.0241	1	0.39	0.153	0	0.28	0.000	0.1769
3	Dryer 3 (Varnish Tunnel Dryer) Header	11,866	240	16,000	2,912	5.495	31.7	32.0	2,860	0.38	0	12	12	0.0016	0.0196	1	0.39	0.150	0	0.28	0.000	0.1696
4	Dryer 4 (Varnish Tunnel Dryer) Header	11,866	240	16,000	2,912	5.495	31.7	32.0	2,860	0.38	0	56	56	0.0016	0.0912	2	0.39	0.300	0	0.28	0.000	0.3913
5	2 & 3 Combined Header	18,458	235	24,000	2,902	8.270	38.9	40.0	2,750	0.36	0	9	9	0.0012	0.0105	2	0.39	0.279	2	0.28	0.200	0.4902
6	1-4 Combined Header to RTO	43,508	222	56,000	2,874	19.482	59.8	60.0	2,850	0.39	32	147	179	0.0008	0.1408	2	0.39	0.306	2	0.28	0.219	0.6659

D.6.1-2 Duct Design and TCI

Total Capital Investment (TCI)
Regenerative Thermal Oxidizer (RTO), 97% TER
Lithographic Press
WestRock - Lithia Springs, GA

Duct System TCI

Direct Cost - Purchased Equipment Costs (PEC)	Cost	Basis / Source / Comment
Equipment Cost (EC) =	$186,736	See "Duct Segments" tab - EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.1.2
Sales Tax (3% EC) =	$6,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Freight and Assembly/Setting (5% EC) =	$9,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Purchased Equipment Costs (PEC) =	**$201,736**	

Direct Cost - Installation	Cost	Basis / Source / Comment
Installation (37.5% PEC) =	$75,651	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.4
Direct Installation Cost =	**$75,651**	

Total Direct Costs (DC) =	**$277,000**

Indirect Costs	Cost
Total Indirect Costs (IC) =	**$0**

Total Duct Work Capital Investment =	**$277,000**

D.6.1-3 Derivation of Cost Estimate

RTO Design Parameters and Specifications
Regenerative Thermal Oxidizer (RTO), 97% TER
Lithographic Press
WestRock - Lithia Springs, GA

Parameter	Unit of Measure	Value
volume flow	scfm	43,508
volume flow	acfm	56,215
temperature	°F	223
moisture	lbs/hr	5174
moisture	%-by-vol	4%
VOC	lbs/yr	69,000
VOC	lbs/hr	8.0
VOC	%-by-wt	0.004%

Dryer Details (from facility)

between color dryer 1

13184	scfm
16177	acfm
188	°F

print tunnel dryer 2

6592	scfm
8576	acfm
227	°F

varnish tunnel dryer 3

11866	scfm
15731	acfm
240	°F

varnish tunnel dryer 4

11866	scfm
15731	acfm
240	°F

Moisture Estimation

between color dryer 1

462	lbs/hr ink max usage	
65%	water in ink	
300	lbs/hr water from ink	1374 lbs/hr water vapor
75	°F dew point	
132	gr water/lb dry air (psychrometric chart)	
1074	lbs/hr water from ambient air	

print tunnel dryer 2

462	lbs/hr ink max usage	
65%	water in ink	
300	lbs/hr water from ink	837 lbs/hr water vapor
75	°F dew point	
132	gr water/lb dry air (psychrometric chart)	
537	lbs/hr water from ambient air	

varnish tunnel dryer 3

735	lbs/hr varnish max usage	
70%	water in varnish	
514	lbs/hr water from varnish	1481 lbs/hr water vapor
75	°F dew point	
132	gr water/lb dry air (psychrometric chart)	
967	lbs/hr water from ambient air	

varnish tunnel dryer 4

735	lbs/hr varnish max usage	
70%	water in varnish	
514	lbs/hr water from varnish	1481 lbs/hr water vapor
75	°F dew point	
132	gr water/lb dry air (psychrometric chart)	
967	lbs/hr water from ambient air	

Flow Parameters - Total

Dryers 1-4

43,508	scfm
56,215	acfm
223	°F
5,174	lbs/hr water vapor
1,846	scfm moisture
4.2%	moisture by vol
41,662	dscfm
187,480	lb/hr dry air

D.6.1-3 Derivation of Cost Estimate

Estimated Fuel Cost - Regenerative Thermal Oxidizer
Regenerative Thermal Oxidizer (RTO), 97% TER
Lithographic Press
WestRock - Lithia Springs, GA

Operating Parameters

Design Flow	43,508	scfm	
Assumed Moisture Content	4.2%	by vol	
Moisture Flow	1,846	scfm	
Dry Air Flow	41,662	dscfm	
Moisture Vapor Density	21.4	ft3/lb	
Moisture Load	5,178	lbs/hr	
VOC Load	8.0	lbs/hr	
VOC Conc	19.4	ppm	

Heat Balance and Supplemental Fuel Use Analysis

HHV for VOC (EtAm)	10,710	BTU/lb	https://cameochemicals.noaa.gov/chris/MEA.pdf
Heat Input from VOC Oxidation (90%)	0.077	mmBTU/hr	
Enthalpy of Comb Chamber Exhaust	28.3	BTU/scf @ 1,500 degF	
Dry Air Heat Flux from Comb Chamber	70.74	mmBTU/hr	
Moisture Enthalpy (1500 °F, 1 atm))	1,804	BTU/lb	
Moisture Heat Flux from Comb Chamber	9.34	mmBTU/hr	
Total Heat Flux from Oxidizer Comb Chamber	80.1	mmBTU/hr out	
Radiant Heat Loss (1% of total)	0.80	mmBTU/hr loss	
Enthalpy of process vent air	2.98	BTU/scf @ 220 degF	
Moisture Enthalpy (220°F, 1 atm))	1,154	BTU/lb	
Heat Input from Process Air	13.42	mmBTU/hr in	
Heat Available for Recovery	65.86	mmBTU/hr	
Heat recovered by Oxidizer	63.9	mmBTU/hr at	**97% thermal eff**
Total Heat Input to Oxidizer Comb Chamber	77.4	BTU/hr total heat input	
Required Burner Heat Input	**2.84**	**mmBTU/hr Burner Input**	

D.6.1-3 Derivation of Cost Estimate

Total Capital Investment (TCI)
Regenerative Thermal Oxidizer (RTO), 97% TER
Lithographic Press
WestRock - Lithia Springs, GA

Control System TCI - Regenerative Thermal Oxidizer

Total Capital Investment		
Direct Cost - Purchased Equipment Costs (PEC)	***Cost***	***Basis / Source / Comment***
Equipment Cost (EC) =	$850,000	Vendor Estimate - Anguil
Sales Tax (3% EC) =	$26,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Freight and Assembly/Setting (5% EC) =	$43,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Purchased Equipment Costs (PEC) =	**$919,000**	

Direct Cost - Installation	***Cost***	***Basis / Source / Comment***
Foundation & Supports (8% PEC) =	$74,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Handling and Erection (14% PEC) =	$129,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Electrical (4% PEC) =	$37,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Piping (2% PEC) =	$18,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Insulation for Ductwork (1% PEC) =	$9,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Painting (1% PEC) =	$9,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Direct Installation Cost =	**$276,000**	

Total Direct Costs (DC) =	**$1,195,000**	

Indirect Costs	***Cost***	***Basis / Source / Comment***
Engineering (10% PEC) =	$92,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Construction and Field Expenses (5% PEC) =	$46,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contractor Fees (10% PEC) =	$92,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Start-up (2% PEC) =	$18,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Performance Test (1% PEC) =	$9,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contingencies (3% PEC) =	$28,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Total Indirect Costs (IC) =	**$193,000**	

Total RTO Capital Investment =	**$1,388,000**	

D.6.1-3 Derivation of Cost Estimate

Summary of Annual O&M Costs
Regenerative Thermal Oxidizer (RTO), 97% TER
Lithographic Press
WestRock - Lithia Springs, GA

Direct Annual Costs:	RTO & Duct Work	*Basis / Source / Comment*
Operating Labor:		
Operator =	$22,500	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Supervisor (15% of operator labor) =	$3,400	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
Annual Operating Labor Cost	**$25,900**	See (a) below
Maintenance Costs:		
Labor (0.5 hrs per shift) =	$17,500	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Material (100% of maintenance labor) =	$17,500	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2.5.1, Table 2.10 (100% of maintenance labor)
Annual Maintenance Cost	**$35,000**	See (a) below
Natural Gas Consumption Cost:		
Annual Natural Gas Cost	**$173,900**	See (b) below
System Fan Electrical Cost:		
Annual Fan Electrical Cost	**$141,100**	See (c) below

Total Direct Annual Operating Cost	**$375,900**

(a) Wage Data from WestRock:

Parameter	Value	Units
Operator Wage, $/hr	$41.07	$/hr
Maintenance Laborer Wage, $/hr	$32.01	$/hr

(b) Natural Gas Calculations:

Parameter	Value	Units
Natural Gas Usage Rate	2.8	MMBtu/hr
Operating Schedule	8,592	hrs/yr
Annual NG Usage	24,413	MMBtu
NG Heat Content [1]	1,032	Btu/scf
Annual Natural Gas Usage	23,655,661	scf/yr
Natural Gas Cost ($/Mscf) [2]	$7.35	$/Mscf
Annual Natural Gas Cost	$173,939	$/yr

(c) System Fan Calculations:

Parameter	Value	Units
Vent flow (including dilution air)	56,000	acfm
ΔP across RTO:	15	in w.g.
ΔP across ducting:	2.216	in w.g.
Operating scenario:	8592	hr/yr
Combined fan-motor efficiency:	0.6	
Electricity price [2]:	$0.0870	$/kWhr
Annual electricity cost [3]:	$141,133	$/yr

Sources:
[1] U.S. Energy Information Administration / Monthly Energy Review May 2016, Table A.4
[2] WestRock Lithia Springs Utility Cost Projection
[3] EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Sect 1, Eqn 1.46

Indirect Annual Costs:	RTO	*Basis / Source / Comment*
Overhead* =	$24,482	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Table 2.10
Property Tax (1% TCI) =	$13,880	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Insurance (1% TCI) =	$13,880	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
General & Administrative (2% TCI) =	$27,760	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Indirect Annual Operating Cost - RTO	**$80,002**	
	Ductwork	*Basis / Source / Comment*
Property Tax (1% TCI) =	$2,770	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
Insurance (1% TCI) =	$2,770	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
General & Administrative (2% TCI) =	$5,540	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
Indirect Annual Operating Cost - Duct Work	**$11,080**	

Total Indirect Annual Operating Cost	**$91,082**

*Since labor costs are loaded with employee benefits costs, the nominal 60% multiplier for plantwide overhead was reduced by 33%. Overhead costs besides employee benefits can include any of the following: Hospital and medical services, General engineering, Safety services, Cafeteria and recreation facilities, General plant maintenance and overhead, Control laboratories, Packaging, Plant protection, Janitor and similar services, Employment offices, Distribution of utilities, Shops, Lighting, Interplant communications and transportation, Warehouses, Shipping and receiving facilities

D.6.1-4 Derivation of Environmental Impacts

Environmental Impact Summary
Regenerative Thermal Oxidizer (RTO), 97% TER
Lithographic Press
WestRock - Lithia Springs, GA

Secondary Emissions Summary

Annual Secondary Emissions of Key Pollutants		
SO_2	2.79	tons/yr
NO_x	2.40	tons/yr
Hg	0.04	kg/yr
CO_{2eq}	2076	tons/yr
CO	0.99	tons/yr

Secondary Emissions Calculations

Electricity Generation

Electricity Demand	1622	MWh/yr

Avg Coal Power Plant Emissions[1]		
SO_2	3.79	kg/MWh
NO_x	1.66	kg/MWh
Hg	2.30E-05	kg/MWh
CO_{2eq}	893	kg/MWh

Secondary Emissions, Electricity Generation		
SO_2	6,148	kg/yr
NO_x	2,693	kg/yr
Hg	0.037	kg/yr
CO_{2eq}	1,448,644	kg/yr

Natural Gas Combustion

Natural Gas Usage	24,413	MMBtu/yr
Natural Gas Usage	23.7	MMscf/yr

Criteria Pollutant Emission Factors[2]		
CO_{2eq}	120,000	lb/MMscf
CO	84	lb/MMscf
NO_x	100	lb/MMscf

Secondary Emissions, NG Combustion		
CO_{2eq}	2,838,679	lb/yr
CO	1,987	lb/yr
NO_x	2,366	lb/yr

Notes:
[1] "North American Power Plant Air Emissions", Commission for Environmental Cooperation of North America (CEC), 2004, Table 1.3
[2] EPA AP-42 Ch. 1, Sect 4, Table 1.4-1 (NOx and CO), Table 1.4-2 (CO2eq)

D.6.2. RTO 95% TER Cost Analysis

D.6.2-1 Summary Table

Cost Summary
Regenerative Thermal Oxidizer (RTO), 95% TER
Lithographic Press
WestRock - Lithia Springs, GA

	Value	Notes / Basis for Estimates
Total Capital Investment		
RTO System	$1,263,000	Vendor budgetary quotes with OAQPS Cost Manual factors for ancillary equip
Ductwork	$277,000	Concept design sizing (Figure 5.5-1) w/ OAQPS ductwork cost factors
Subtotal (TCI)	**$1,540,000**	
Annual Costs		
Direct Annual Cost		
Labor	$25,900	WestRock Labor Rats w/ OAQPS factors forO&M hours required
Maintenance Supplies	$35,000	OAQPS assumption - 100% of maintenance labor cost
Natural Gas Consumption	$258,800	RTO Heat balance w/ WetRock estimate for nat gas unit cost
Electricity	$120,600	OAQPS formula (ΔP, Q, Eff, etc.) w/ WestRock est for elec power rate
Indirect Annual Cost		
Overhead	$24,482	OAQPS Cost Manual Factor
Administrative	$30,800	OAQPS Cost Manual Factor
Property Tax	$15,400	OAQPS Cost Manual Factor
Insurance	$15,400	OAQPS Cost Manual Factor
Capital Recovery (*i* % @ N yr project life)	**$169,000**	
i, interest rate per period	7%	WestRock estimate for weighted average cost of captial
N, project life (no. of years)	15	
A/P	0.1098	
Total Annual Cost	**$695,382**	
Total VOC Removed (tons/yr)	**31.1**	Max Press VOC emission estimate time 90% DRE for RTO
Cost Effectiveness ($/ton)	**$22,396**	

D.6.2-2 Duct Design and TCI

Duct Design
Regenerative Thermal Oxidizer (RTO), 95% TER
Lithographic Press
WestRock - Lithia Springs, GA

Installation Cost = 50% PEC

1993 Material Cost from OAQPS

Summary

Duct Segment	Description	Duct Material	Gas Flow (scfm)	Gas Flow (acfm)	Temp (°F)	Target Vel. (fpm) *	Duct Area (ft2)	Calculated Duct Dia. (in)	Nominal Duct Dia (in)	Total Length (ft)	Enlargers	No. of Elbows	No. of Branch Tees	No. of Vol Control Dampers	Duct $/ft	Enlarger $/each	Elbow $/each	Tee $/each	Damper $/each	Total Cost ($)
1	Dryer 1 (Between Deck Dryer) Header	Sheet-galv CS	13,184	16,000	188	**2,801**	5.7	32.4	34.0	48	0	2	0	1	$143.68	$229.07	$229.07	$229.07	$3,384.26	**10,739**
2	Dryer 2 (Press Tunnel Dryer) Header	Sheet-galv CS	6,592	9,000	227	**2,884**	3.1	23.9	24.0	10	0	1	0	1	$96.26	$126.47	$126.47	$126.47	$2,569.27	**3,658**
3	Dryer 3 (Varnish Tunnel Dryer) Header	Sheet-galv CS	11,866	16,000	240	**2,912**	5.5	31.7	32.0	12	0	1	0	1	$134.01	$203.41	$203.41	$203.41	$3,225.80	**5,037**
4	Dryer 4 (Varnish Tunnel Dryer) Header	Sheet-galv CS	11,866	16,000	240	**2,912**	5.5	31.7	32.0	56	0	2	0	1	$134.01	$203.41	$203.41	$203.41	$3,225.80	**11,137**
5	2 & 3 Combined Header	Sheet-galv CS	18,458	24,000	235	**2,902**	8.3	38.9	40.0	9	1	2	2	0	$173.21	$327.16	$327.16	$327.16	$3,848.51	**3,195**
6	1-4 Combined Header to RTO	Sheet-galv CS	43,508	56,000	222	**2,874**	19.5	59.8	60.0	179	1	2	2	0	$276.10	$1,073.25	$1,073.25	$1,073.25	$5,303.72	**54,789**

* Target Velocity calculated to velocity pressure of:	0.40	in. W.C.

Purchase and Installation Cost Summary

1993$ Purchased Equipment Cost	$88,555
Construction Cost Escalation Factor[1], 1993$ to 2016$	2.11
Equipment Cost	$186,736

[1] from Turner Construction Company Cost Index, 2016.

Segment Measurements from Site Layout Map

Scale	cm	ft	ft/cm	
	2.85	9.51	3.34	
Segment*	**cm**	**Long. Ft**	**Vert. Ft**	**Total Ft**
1	14.1	48	0	48
2	2.8	10	0	10
3	3.3	12	0	12
4	16.7	56	0	56
5	2.4	9	0	9
6	11.7	147	32	179

*scale for segment 6 is 4 cm = 50 ft

Detail

Duct Segment	Description	Flow (scfm)	Air Temp (degF)	Flow (acfm)	Design Duct Velocity (fpm)	Req'd Area (ft2)	Calc'd Duct Dia (in)	Nominal Duct Diameter (in)	Calc'd Duct Velocity (fpm)	Approx VP (in w.g.)	Duct Length Rise (ft)	Duct Length Run (ft)	Duct Length Total (ft)	Friction Loss per ft (in. w.g. / ft)	Straight Run Press Drop (in w.g.)	No. of Elbows	Loss Factor Coeff	Elbow Press Drop (in w.g.)	No of Branch Entries	Loss Factor Coeff	Entry Press Drop (in w.g.)	Total Press Drop thru Leg (in w.g.)
1	Dryer 1 (Between Deck Dryer) Header	13,184	188	16,000	2,801	5.712	32.4	34.0	2,540	0.33	0	48	48	0.0014	0.0669	2	0.39	0.256	0	0.28	0.000	0.3225
2	Dryer 2 (Press Tunnel Dryer) Header	6,592	227	9,000	2,884	3.120	23.9	24.0	2,860	0.39	0	10	10	0.0024	0.0241	1	0.39	0.153	0	0.28	0.000	0.1769
3	Dryer 3 (Varnish Tunnel Dryer) Header	11,866	240	16,000	2,912	5.495	31.7	32.0	2,860	0.38	0	12	12	0.0016	0.0196	1	0.39	0.150	0	0.28	0.000	0.1696
4	Dryer 4 (Varnish Tunnel Dryer) Header	11,866	240	16,000	2,912	5.495	31.7	32.0	2,860	0.38	0	56	56	0.0016	0.0912	2	0.39	0.300	0	0.28	0.000	0.3913
5	2 & 3 Combined Header	18,458	235	24,000	2,902	8.270	38.9	40.0	2,750	0.36	0	9	9	0.0012	0.0105	2	0.39	0.279	2	0.28	0.200	0.4902
6	1-4 Combined Header to RTO	43,508	222	56,000	2,874	19.482	59.8	60.0	2,850	0.39	32	147	179	0.0008	0.1408	2	0.39	0.306	2	0.28	0.219	0.6659

D.6.2-2 Duct Design and TCI

Total Capital Investment (TCI)
Regenerative Thermal Oxidizer (RTO), 95% TER
Lithographic Press
WestRock - Lithia Springs, GA

Duct System TCI

Direct Cost - Purchased Equipment Costs (PEC)	*Cost*	*Basis / Source / Comment*
Equipment Cost (EC) =	$186,736	See "Duct Segments" tab - EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.1.2
Sales Tax (3% EC) =	$6,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Freight and Assembly/Setting (5% EC) =	$9,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Purchased Equipment Costs (PEC) =	**$201,736**	

Direct Cost - Installation	*Cost*	*Basis / Source / Comment*
Installation (37.5% PEC) =	$75,651	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.4
Direct Installation Cost =	**$75,651**	

Total Direct Costs (DC) =	**$277,000**

Indirect Costs	*Cost*
Total Indirect Costs (IC) =	**$0**

Total Duct Work Capital Investment =	**$277,000**

D.6.2-3 Derivation of Cost Estimate

RTO Design Parameters and Specifications
Regenerative Thermal Oxidizer (RTO), 95% TER
Lithographic Press
WestRock - Lithia Springs, GA

Parameter	Unit of Measure	Value
volume flow	scfm	43,508
volume flow	acfm	56,215
temperature	°F	223
moisture	lbs/hr	5174
moisture	%-by-vol	4%
VOC	lbs/yr	69,000
VOC	lbs/hr	8.0
VOC	%-by-wt	0.004%

Dryer Details (from facility)

between color dryer 1

13184	scfm
16177	acfm
188	°F

print tunnel dryer 2

6592	scfm
8576	acfm
227	°F

varnish tunnel dryer 3

11866	scfm
15731	acfm
240	°F

varnish tunnel dryer 4

11866	scfm
15731	acfm
240	°F

Moisture Estimation

between color dryer 1

462	lbs/hr ink max usage
65%	water in ink
300	lbs/hr water from ink
75	°F dew point
132	gr water/lb dry air (psychrometric chart)
1074	lbs/hr water from ambient air

1374 lbs/hr water vapor

print tunnel dryer 2

462	lbs/hr ink max usage
65%	water in ink
300	lbs/hr water from ink
75	°F dew point
132	gr water/lb dry air (psychrometric chart)
537	lbs/hr water from ambient air

837 lbs/hr water vapor

varnish tunnel dryer 3

735	lbs/hr varnish max usage
70%	water in varnish
514	lbs/hr water from varnish
75	°F dew point
132	gr water/lb dry air (psychrometric chart)
967	lbs/hr water from ambient air

1481 lbs/hr water vapor

varnish tunnel dryer 4

735	lbs/hr varnish max usage
70%	water in varnish
514	lbs/hr water from varnish
75	°F dew point
132	gr water/lb dry air (psychrometric chart)
967	lbs/hr water from ambient air

1481 lbs/hr water vapor

Flow Parameters - Total

Dryers 1-4

43,508	scfm
56,215	acfm
223	°F
5,174	lbs/hr water vapor
1,846	scfm moisture
4.2%	moisture by vol
41,662	dscfm
187,480	lb/hr dry air

D.6.2-3 Derivation of Cost Estimate

Estimated Fuel Cost - Regenerative Thermal Oxidizer
Regenerative Thermal Oxidizer (RTO), 95% TER
Lithographic Press
WestRock - Lithia Springs, GA

Operating Parameters

Design Flow	43,508	scfm	
Assumed Moisture Content	4.2%	by vol	
Moisture Flow	1,846	scfm	
Dry Air Flow	41,662	dscfm	
Moisture Vapor Density	21.4	ft3/lb	
Moisture Load	5,178	lbs/hr	
VOC Load	8.0	lbs/hr	
VOC Conc	19.4	ppm	

Heat Balance and Supplemental Fuel Use Analysis

HHV for VOC (EtAm)	10,710	BTU/lb	https://cameochemicals.noaa.gov/chris/MEA.pdf
Heat Input from VOC Oxidation (90%)	0.077	mmBTU/hr	
Enthalpy of Comb Chamber Exhaust	28.3	BTU/scf @ 1,500 degF	
Dry Air Heat Flux from Comb Chamber	70.74	mmBTU/hr	
Moisture Enthalpy (1500 °F, 1 atm))	1,804	BTU/lb	
Moisture Heat Flux from Comb Chamber	9.34	mmBTU/hr	
Total Heat Flux from Oxidizer Comb Chamber	80.1	mmBTU/hr out	
Radiant Heat Loss (1% of total)	0.80	mmBTU/hr loss	
Enthalpy of process vent air	2.98	BTU/scf @ 220 degF	
Moisture Enthalpy (220°F, 1 atm))	1,154	BTU/lb	
Heat Input from Process Air	13.42	mmBTU/hr in	
Heat Available for Recovery	65.86	mmBTU/hr	
Heat recovered by Oxidizer	62.6	mmBTU/hr at	**95% thermal eff**
Total Heat Input to Oxidizer Comb Chamber	76.1	BTU/hr total heat input	
Required Burner Heat Input	**4.23**	**mmBTU/hr Burner Input**	

D.6.2-3 Derivation of Cost Estimate

Total Capital Investment (TCI)
Regenerative Thermal Oxidizer (RTO), 95% TER
Lithographic Press
WestRock - Lithia Springs, GA

Control System TCI - Regenerative Thermal Oxidizer

Total Capital Investment		
Direct Cost - Purchased Equipment Costs (PEC)	***Cost***	***Basis / Source / Comment***
Equipment Cost (EC) =	$775,000	Vendor Estimate - Anguil
Sales Tax (3% EC) =	$23,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Freight and Assembly/Setting (5% EC) =	$39,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Purchased Equipment Costs (PEC) =	**$837,000**	

Direct Cost - Installation	***Cost***	***Basis / Source / Comment***
Foundation & Supports (8% PEC) =	$67,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Handling and Erection (14% PEC) =	$117,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Electrical (4% PEC) =	$33,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Piping (2% PEC) =	$17,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Insulation for Ductwork (1% PEC) =	$8,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Painting (1% PEC) =	$8,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Direct Installation Cost =	**$250,000**	

Total Direct Costs (DC) =	**$1,087,000**	

Indirect Costs	***Cost***	***Basis / Source / Comment***
Engineering (10% PEC) =	$84,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Construction and Field Expenses (5% PEC) =	$42,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contractor Fees (10% PEC) =	$84,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Start-up (2% PEC) =	$17,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Performance Test (1% PEC) =	$8,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contingencies (3% PEC) =	$25,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Total Indirect Costs (IC) =	**$176,000**	

Total RTO Capital Investment =	**$1,263,000**	

D.6.2-3 Derivation of Cost Estimate

Summary of Annual O&M Costs
Regenerative Thermal Oxidizer (RTO), 95% TER
Lithographic Press
WestRock - Lithia Springs, GA

Direct Annual Costs:	RTO & Duct Work	*Basis / Source / Comment*
Operating Labor:		
Operator =	$22,500	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Supervisor (15% of operator labor) =	$3,400	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
Annual Operating Labor Cost	**$25,900**	See (a) below
Maintenance Costs:		
Labor (0.5 hrs per shift) =	$17,500	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Material (100% of maintenance labor) =	$17,500	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2.5.1, Table 2.10 (100% of maintenance labor)
Annual Maintenance Cost	**$35,000**	See (a) below
Natural Gas Consumption Cost:		
Annual Natural Gas Cost	**$258,800**	See (b) below
System Fan Electrical Cost:		
Annual Fan Electrical Cost	**$120,600**	See (c) below

Total Direct Annual Operating Cost	**$440,300**

(a) Wage Data from WestRock:

Parameter	Value	Units
Operator Wage, $/hr	$41.07	$/hr
Maintenance Laborer Wage, $/hr	$32.01	$/hr

(b) Natural Gas Calculations:

Parameter	Value	Units
Natural Gas Usage Rate	4.2	MMBtu/hr
Operating Schedule	8,592	hrs/yr
Annual NG Usage	36,326	MMBtu
NG Heat Content [1]	1,032	Btu/scf
Annual Natural Gas Usage	35,199,442	scf/yr
Natural Gas Cost ($/Mscf) [2]	$7.35	$/Mscf
Annual Natural Gas Cost	$258,819	$/yr

(c) Natural Gas Calculations:

Parameter	Value	Units
Vent flow (including dilution air)	56,000	acfm
ΔP across RTO:	12.5	in w.g.
ΔP across ducting:	2.216	in w.g.
Operating scenario:	8592	hr/yr
Combined fan-motor efficiency:	0.6	
Electricity price [2]:	$0.0870	$/kWhr
Annual electricity cost [3]:	$120,639	$/yr

Sources:
[1] U.S. Energy Information Administration / Monthly Energy Review May 2016, Table A.4
[2] WestRock Lithia Springs Utility Cost Projection
[3] EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Sect 1, Eqn 1.46

Indirect Annual Costs:	RTO	*Basis / Source / Comment*
Overhead* =	$24,482	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Table 2.10
Property Tax (1% TCI) =	$12,630	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Insurance (1% TCI) =	$12,630	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
General & Administrative (2% TCI) =	$25,260	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Indirect Annual Operating Cost - RTO	**$75,002**	
	Ductwork	*Basis / Source / Comment*
Property Tax (1% TCI) =	$2,770	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
Insurance (1% TCI) =	$2,770	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
General & Administrative (2% TCI) =	$5,540	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
Indirect Annual Operating Cost - Duct Work	**$11,080**	

Total Indirect Annual Operating Cost	**$86,082**

*Since labor costs are loaded with employee benefits costs, the nominal 60% multiplier for plantwide overhead was reduced by 33%. Overhead costs besides employee benefits can include any of the following: Hospital and medical services, General engineering, Safety services, Cafeteria and recreation facilities, General plant maintenance and overhead, Control laboratories, Packaging, Plant protection, Janitor and similar services, Employment offices, Distribution of utilities, Shops, Lighting, Interplant communications and transportation, Warehouses, Shipping and receiving facilities

D.6.2-4 Derivations of Environmental Impacts

Environmental Impact Summary

Regenerative Thermal Oxidizer (RTO), 95% TER

Lithographic Press

WestRock - Lithia Springs, GA

Secondary Emissions Summary

Annual Secondary Emissions of Key Pollutants		
SO_2	**2.38**	**tons/yr**
NO_x	**2.80**	**tons/yr**
Hg	**0.03**	**kg/yr**
CO_{2eq}	**2673.65**	**tons/yr**
CO	**1.48**	**tons/yr**

Secondary Emissions Calculations

Electricity Generation

Electricity Demand	1387	MWh/yr

Avg Coal Power Plant Emissions[1]		
SO_2	3.79	kg/MWh
NO_x	1.66	kg/MWh
Hg	2.30E-05	kg/MWh
CO_{2eq}	893	kg/MWh

Secondary Emissions, Electricity Generation		
SO_2	5,255	kg/yr
NO_x	2,302	kg/yr
Hg	0.032	kg/yr
CO_{2eq}	1,238,286	kg/yr

Natural Gas Combustion

Natural Gas Usage	36,326	MMBtu/yr
Natural Gas Usage	35.2	MMscf/yr

Criteria Pollutant Emission Factors[2]		
CO_{2eq}	120,000	lb/MMscf
CO	84	lb/MMscf
NO_x	100	lb/MMscf

Secondary Emissions, NG Combustion		
CO_{2eq}	4,223,933	lb/yr
CO	2,957	lb/yr
NO_x	3,520	lb/yr

Notes:

[1] "North American Power Plant Air Emissions", Commission for Environmental Cooperation of North

[2] EPA AP-42 Ch. 1, Sect 4, Table 1.4-1 (NOx and CO), Table 1.4-2 (CO2eq)

D.6.3. RCO Cost Analysis

D.6.3-1 Summary Table

Cost Summary
Regenerative Catalytic Oxidizer (RCO)
Lithographic Press
WestRock - Lithia Springs, GA

	Value	Notes / Basis for Estimates
Total Capital Investment		
RCO System	$1,714,000	Vendor budgetary quote with OAQPS Cost Manual factors for ancillary equip
Ductwork	$122,000	Concept design sizing (Figure 5.5-1) w/ OAQPS ductwork cost factors
Subtotal (TCI)	**$1,836,000**	
Annual Costs		
Direct Annual Cost		
Catalyst Replacement	$37,100	Estimated frequency of and cost per replacement based on industry standards
Labor	$25,900	WestRock Labor Rates w/ OAQPS factors for O&M hours required
Maintenance Supplies	$35,000	OAQPS assumption - 100% of maintenance labor cost
Natural Gas Consumption	$97,200	RTO Heat balance w/ WetRock estimate for nat gas unit cost
Electricity	$149,300	OAQPS formula (ΔP, Q, Eff, etc.) w/ WestRock est for elec power rate
Indirect Annual Cost		
Overhead	$24,482	OAQPS Cost Manual Factor
Administrative	$36,720	OAQPS Cost Manual Factor
Property Tax	$18,360	OAQPS Cost Manual Factor
Insurance	$18,360	OAQPS Cost Manual Factor
Capital Recovery (*i* % @ N yr project life)	**$202,000**	
i, interest rate per period	7%	WestRock estimate for weighted average cost of captial
N, project life (no. of years)	15	
A/P	0.1098	
Total Annual Cost	**$644,422**	
Total VOC Removed (tons/yr)	**31.1**	Max Press VOC emission estimate time 90% DRE for RCO
Cost Effectiveness ($/ton)	**$20,754**	

D.6.3-2 Duct Design and TCI

Duct Design
Regenerative Catalytic Oxidizer (RCO)
Lithographic Press
WestRock - Lithia Springs, GA

Installation Cost = 50% PEC

Summary

Duct Segment	Description	Duct Material	Gas Flow (scfm)	Gas Flow (acfm)	Temp (°F)	Target Vel. (fpm) *	Duct Area (ft2)	Calculated Duct Dia. (in)	Nominal Duct Dia (in)	Total Length (ft)	Enlargers	No. of Elbows	No. of Branch Tees	No. of Vol Control Dampers	Duct $/ft	Enlarger $/each	Elbow $/each	Tee $/each	Damper $/each	Total Cost ($)
1	Dryer 1 (Between Deck Dryer) Header	Sheet-galv CS	13,184	16,000	188	**2,801**	5.7	32.4	34.0	48	0	2	0	1	$143.68	$229.07	$229.07	$229.07	$3,384.26	**10,739**
2	Dryer 2 (Press Tunnel Dryer) Header	Sheet-galv CS	6,592	9,000	227	**2,884**	3.1	23.9	24.0	10	0	1	0	1	$96.26	$126.47	$126.47	$126.47	$2,569.27	**3,658**
3	Dryer 3 (Varnish Tunnel Dryer) Header	Sheet-galv CS	11,866	16,000	240	**2,912**	5.5	31.7	32.0	12	0	1	0	1	$134.01	$203.41	$203.41	$203.41	$3,225.80	**5,037**
4	Dryer 4 (Varnish Tunnel Dryer) Header	Sheet-galv CS	11,866	16,000	240	**2,912**	5.5	31.7	32.0	56	0	2	0	1	$134.01	$203.41	$203.41	$203.41	$3,225.80	**11,137**
5	2 & 3 Combined Header	Sheet-galv CS	18,458	24,000	235	**2,902**	8.3	38.9	40.0	9	1	2	2	0	$173.21	$327.16	$327.16	$327.16	$3,848.51	**3,195**
6	1-4 Combined Header to RTO	Sheet-galv CS	43,508	56,000	222	**2,874**	19.5	59.8	60.0	0	1	2	2	0	$276.10	$1,073.25	$1,073.25	$1,073.25	$5,303.72	**5,366**

* Target Velocity calculated to velocity pressure of:	0.40	in. W.C.

Purchase and Installation Cost Summary

1993$ Purchased Equipment Cost	$39,133
Construction Cost Escalation Factor[1], 1993$ to 2016$	2.11
Equipment Cost	$82,519

[1] from Turner Construction Company Cost Index, 2016.

Segment Measurements from Site Layout Map

Scale	cm	ft	ft/cm	
	2.85	9.51	3.34	
Segment*	**cm**	**Long. Ft**	**Vert. Ft**	**Total Ft**
1	14.1	48	0	48
2	2.8	10	0	10
3	3.3	12	0	12
4	16.7	56	0	56
5	2.4	9	0	9
6	11.7	147	32	

*scale for segment 6 is 4 cm = 50 ft

Detail

Duct Segment	Description	Flow (scfm)	Air Temp (degF)	Flow (acfm)	Design Duct Velocity (fpm)	Req'd Area (ft2)	Calc'd Duct Dia (in)	Nominal Duct Diameter (in)	Calc'd Duct Velocity (fpm)	Approx VP (in w.g.)	Duct Length Rise (ft)	Duct Length Run (ft)	Duct Length Total (ft)	Friction Loss per ft (in. w.g. / ft)	Straight Run Press Drop (in w.g.)	No. of Elbows	Loss Factor Coeff	Elbow Press Drop (in w.g.)	No of Branch Entries	Loss Factor Coeff	Entry Press Drop (in w.g.)	Total Press Drop thru Leg (in w.g.)
1	Dryer 1 (Between Deck Dryer) Header	13,184	188	16,000	2,801	5.7	32.4	34	2,540	0.328	0	48	48	0.0014	0.0669	2	0.3900	0.2556	0	0.2800	0.0000	0.32
2	Dryer 2 (Press Tunnel Dryer) Header	6,592	227	9,000	2,884	3.1	23.9	24	2,860	0.392	0	10	10	0.0024	0.0241	1	0.3900	0.1529	0	0.2800	0.0000	0.18
3	Dryer 3 (Varnish Tunnel Dryer) Header	11,866	240	16,000	2,912	5.5	31.7	32	2,860	0.385	0	12	12	0.0016	0.0196	1	0.3900	0.1500	0	0.2800	0.0000	0.17
4	Dryer 4 (Varnish Tunnel Dryer) Header	11,866	240	16,000	2,912	5.5	31.7	32	2,860	0.385	0	56	56	0.0016	0.0912	2	0.3900	0.3000	0	0.2800	0.0000	0.39
5	2 & 3 Combined Header	18,458	235	24,000	2,902	8.3	38.9	40	2,750	0.358	0	9	9	0.0012	0.0105	2	0.3900	0.2792	2	0.2800	0.2005	0.49
6	1-4 Combined Header to RTO	43,508	222	56,000	2,874	19.5	59.8	60	2,850	0.392	32	147	179	0.0008	0.1408	2	0.3900	0.3057	2	0.2800	0.2195	0.67

D.6.3-2 Duct Design and TCI

Total Capital Investment (TCI)
Regenerative Catalytic Oxidizer (RCO)
Lithographic Press
WestRock - Lithia Springs, GA

Duct System TCI

Direct Cost - Purchased Equipment Costs (PEC)	***Cost***	***Basis / Source / Comment***
Equipment Cost (EC) =	$82,519	See "Duct Segments" tab - EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.1.2
Sales Tax (3% EC) =	$2,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Freight and Assembly/Setting (5% EC) =	$4,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Purchased Equipment Costs (PEC) =	**$88,519**	

Direct Cost - Installation	***Cost***	***Basis / Source / Comment***
Installation (37.5% PEC) =	$33,194	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.4
Direct Installation Cost =	**$33,194**	

Total Direct Costs (DC) =	**$122,000**

Indirect Costs	***Cost***
Total Indirect Costs (IC) =	**$0**

Total Duct Work Capital Investment =	**$122,000**

D.6.3-3 Derivation of Cost Estimate

RCO Parameters and Specifications
Regenerative Catalytic Oxidizer (RCO)
Lithographic Press
WestRock - Lithia Springs, GA

Parameter	Unit of Measure	Value
volume flow	scfm	43,508
volume flow	acfm	56,215
temperature	°F	223
moisture	lbs/hr	5174
moisture	%-by-vol	4.2%
VOC	lbs/yr	69,000
VOC	lbs/hr	8.0
VOC	%-by-wt	0.004%

Dryer Details (from facility)

between color dryer 1
13184 scfm
16177 acfm
188 °F

print tunnel dryer 2
6592 scfm
8576 acfm
227 °F

varnish tunnel dryer 3
11866 scfm
15731 acfm
240 °F

varnish tunnel dryer 4
11866 scfm
15731 acfm
240 °F

Moisture Estimation

between color dryer 1
462 lbs/hr ink max usage
65% water in ink
300 lbs/hr water from ink — 1374 lbs/hr water vapor
75 °F dew point
132 gr water/lb dry air (psychrometric chart)
1074 lbs/hr water from ambient air

print tunnel dryer 2
462 lbs/hr ink max usage
65% water in ink
300 lbs/hr water from ink — 837 lbs/hr water vapor
75 °F dew point
132 gr water/lb dry air (psychrometric chart)
537 lbs/hr water from ambient air

varnish tunnel dryer 3
735 lbs/hr varnish max usage
70% water in varnish
514 lbs/hr water from varnish — 1481 lbs/hr water vapor
75 °F dew point
132 gr water/lb dry air (psychrometric chart)
967 lbs/hr water from ambient air

varnish tunnel dryer 4
735 lbs/hr varnish max usage
70% water in varnish
514 lbs/hr water from varnish — 1481 lbs/hr water vapor
75 °F dew point
132 gr water/lb dry air (psychrometric chart)
967 lbs/hr water from ambient air

Flow Parameters - Total

Dryers 1-4
43,508 scfm
56,215 acfm
223 °F
5,174 lbs/hr water vapor
1,846 scfm moisture
4.2% moisture by vol
41,662 dscfm
187,480 lb/hr dry air

D.6.3-3 Derivation of Cost Estimate

Estimated Fuel Cost - Regenerative Thermal Oxidizer
Regenerative Catalytic Oxidizer (RCO)
Lithographic Press
WestRock - Lithia Springs, GA

Operating Parameters

Design Flow	43,508	scfm	
Assumed Moisture Content	4.2%	by vol	
Moisture Flow	1,846	scfm	
Dry Air Flow	41,662	dscfm	
Moisture Vapor Density	21.4	ft3/lb	
Moisture Load	5,178	lbs/hr	
VOC Load	8.0	lbs/hr	
VOC Conc	19.4	ppm	

Heat Balance and Supplemental Fuel Use Analysis

HHV for VOC (EtAm)	10,710	BTU/lb	
Heat Input from VOC Oxidation (90%)	0.077	mmBTU/hr	
Enthalpy of Comb Chamber Exhaust	10.85	BTU/scf @ 650 degF	
Dry Air Heat Flux from Comb Chamber	27.12	mmBTU/hr	
Moisture Enthalpy (650 °F, 1 atm))	1,078	BTU/lb	
Moisture Heat Flux from Comb Chamber	5.58	mmBTU/hr	
Total Heat Flux from Oxidizer Comb Chamber	32.7	mmBTU/hr out	
Radiant Heat Loss (2% of total)	0.65	mmBTU/hr loss	
Enthalpy of process vent air	2.98	BTU/scf @ 220 degF	
Moisture Enthalpy (220°F, 1 atm))	1,154	BTU/lb	
Heat Input from Process Air	13.42	mmBTU/hr in	
Heat Available for Recovery	18.63	mmBTU/hr	
Heat recovered by Oxidizer	17.7	mmBTU/hr at	**95% thermal eff**
Total Heat Input to Oxidizer Comb Chamber	31.2	BTU/hr total heat input	
Required Burner Heat Input	**1.59**	**mmBTU/hr Burner Input**	

D.6.3-3 Derivation of Cost Estimate

Total Capital Investment (TCI)
Regenerative Catalytic Oxidizer (RCO)
Lithographic Press
WestRock - Lithia Springs, GA

Control System TCI - Regenerative Catalytic Oxidizer

Total Capital Investment		
Direct Cost - Purchased Equipment Costs (PEC)	*Cost*	*Basis / Source / Comment*
Equipment Cost (EC) =	$1,050,000	Vendor Estimate - Anguil
Sales Tax (3% EC) =	$32,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Freight and Assembly/Setting (5% EC) =	$53,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Purchased Equipment Costs (PEC) =	**$1,135,000**	

Direct Cost - Installation	*Cost*	*Basis / Source / Comment*
Foundation & Supports (8% PEC) =	$91,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Handling and Erection (14% PEC) =	$159,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Electrical (4% PEC) =	$45,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Piping (2% PEC) =	$23,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Insulation for Ductwork (1% PEC) =	$11,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Painting (1% PEC) =	$11,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Direct Installation Cost =	**$340,000**	

Total Direct Costs (DC) =	**$1,475,000**	

Indirect Costs	*Cost*	*Basis / Source / Comment*
Engineering (10% PEC) =	$114,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Construction and Field Expenses (5% PEC) =	$57,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contractor Fees (10% PEC) =	$114,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Start-up (2% PEC) =	$23,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Performance Test (1% PEC) =	$11,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contingencies (3% PEC) =	$34,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Total Indirect Costs (IC) =	**$239,000**	

Total RCO Capital Investment =	**$1,714,000**	

D.6.3-3 Derivation of Cost Estimate

Summary of Annual O&M Costs
Regenerative Catalytic Oxidizer (RCO)
Lithographic Press
WestRock - Lithia Springs, GA

Direct Annual Costs:	**RCO & Duct Work**	***Basis / Source / Comment***
Catalyst Replacement:		
Annual Catalyst Replacement Cost	**$37,100**	See (a) below
Operating Labor:		
Operator =	$22,500	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Supervisor (15% of operator labor) =	$3,400	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
Annual Operating Labor Cost	**$25,900**	See (b) below
Maintenance Costs:		
Labor (0.5 hrs per shift) =	$17,500	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Material (100% of maintenance labor) =	$17,500	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2.5.1, Table 2.10 (100% of maintenance labor)
Annual Maintenance Cost	**$35,000**	See (b) below
Natural Gas Consumption Cost:		
Annual Natural Gas Cost	**$97,200**	See (c) below
System Fan Electrical Cost:		
Annual Fan Electrical Cost	**$149,300**	See (d) below

Total Direct Annual Operating Cost	**$344,500**

(a) Catalyst Replacement Calculations:

Cost of Cat Change (Anguil Estimate)	$225,000
Net Present Value, (P/F, i%, N) = 1/(1+i)^N	
i =	7%
Cat Change #1 (3 yrs)	$183,667
Cat Change #2 (6 yrs)	$149,927
Cat Change #3 (9 yrs)	$122,385
Cat Change #4 (12 yrs)	$99,903
Annual Cost of Catalyst Replacement	$37,059

D.6.3-3 Derivation of Cost Estimate

Summary of Annual O&M Costs
Regenerative Catalytic Oxidizer (RCO)
Lithographic Press
WestRock - Lithia Springs, GA

(b) Wage Data from WestRock:

Parameter	Value	Units
Operator Wage, $/hr	$41.07	$/hr
Maintenance Laborer Wage, $/hr	$32.01	$/hr

(c) Natural Gas Calculations:

Parameter	Value	Units
Natural Gas Usage Rate	1.6	MMBtu/hr
Operating Schedule	8,592	hrs/yr
Annual NG Usage	13,639	MMBtu
NG Heat Content [1]	1,032	Btu/scf
Annual Natural Gas Usage	13,216,369	scf/yr
Natural Gas Cost ($/Mscf) [2]	$7.35	$/Mscf
Annual Natural Gas Cost	$97,179.19	$/yr

(d) System Fan Calculations:

Parameter	Value	Units
Vent flow (including dilution air)	56,000	acfm
ΔP across RCO:	16	in w.g.
ΔP across ducting:	2.216	in w.g.
Operating scenario:	8592	hr/yr
Combined fan-motor efficiency:	0.6	
Electricity price [2]:	$0.0870	$/kWhr
Annual electricity cost [3]:	$149,331	$/yr

Sources:
[1] U.S. Energy Information Administration / Monthly Energy Review May 2016, Table A.4
[2] WestRock Lithia Springs Utility Cost Projection
[3] EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Sect 1, Eqn 1.46

Indirect Annual Costs:	RCO	*Basis / Source / Comment*
Overhead* =	$24,482	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Table 2.10
Property Tax (1% TCI) =	$17,140	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Insurance (1% TCI) =	$17,140	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
General & Administrative (2% TCI) =	$34,280	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Indirect Annual Operating Cost - RTO	**$93,042**	
	Ductwork	*Basis / Source / Comment*
Property Tax (1% TCI) =	$1,220	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
Insurance (1% TCI) =	$1,220	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
General & Administrative (2% TCI) =	$2,440	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
Indirect Annual Operating Cost - Duct Work	**$4,880**	
Total Indirect Annual Operating Cost	**$97,922**	

*Since labor costs are loaded with employee benefits costs, the nominal 60% multiplier for plantwide overhead was reduced by 33%. Overhead costs besides employee benefits can include any of the following: Hospital and medical services, General engineering, Safety services, Cafeteria and recreation facilities, General plant maintenance and overhead, Control laboratories, Packaging, Plant protection, Janitor and similar services, Employment offices, Distribution of utilities, Shops, Lighting, Interplant communications and transportation, Warehouses, Shipping and receiving facilities

D.6.3-3 Derivation of Environmental Impacts

Environmental Impact Summary
Regenerative Catalytic Oxidizer (RCO)
Lithographic Press
WestRock - Lithia Springs, GA

Secondary Emissions Summary

Annual Secondary Emissions of Key Pollutants		
SO_2	**2.95**	**tons/yr**
NO_x	**1.95**	**tons/yr**
Hg	**0.04**	**kg/yr**
CO_{2eq}	**1488**	**tons/yr**
CO	**0.56**	**tons/yr**

Secondary Emissions Calculations

Electricity Generation

Electricity Demand	1716	MWh/yr

Avg Coal Power Plant Emissions[1]		
SO_2	3.79	kg/MWh
NO_x	1.66	kg/MWh
Hg	2.30E-05	kg/MWh
CO_{2eq}	893	kg/MWh

Secondary Emissions, Electricity Generation		
SO_2	6,505	kg/yr
NO_x	2,849	kg/yr
Hg	0.039	kg/yr
CO_{2eq}	1,532,788	kg/yr

Natural Gas Combustion

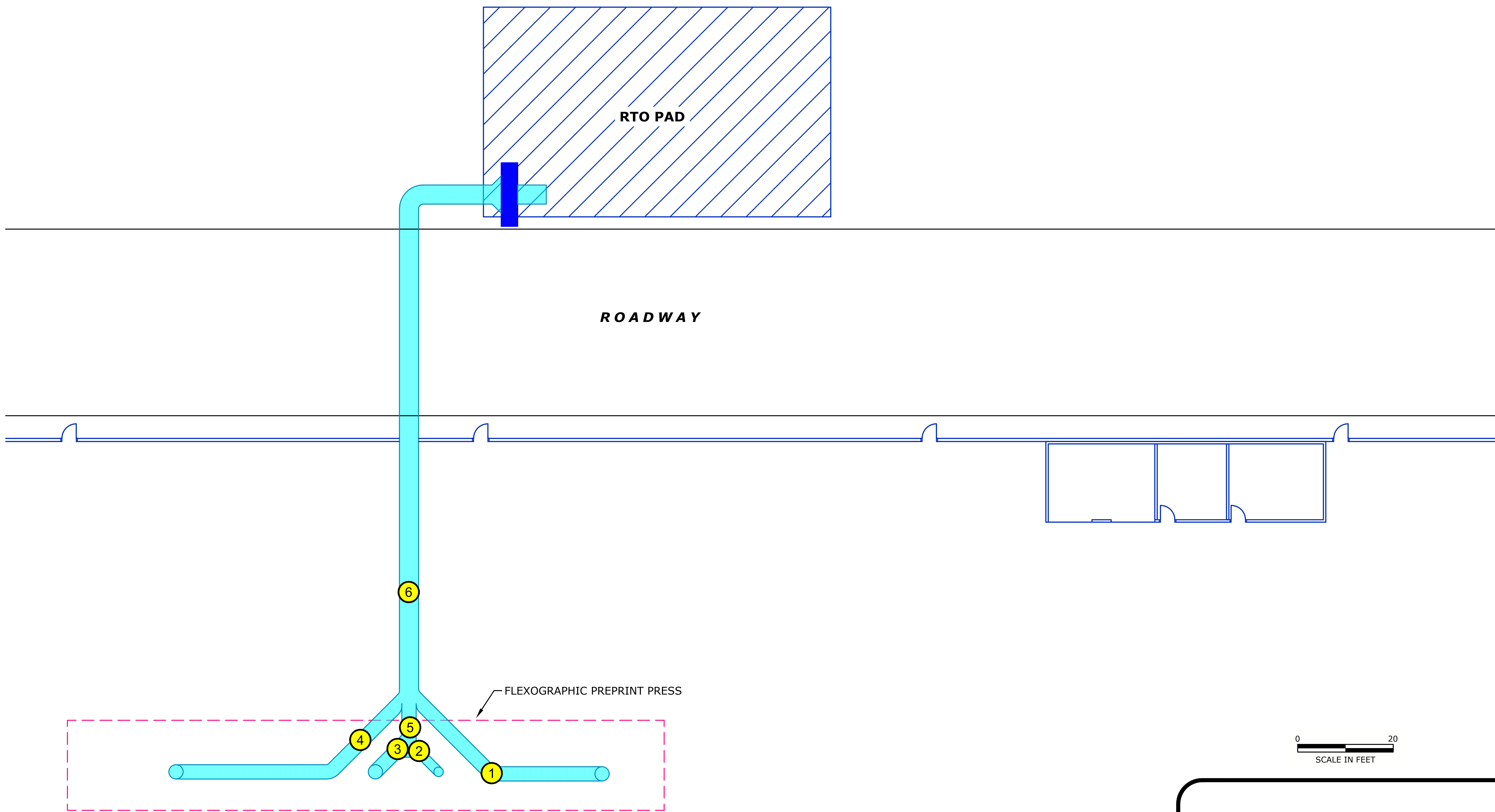
Natural Gas Usage	13,639	MMBtu/yr
Natural Gas Usage	13.2	MMscf/yr

Criteria Pollutant Emission Factors[2]		
CO_{2eq}	120,000	lb/MMscf
CO	84	lb/MMscf
NO_x	100	lb/MMscf

Secondary Emissions, NG Combustion		
CO_{2eq}	1,585,964	lb/yr
CO	1,110	lb/yr
NO_x	1,322	lb/yr

Notes:
[1] "North American Power Plant Air Emissions", Commission for Environmental Cooperation of North America (CEC), 2004, Table 1.3
[2] EPA AP-42 Ch. 1, Sect 4, Table 1.4-1 (NOx and CO), Table 1.4-2 (CO2eq)

D.6.4. RTO Diagram



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SITE LAYOUT
TOLEDO, OHIO

RAMBOLL ENVIRON

FIGURE **1**

DRAFTED BY: ELS | DATE: 6/28/16 | 1937660A

D.7. Printing Plate Processor Cost Estimates

D.7.1. Recuperative TO Cost Analysis

D.7.1-1 Summary Table

Cost Summary

Recuperative Thermal Oxidizer

Printing Plate Processor

WestRock - Lithia Springs, GA

	Value	Notes / Basis for Estimates
Total Capital Investment		
Recup. TO System	$236,000	OAQPS Cost Manual factors
Ductwork	$18,400	Concept design sizing (Figure 5.5-1) w/ OAQPS ductwork cost factors
Subtotal (TCI)	**$254,400**	
Annual Costs		
Direct Annual Cost		
Labor	$29,700	WestRock Labor Rates w/ OAQPS factors for O&M hours required
Maintenance Supplies	$12,000	OAQPS assumption - 100% of maintenance labor cost
Natural Gas	$23,600	OAQPS Cost Manual Factor
Electricity	$600	OAQPS formula (ΔP, Q, Eff, etc.) w/ WestRock est for elec power rate
Indirect Annual Cost		
Overhead	$16,763	OAQPS Cost Manual Factor
Administrative	$5,088	OAQPS Cost Manual Factor
Property Tax	$2,544	OAQPS Cost Manual Factor
Insurance	$2,544	OAQPS Cost Manual Factor
Capital Recovery (*i* % @ N yr project life)	**$28,000**	
i, interest rate per period	7%	WestRock estimate for weighted average cost of captial
N, project life (no. of years)	15	
A/P	0.1098	
Total Annual Cost	**$120,839**	
Total VOC Removed (tons/yr)	**3.1**	Max VOC emission estimate times 98% DRE for oxidizer
Cost Effectiveness ($/ton)	**$39,145**	

D.7.2-2 Duct Design and TCI

Lithia Springs, GA - Duct Runs - Printing Plate Processor, Recuperative Thermal Oxidizer Control

Duct System Total Capital Investment

Direct Cost - Purchased Equipment Costs (PEC)	*Cost*	*Basis / Source / Comment*
EC, Duct	$4,700	See "Duct Design Summary" below
EC, Blowers	$2,300	Cost Estimate - Grainger Products
Equipment Cost (EC) =	**$7,000**	See "Duct Segments" tab - EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.1.2
Sales Tax (3% EC) =	$210	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Freight and Assembly/Setting (5% EC) =	$350	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Purchased Equipment Costs (PEC) =	**$7,600**	
Direct Cost - Installation	*Cost*	*Basis / Source / Comment*
Installation (50% PEC) =	$3,800	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.4
Direct Installation Cost =	**$3,800**	
Indirect Installation Cost =	**$0**	
Total Duct Work Capital Investment =	**$18,400**	

Duct Design Summary

Duct Segment	Description	Duct Material	Gas Flow (scfm)	Gas Flow (acfm)	Temp (°F)	Nominal Duct Dia (in)	Total Length (ft)	No. of Reducers	No. of Elbows	No. of Branch Tees	No. of Vol Control Dampers	No. of Vol Auto Dampers	Duct $/ft	Reducer $/each	Elbow $/each	Tee $/each	Damper $/each	Auto Damper $/each	Total Cost ($)
1	Duct from Printing Plate Processor to Carbon Beds	Sheet-galv CS	700	800	113	8.0	162	0	6	1	2	1	$4.07	$48.89	$48.89	$48.89	$73.36	$1,077.48	**$2,227**

* Target Velocity calculated to velocity pressure of:	0.40	in. W.C.

Purchase and Installation Cost Summary

1993$ Purchased Equipment Cost	$2,227
Construction Cost Escalation Factor[1], 1993$ to 2016$	2.11
Equipment Cost	$4,697

[1] from Turner Construction Company Cost Index, 2016.

Design Detail

Duct Segment	Description	Flow (scfm)	Air Temp (degF)	Flow (acfm)	Velocity (fpm)	Area (ft2)	Duct (in)	Duct (in)	Duct (fpm)	Approx. VP (in w.g.)	Duct Length Rise (ft)	Duct Length Run (ft)	Duct Length Total (ft)	per Foot (in. w.g. / ft)	Pressure (in w.g.)	No. of Elbows	Elbow Loss Factor Coefficient	Drop (in w.g.)	No. of Branch Entries	Branch Loss Factor Coefficient	Pressure (in w.g.)	Pressure (in w.g.)
1	Duct from Printing Plate Processor to Carbon Beds	700	113	760	2,634	0.288	7.3	8.0	2,180	0.27	64	98	162	0.0077	1.2575	6	0.39	0.639	1	0.28	0.076	2.0

D.7.2-2 Duct Design and TCI

Oxidizer Design Parameters and Heat Balance

Recuperative Thermal Oxidizer

Printing Plate Processor

WestRock - Lithia Springs, GA

Design Parameters

Parameter	Unit of Measure	Value
volume flow	scfm	700
volume flow	acfm	760
temperature	°F	113
moisture flow	scfm	11
moisture concentration	ppmv	15000
VOC	lbs/hr	1.05
VOC	ppmv	73

Heat Balance

Operating Parameters

Design Flow	700	scfm
Assumed Moisture Content	1.5%	by vol
Moisture Flow	11	scfm
Dry Air Flow	690	dscfm
Moisture Vapor Density	21.4	ft3/lb
Moisture Load	29	lbs/hr
VOC Load	1.1	lbs/hr
VOC Conc	73.0	ppm

Heat Balance and Supplemental Fuel Use Analysis

HHV for VOC	15,000	BTU/lb	
Heat Input from VOC Oxidation (98%)	0.015	mmBTU/hr	
Enthalpy of Comb Chamber Exhaust	26.2	BTU/scf @ 1400°F	
Dry Air Heat Flux from Comb Chamber	1.08	mmBTU/hr	
Moisture Enthalpy (1400 °F, 1 atm))	1,748	BTU/lb	
Moisture Heat Flux from Comb Chamber	0.05	mmBTU/hr	
Total Heat Flux from Oxidizer Comb Chamber	1.1	mmBTU/hr out	
Radiant Heat Loss (2% of total)	0.02	mmBTU/hr loss	
Enthalpy of process vent air	1.10	BTU/scf @ 113°F	
Moisture Enthalpy (113°F, 1 atm))	1,109	BTU/lb	
Heat Input from Process Air	0.08	mmBTU/hr in	
Heat Available for Recovery	1.03	mmBTU/hr	
Heat recovered by Oxidizer	0.5	mmBTU/hr at	**50% thermal eff**
Total Heat Input to Oxidizer Comb Chamber	0.6	BTU/hr total heat input	
Required Burner Heat Input	**0.55**	**mmBTU/hr Burner Input**	

D.7.2-2 Duct Design and TCI

Total Capital Investment (TCI)
Recuperative Thermal Oxidizer
Printing Plate Processor
WestRock - Lithia Springs, GA

Control System TCI - Regenerative Thermal Oxidizer

Total Capital Investment		
Direct Cost - Purchased Equipment Costs (PEC)	***Cost***	***Basis / Source / Comment***
Equipment Cost (EC) =	$144,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Figure 2.8; adjusted for inflation.
Sales Tax (3% EC) =	$4,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Freight and Assembly/Setting (5% EC) =	$7,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Purchased Equipment Costs (PEC) =	**$155,000**	

Direct Cost - Installation	***Cost***	***Basis / Source / Comment***
Foundation & Supports (8% PEC) =	$12,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Handling and Erection (14% PEC) =	$22,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Electrical (4% PEC) =	$6,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Piping (2% PEC) =	$3,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Insulation for Ductwork (1% PEC) =	$2,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Painting (1% PEC) =	$2,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Direct Installation Cost =	**$47,000**	

Total Direct Costs (DC) =	**$202,000**	

Indirect Costs	***Cost***	***Basis / Source / Comment***
Engineering (10% PEC) =	$16,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Construction and Field Expenses (5% PEC) =	$8,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contractor Fees (10% PEC) =	$16,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Start-up (2% PEC) =	$3,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Performance Test (1% PEC) =	$2,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contingencies (3% PEC) =	$5,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Total Indirect Costs (IC) =	**$34,000**	

Total RCO Capital Investment =	**$236,000**	

D.7.2-3 Derivation of Cost Estimate

Summary of Annual O&M Costs
Recuperative Thermal Oxidizer
Printing Plate Processor
WestRock - Lithia Springs, GA

Direct Annual Costs:	Cost	*Basis / Source / Comment*
Operating Labor:		
Operator =	$15,400	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Supervisor (15% of operator labor) =	$2,300	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
Annual Operating Labor Cost	**$17,700**	See (a) below
Maintenance Costs:		
Labor (0.5 hrs per shift) =	$12,000	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Material (100% of maintenance labor) =	$12,000	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2.5.1, Table 2.10 (100% of maintenance labor)
Annual Maintenance Cost	**$24,000**	See (a) below
Natural Gas Consumption Cost:		
Annual Natural Gas Cost	**$23,600**	See (b) below
System Fan Electrical Cost:		
Annual Fan Electrical Cost	**$600**	See (c) below

Total Direct Annual Operating Cost	**$42,300**

(a) Wage Data from WestRock:

Parameter	Value	Units
Operator Wage, $/hr	$41.07	$/hr
Maintenance Laborer Wage, $/hr	$32.01	$/hr

(b) Natural Gas Calculations:

Parameter	Value	Units
Natural Gas Usage Rate	0.6	MMBtu/hr
Operating Schedule	6,000	hrs/yr
Annual NG Usage	3,313	MMBtu
NG Heat Content [1]	1,032	Btu/scf
Annual Natural Gas Usage	3,210,042	scf/yr
Natural Gas Cost ($/Mscf) [2]	$7.35	$/Mscf
Annual Natural Gas Cost	$23,603.25	$/yr

(c) System Fan Calculations:

Parameter	Value	Units
Vent flow (including dilution air)	760	acfm
ΔP across oxidizer:	6	in w.g.
ΔP across ducting:	2.0	in w.g.
Operating scenario:	6000	hr/yr
Combined fan-motor efficiency:	0.6	
Electricity price [1]:	$0.0870	$/kWhr
Annual electricity cost [2]:	$619	$/yr

Sources:
[1] U.S. Energy Information Administration / Monthly Energy Review May 2016, Table A.4
[2] WestRock Lithia Springs Utility Cost Projection
[3] EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Sect 1, Eqn 1.46

Indirect Annual Costs:	RTO & Ductwork	*Basis / Source / Comment*
Overhead* =	$16,763	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Table 2.10
Property Tax (1% TCI) =	$2,544	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Insurance (1% TCI) =	$2,544	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
General & Administrative (2% TCI) =	$5,088	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Total Indirect Annual Operating Cost	**$26,900**	

*Since labor costs are loaded with employee benefits costs, the nominal 60% multiplier for plantwide overhead was reduced by 33%. Overhead costs besides employee benefits can include any of the following: Hospital and medical services, General engineering, Safety services, Cafeteria and recreation facilities, General plant maintenance and overhead, Control laboratories, Packaging, Plant protection, Janitor and similar services, Employment offices, Distribution of utilities, Shops, Lighting, Interplant communications and transportation, Warehouses, Shipping and receiving facilities

D.7.2-4 Derivation of Environmental Impacts

Environmental Impact Summary
Recuperative Thermal Oxidizer
Printing Plate Processor
WestRock - Lithia Springs, GA

Secondary Emissions Summary

Annual Secondary Emissions of Key Pollutants		
SO_2	**0.012**	**tons/yr**
NO_x	**0.166**	**tons/yr**
Hg	**0.0002**	**kg/yr**
CO_{2eq}	**195**	**tons/yr**
CO	**0.13482**	**tons/yr**

Secondary Emissions Calculations

Electricity Generation

Electricity Demand	7	MWh/yr

Avg Coal Power Plant Emissions[1]		
SO_2	3.79	kg/MWh
NO_x	1.66	kg/MWh
Hg	2.30E-05	kg/MWh
CO_{2eq}	893	kg/MWh

Secondary Emissions, Electricity Generation		
SO_2	27	kg/yr
NO_x	12	kg/yr
Hg	0.000	kg/yr
CO_{2eq}	6,355	kg/yr

Natural Gas Combustion

Natural Gas Usage	3,313	MMBtu/yr
Natural Gas Usage	3.2	MMscf/yr

Criteria Pollutant Emission Factors[2]		
CO_{2eq}	120,000	lb/MMscf
CO	84	lb/MMscf
NO_x	100	lb/MMscf

Secondary Emissions, NG Combustion		
CO_{2eq}	385,205	lb/yr
CO	270	lb/yr
NO_x	321	lb/yr

Notes:

[1] "North American Power Plant Air Emissions", Commission for Environmental Cooperation of North America (CEC), 2004, Table 1.3

[2] EPA AP-42 Ch. 1, Sect 4, Table 1.4-1 (NOx and CO), Table 1.4-2 (CO2eq)

D.7.2. RTO Cost Analysis

D.7.2-1 Summary Table

Cost Summary
Regenerative Thermal Oxidizer (RTO)
Printing Plate Processor
WestRock - Lithia Springs, GA

	Value	Notes / Basis for Estimates
Total Capital Investment		
RTO System	$337,000	Vendor budgetary quote with OAQPS Cost Manual factors for ancillary equip
Ductwork	$18,400	Concept design sizing (Figure 5.5-1) w/ OAQPS ductwork cost factors
Subtotal (TCI)	**$355,400**	
Annual Costs		
Direct Annual Cost		
Labor	$43,400	WestRock Labor Rates w/ OAQPS factors for O&M hours required
Maintenance Supplies	$17,500	OAQPS assumption - 100% of maintenance labor cost
Natural Gas	$2,900	OAQPS Cost Manual Factor
Electricity	$900	OAQPS formula (ΔP, Q, Eff, etc.) w/ WestRock est for elec power rate
Indirect Annual Cost		
Overhead	$24,482	OAQPS Cost Manual Factor
Administrative	$7,108	OAQPS Cost Manual Factor
Property Tax	$3,554	OAQPS Cost Manual Factor
Insurance	$3,554	OAQPS Cost Manual Factor
Capital Recovery (*i* % @ N yr project life)	**$39,000**	
i, interest rate per period	7%	WestRock estimate for weighted average cost of captial
N, project life (no. of years)	15	
A/P	0.1098	
Total Annual Cost	**$142,398**	
Total VOC Removed (tons/yr)	**3.1**	Max VOC emission estimate times 98% DRE for RTO
Cost Effectiveness ($/ton)	**$46,128**	

D.7.2-2 Duct Design and TCI

Lithia Springs, GA - Duct Runs - Printing Plate Processor, RTO Control

Installation Cost = 50% PEC
1993 Material Cost from OAQPS

Duct System Total Capital Investment

Direct Cost - Purchased Equipment Costs (PEC)	***Cost***	***Basis / Source / Comment***
EC, Duct	$4,700	See "Duct Design Summary" below
EC, Blowers	$2,300	Cost Estimate - Grainger Products
Equipment Cost (EC) =	**$7,000**	See "Duct Segments" tab - EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.1.2
Sales Tax (3% EC) =	$210	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Freight and Assembly/Setting (5% EC) =	$350	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Purchased Equipment Costs (PEC) =	**$7,600**	
Direct Cost - Installation	***Cost***	***Basis / Source / Comment***
Installation (50% PEC) =	$3,800	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.4
Direct Installation Cost =	**$3,800**	
Indirect Installation Cost =	**$0**	
Total Duct Work Capital Investment =	**$18,400**	

Duct Design Summary

Duct Segment	Description	Duct Material	Gas Flow (scfm)	Gas Flow (acfm)	Temp (°F)	Nominal Duct Dia (in)	Total Length (ft)	No. of Reducers	No. of Elbows	No. of Branch Tees	No. of Vol Control Dampers	No. of Vol Auto Dampers	Duct $/ft	Reducer $/each	Elbow $/each	Tee $/each	Damper $/each	Auto Damper $/each	Total Cost ($)
1	Duct from Printing Plate Processor to Carbon Beds	Sheet-galv CS	700	800	113	8.0	162	0	6	1	2	1	$4.07	$48.89	$48.89	$48.89	$73.36	$1,077.48	**$2,227**

* Target Velocity calculated to velocity pressure of:	0.40	in. W.C.

Purchase and Installation Cost Summary

1993$ Purchased Equipment Cost	$2,227
Construction Cost Escalation Factor[1], 1993$ to 2016$	2.11
Equipment Cost	$4,697

[1] from Turner Construction Company Cost Index, 2016.

Design Detail

Duct Segment	Description	Flow (scfm)	Air Temp (degF)	Flow (acfm)	Duct (fpm)	Area (ft2)	Duct (in)	Duct (in)	Duct (fpm)	Approx. VP (in w.g.)	Duct Length Rise (ft)	Duct Length Run (ft)	Duct Length Total (ft)	per Foot (in. w.g. / ft)	Pressure (in w.g.)	No. of Elbows	Elbow Loss Factor Coefficient	Drop (in w.g.)	No. of Branch Entries	Branch Loss Factor Coefficient	Pressure (in w.g.)	Pressure (in w.g.)
1	Duct from Printing Plate Processor to Carbon Beds	700	113	760	2,634	0.288	7.3	8.0	2,180	0.27	64	98	162	0.0077	1.2575	6	0.39	0.639	1	0.28	0.076	2.0

D.7.2-3 Derivation of Cost Estimate

RTO Design Parameters and Heat Balance
Regenerative Thermal Oxidizer (RTO)
Printing Plate Processor
WestRock - Lithia Springs, GA

Design Parameters

Parameter	Unit of Measure	Value
volume flow	scfm	700
volume flow	acfm	760
temperature	°F	113
moisture flow	scfm	11
moisture concentration	ppmv	15000
VOC	lbs/hr	1.05
VOC	ppmv	73

Heat Balance

Operating Parameters

Design Flow	700	scfm
Assumed Moisture Content	1.5%	by vol
Moisture Flow	11	scfm
Dry Air Flow	690	dscfm
Moisture Vapor Density	21.4	ft3/lb
Moisture Load	29	lbs/hr
VOC Load	1.1	lbs/hr
VOC Conc	73.0	ppm

Heat Balance and Supplemental Fuel Use Analysis

HHV for VOC	15,000	BTU/lb	
Heat Input from VOC Oxidation (98%)	0.015	mmBTU/hr	
Enthalpy of Comb Chamber Exhaust	28.3	BTU/scf @ 1500°F	
Dry Air Heat Flux from Comb Chamber	1.17	mmBTU/hr	
Moisture Enthalpy (1500 °F, 1 atm))	1,804	BTU/lb	
Moisture Heat Flux from Comb Chamber	0.05	mmBTU/hr	
Total Heat Flux from Oxidizer Comb Chamber	1.2	mmBTU/hr out	
Radiant Heat Loss (2% of total)	0.02	mmBTU/hr loss	
Enthalpy of process vent air	1.10	BTU/scf @ 113°F	
Moisture Enthalpy (113°F, 1 atm))	1,109	BTU/lb	
Heat Input from Process Air	0.08	mmBTU/hr in	
Heat Available for Recovery	1.12	mmBTU/hr	
Heat recovered by Oxidizer	1.1	mmBTU/hr at	**95% thermal ef**
Total Heat Input to Oxidizer Comb Chamber	1.2	BTU/hr total heat input	
Required Burner Heat Input	**0.07**	**mmBTU/hr Burner Input**	

D.7.2-3 Derivation of Cost Estimate

Total Capital Investment (TCI)
Regenerative Thermal Oxidizer (RTO)
Printing Plate Processor
WestRock - Lithia Springs, GA

Control System TCI - Regenerative Thermal Oxidizer

Total Capital Investment		
Direct Cost - Purchased Equipment Costs (PEC)	***Cost***	***Basis / Source / Comment***
Equipment Cost (EC) =	$208,980	Vendor Estimate - Cycle-Therm, 2008, ratioed with 6/10 rule and adjusted for inflation. See (a) below.
Sales Tax (3% EC) =	$6,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Freight and Assembly/Setting (5% EC) =	$10,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Purchased Equipment Costs (PEC) =	**$224,980**	

Direct Cost - Installation	***Cost***	***Basis / Source / Comment***
Foundation & Supports (8% PEC) =	$18,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Handling and Erection (14% PEC) =	$31,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Electrical (4% PEC) =	$9,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Piping (2% PEC) =	$4,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Insulation for Ductwork (1% PEC) =	$2,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Painting (1% PEC) =	$2,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 3.2, Chapter 2, Table 2.8
Direct Installation Cost =	**$66,000**	

Total Direct Costs (DC) =	**$291,000**	

Indirect Costs	***Cost***	***Basis / Source / Comment***
Engineering (10% PEC) =	$22,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Construction and Field Expenses (5% PEC) =	$11,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contractor Fees (10% PEC) =	$22,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Start-up (2% PEC) =	$4,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Performance Test (1% PEC) =	$2,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Contingencies (3% PEC) =	$7,000	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Table 2.8
Total Indirect Costs (IC) =	**$46,000**	

Total RCO Capital Investment =	**$337,000**	

(a) RTO Equipment Cost Estimate Calculations:

Vendor Estimate (Cycle-Therm), 1500 scfm RTO Unit	$237,980
Adjusted cost for 1000 scfm unit, 0.6 power rule	$186,589
PEC, Adjusted from 2008$ to 2016$	$208,980

D.7.2-3 Derivation of Cost Estimate

Summary of Annual O&M Costs
Regenerative Thermal Oxidizer (RTO)
Printing Plate Processor
WestRock - Lithia Springs, GA

Direct Annual Costs:	*Cost*	*Basis / Source / Comment*
Operating Labor:		
Operator =	$22,500	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Supervisor (15% of operator labor) =	$3,400	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
Annual Operating Labor Cost	**$25,900**	See (a) below
Maintenance Costs:		
Labor (0.5 hrs per shift) =	$17,500	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (0.5 hours per shift)
Material (100% of maintenance labor) =	$17,500	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2.5.1, Table 2.10 (100% of maintenance labor)
Annual Maintenance Cost	**$35,000**	See (a) below
Natural Gas Consumption Cost:		
Annual Natural Gas Cost	**$2,900**	See (b) below
System Fan Electrical Cost:		
Annual Fan Electrical Cost	**$900**	See (c) below

Total Direct Annual Operating Cost	**$61,800**

(a) Wage Data from WestRock:

Parameter	Value	Units
Operator Wage, $/hr	$41.07	$/hr
Maintenance Laborer Wage, $/hr	$32.01	$/hr

(b) Natural Gas Calculations:

Parameter	Value	Units
Natural Gas Usage Rate	0.1	MMBtu/hr
Operating Schedule	6,000	hrs/yr
Annual NG Usage	411	MMBtu
NG Heat Content [1]	1,032	Btu/scf
Annual Natural Gas Usage	398,444	scf/yr
Natural Gas Cost ($/Mscf) [2]	$7.35	$/Mscf
Annual Natural Gas Cost	$2,929.73	$/yr

(c) System Fan Calculations:

Parameter	Value	Units
Vent flow (including dilution air)	760	acfm
ΔP across RTO:	10	in w.g.
ΔP across ducting:	2.0	in w.g.
Operating scenario:	6000	hr/yr
Combined fan-motor efficiency:	0.6	
Electricity price [1]:	$0.0870	$/kWhr
Annual electricity cost [2]:	$930	$/yr

Sources:
[1] U.S. Energy Information Administration / Monthly Energy Review May 2016, Table A.4
[2] WestRock Lithia Springs Utility Cost Projection
[3] EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Sect 1, Eqn 1.46

Indirect Annual Costs:	**RTO & Ductwork**	*Basis / Source / Comment*
Overhead* =	$24,482	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Table 2.10
Property Tax (1% TCI) =	$3,554	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Insurance (1% TCI) =	$3,554	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
General & Administrative (2% TCI) =	$7,108	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2, Part 2.5.2.2
Total Indirect Annual Operating Cost	**$38,700**	

*Since labor costs are loaded with employee benefits costs, the nominal 60% multiplier for plantwide overhead was reduced by 33%. Overhead costs besides employee benefits can include any of the following: Hospital and medical services, General engineering, Safety services, Cafeteria and recreation facilities, General plant maintenance and overhead, Control laboratories, Packaging, Plant protection, Janitor and similar services, Employment offices, Distribution of utilities, Shops, Lighting, Interplant communications and transportation, Warehouses, Shipping and receiving facilities

D.7.2-4 Derivation of Environmental Impacts

Environmental Impact Summary
Regenerative Thermal Oxidizer (RTO)
Printing Plate Processor
WestRock - Lithia Springs, GA

Secondary Emissions Summary

Annual Secondary Emissions of Key Pollutants		
SO_2	**0.018**	**tons/yr**
NO_x	**0.028**	**tons/yr**
Hg	**0.0002**	**kg/yr**
CO_{2eq}	**28**	**tons/yr**
CO	**0.0167**	**tons/yr**

Secondary Emissions Calculations

Electricity Generation

Electricity Demand	11	MWh/yr

Avg Coal Power Plant Emissions[1]		
SO_2	3.79	kg/MWh
NO_x	1.66	kg/MWh
Hg	2.30E-05	kg/MWh
CO_{2eq}	893	kg/MWh

Secondary Emissions, Electricity Generation		
SO_2	41	kg/yr
NO_x	18	kg/yr
Hg	0.000	kg/yr
CO_{2eq}	9,543	kg/yr

Natural Gas Combustion

Natural Gas Usage	411	MMBtu/yr
Natural Gas Usage	0.4	MMscf/yr

Criteria Pollutant Emission Factors[2]		
CO_{2eq}	120,000	lb/MMscf
CO	84	lb/MMscf
NO_x	100	lb/MMscf

Secondary Emissions, NG Combustion		
CO_{2eq}	47,813	lb/yr
CO	33	lb/yr
NO_x	40	lb/yr

Notes:
[1] "North American Power Plant Air Emissions", Commission for Environmental Cooperation of North America (CEC), 2004, Table 1.3
[2] EPA AP-42 Ch. 1, Sect 4, Table 1.4-1 (NOx and CO), Table 1.4-2 (CO2eq)

D.7.3. Carbon Adsorption Cost Analysis

D.7.3-1 Summary Table

Carbon Adsorbtion
Printing Plate Processor
WestRock - Lithia Springs, GA

	Value	Notes / Basis for Estimates
Total Capital Investment		
Carbon/Condenser/Refrigeration	$109,300	OAQPS Cost Manual factors for ancillary equip
Ductwork	$18,400	Concept design sizing (Figure 5.5-1) w/ OAQPS ductwork cost factors
Subtotal (TCI)	**$127,700**	
Annual Costs		
Direct Annual Cost		
Carbon Replacement	$18,900	
Labor	$5,800	WestRock Labor Rats w/ OAQPS factors forO&M hours required
Maintenance Supplies	$1,700	OAQPS assumption - 100% of maintenance labor cost
Electricity	$1,400	OAQPS formula (ΔP, Q, Eff, etc.) w/ WestRock est for elec power rate
Indirect Annual Cost		
Overhead	$3,015	OAQPS Cost Manual Factor
Administrative	$2,556	OAQPS Cost Manual Factor
Property Tax	$1,273	OAQPS Cost Manual Factor
Insurance	$1,273	OAQPS Cost Manual Factor
Capital Recovery (*i* % @ N yr project life)	**$14,000**	
i, interest rate per period	7%	WestRock estimate for weighted average cost of captial
N, project life (no. of years)	15	
A/P	0.1098	
Total Annual Cost	**$49,917**	
Total VOC Removed (tons/yr)	**2.8**	Max VOC emission estimate time 90% DRE
Cost Effectiveness ($/ton)	**$17,607**	

D.7.3-2 Duct Design

Duct Design
Carbon Adsorbtion
Printing Plate Processor
WestRock - Lithia Springs, GA

Duct System Total Capital Investment

Direct Cost - Purchased Equipment Costs (PEC)	***Cost***	***Basis / Source / Comment***
EC, Duct	$4,700	See "Duct Design Summary" below
EC, Blowers	$2,300	Cost Estimate - Grainger Products
Equipment Cost (EC) =	**$7,000**	See "Duct Segments" tab - EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.1.2
Sales Tax (3% EC) =	$210	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Freight and Assembly/Setting (5% EC) =	$350	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Equation 1.44
Purchased Equipment Costs (PEC) =	**$7,600**	
Direct Cost - Installation	***Cost***	***Basis / Source / Comment***
Installation (50% PEC) =	$3,800	EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Section 2, Chapter 1, Part 1.4.4
Direct Installation Cost =	**$3,800**	
Indirect Installation Cost =	**$0**	
Total Duct Work Capital Investment =	**$18,400**	

Duct Design Summary

Duct Segment	**Description**	**Duct Material**	**Gas Flow (scfm)**	**Gas Flow (acfm)**	**Temp (°F)**	**Nominal Duct Dia (in)**	**Total Length (ft)**	**No. of Reducers**	**No. of Elbows**	**No. of Branch Tees**	**No. of Vol Control Dampers**	**No. of Vol Auto Dampers**	**Duct $/ft**	**Reducer $/each**	**Elbow $/each**	**Tee $/each**	**Damper $/each**	**Auto Damper $/each**	**Total Cost ($)**
1	Duct from Printing Plate Processor to Carbon Beds	Sheet-galv CS	700	800	113	8.0	162	0	6	1	2	1	$4.07	$48.89	$48.89	$48.89	$73.36	$1,077.48	**$2,227**

* Target Velocity calculated to velocity pressure of:	0.40	in. W.C.

Purchase and Installation Cost Summary

1993$ Purchased Equipment Cost	$2,227
Construction Cost Escalation Factor[1], 1993$ to 2016$	2.11
Equipment Cost	$4,697

[1] from Turner Construction Company Cost Index, 2016.

Design Detail

Duct Segment	Description	Flow (scfm)	Air Temp (degF)	Flow (acfm)	Design Duct Velocity (fpm)	Required Area (ft2)	Calculated Duct Diameter (in)	Nominal Duct Diameter (in)	Calculated Duct Velocity (fpm)	Approx. VP (in w.g.)	Duct Length: Rise (ft)	Duct Length: Run (ft)	Duct Length: Total (ft)	Friction Loss per Foot (in. w.g. / ft)	Straight Run Pressure Drop (in w.g.)	No. of Elbows	Elbow Loss Factor Coefficient	Elbow Pressure Drop (in w.g.)	No. of Branch Entries	Branch Loss Factor Coefficient	Entry Pressure Drop (in w.g.)	Total Pressure Drop (in w.g.)
1	Duct from Printing Plate Processor to Carbon Beds	700	113	760	2,634	0.288	7.3	8.0	2,180	0.27	64	98	162	0.0077	1.2575	6	0.39	0.639	1	0.28	0.076	2.0

D.7.3-3 Condenser Design

Condenser Design Parameters and Specifications
Carbon Adsorbtion
Printing Plate Processor
WestRock - Lithia Springs, GA

Parameter	Value	Unit	Description	Source / Comment
Waste gas Molar Flow Rates				
Q_{in}	700	scfm	combined exhaust flow from Washout and Dryer Cycle	
$y_{VOC,in}$	7.30E-05	vol frac	VOC vapor fraction	
$M_{voc,in}$	7.82E-03	lb-mol/hr	$(Q_{in}/392)(y_{VOC,in})(60\ min/hr)$	
eff	0%			
$M_{voc,out}$	7.82E-03	lb-mol/hr		
$M_{voc,con}$	0.00E+00	lb-mol/hr		
Enthalpy Change, Condensed Vapors				
$M_{voc,con}$	0.00	lb-mol/hr		
H_{voc}	N/A	Btu/lb-mol		
T_{in}	113	°F		
T_{in}	572.67	°R		
T_{con}	77	°F		
T_{con}	536.67	°R		
T_{mean}	95	°F		
T_{mean}	554.67	°R		
T_c	N/A	°R	critical temperature	
T_1	N/A	°F		
T_1	N/A	°R		
$C_{p,VOC}$	N/A	Btu/lb-molF		
$H_{voc,mean}$	0	Btu/lb-mol (at T_{mean} for toluene)	$H_{VOC} \times [(1-(T_{mean}/T_c))/(1-(T_1/T_c))]^{0.38}$	
$\mathbf{H_{con}}$	**0**	**Btu/hr**	$M_{voc,con}\ [H_{voc,mean} + C_{p,voc}(T_{in} - T_{con})]$	
Enthalpy Change, Uncondensed Vapors				
$M_{voc,out}$	7.82E-03	lb-mol/hr		
$C_{p,VOC}$	53.31	Btu/lb-molF	for benzyl alcohol	
T_{in}	113	°F		
T_{con}	77	°F		
$\mathbf{H_{uncon}}$	**15**	**Btu/hr**	$M_{voc,out}\ C_{p,VOC}\ (T_{in} - T_{con})$	
Enthalpy Change, Noncondensible Vapors (air)				
Q_{in}	700.00	ft3/min		
$M_{voc,in}$	7.82E-03	lb-mol/hr		
C_p	6.95	Btu/lb-mol °F	for air	
T_{in}	113	°F		
T_{con}	77	°F		
$\mathbf{H_{noncon}}$	**26,805**	**Btu/hr**	$[(Q_{in}/392 * 60) - M_{voc,in}]\ C_p(T_{in} - T_{con})$	
Energy Balance				
H_{load} =	26,820	Btu/hr	$H_{load} = H_{con} + H_{uncon} + H_{noncon}$	
Refrigeration Capacity				
R =	**2.24**	**tons**	$R = H_{load}/12{,}000$	
Required Condenser Surface Area				
H_{load} =	26,820	Btu/hr	system total	
U =	40	Btu/hr-ft2-°F	average of given range, 20-60	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Part 2.2.3
$T_{cool,in}$ =	62	°F	15°F less than T_{con}	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Equation 2.19
$T_{cool,out}$ =	87	°F	25°F higher than $T_{cool,in}$	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Equation 2.20
T_{in} =	113	°F		
T_{con} =	77	°F		
T_{lm} =	20.0	°F	$[(T_{in} - T_{cool,out}) - (T_{con} - T_{cool,in})] / \{ln[(T_{in} - T_{cool,out})/(T_{con} - T_{cool,in})]\}$	
$\mathbf{A_{con}}$ =	**33.53**	$\mathbf{ft^2}$	$A_{con} = H_{load} / (U\ T_{lm})$	

D.7.3-4 Derivation of Cost Estimate

Capital Cost Estimate - Carbon Capture and Heat Exchanger Control System
Carbon Adsorbtion
Printing Plate Processor
WestRock - Lithia Springs, GA

Item	Cost	Description	Source
Purchased Equipment Costs			
EC, carbon	$18,800		
EC, refrigeration	$16,374	EC_r = exp (9.83 - 0.014T_{con} + 0.34 ln R)	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Equation 2.25, adjusted with 1.97 construction cost escalation factor (1995$ to 2016$)
EC, condensers	$9,643	EC_{con} = 34A_{con} + 3,755	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Equation 2.30, adjusted with 1.97 construction cost escalation factor (1995$ to 2016$)
EC, condensate tank	$4,129	EC_{tank} = 2.72V_{tank} + 1,960; 50 gal tank	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Equation 2.31, adjusted with 1.97 construction cost escalation factor (1995$ to 2016$)
EC, piping/aux	$7,537	EC_{aux} = 0.25 (EC_r + EC_{con} + EC_{tank})	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Equation 2.32
EC, total	**$56,483**	Σ	
Instrumentation	$5,648	0.10 x EC_{Total}	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Equation 2.33
Sales Tax	$1,694	0.03 x EC_{Total}	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Equation 2.33
Freight	$2,824	0.05 x EC_{Total}	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Equation 2.33
Purchased Equipment Costs, PEC	**$66,650**		
Direct Installation Costs			
Foundation & Supports	$9,331	0.14 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Handling & Erection	$5,332	0.08 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Electrical	$5,332	0.08 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Piping	$1,333	0.02 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Insulation	$6,665	0.10 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Painting	$667	0.01 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Direction Installation Costs	**$28,660**		
Indirect Costs (Installation)			
Engineering	$6,665	0.10 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Construction & Field Expenses	$3,333	0.05 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Contractor Fees	$6,665	0.10 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Start-up	$1,333	0.02 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Performance Test	$667	0.01 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Contingencies	$2,000	0.03 x PEC	EPA Air Pollution Control Cost Manual, Section 3, Chapter 2, Table 2.3
Indirect Costs	**$13,997**		
Total Capital Investment			
Total Capital Investment	**$109,300**		

D.7.3-4 Derivation of Cost Estimate

Summary of Annual O&M Costs
Carbon Adsorbtion
Printing Plate Processor
WestRock - Lithia Springs, GA

Direct Annual Costs:	Cost	*Basis / Source / Comment*
Carbon Replacement	18	Canister removals per year
	$1,050	Cost per removal
	$18,900	Cost per removal times number of removals per year
Operating Labor:		
Operator =	$3,600	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (1 hour per week, 2 hours per cat. change)
Supervisor (15% of operator labor) =	$500	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
Annual Operating Labor Cost	**$4,100**	See (a) below
Maintenance Costs:		
Maintenance Labor =	$1,700	EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4 (1 hour per week)
Material (100% of maintenance labor) =	$1,700	EPA Air Pollution Control Cost Manual, Section 3.2, Chapter 2.5.1, Table 2.10 (100% of maintenance labor)
Annual Maintenance Cost	**$9,000**	See (a) below
System Fan Electrical Cost:		
Annual Fan Electrical Cost	$1,400	See (b) below
Annual Refrigeration Electricity Cost	$2,000	See (c) below
Annual Electricity Cost	**$3,400**	
Total Direct Annual Operating Cost	**$35,400**	

(a) Wage Data from WestRock:

Parameter	Value	Units
Operator Wage, $/hr	$41.07	$/hr
Maintenance Laborer Wage, $/hr	$32.01	$/hr

(b) System Fan Calculations:

Parameter	Value	Units
Vent flow (including dilution air)	760	acfm
ΔP across carbon beds:	16	in w.g.
ΔP across ducting:	2.0	in w.g.
Operating scenario:	6000	hr/yr
Combined fan-motor efficiency:	0.6	
Electricity price [1]:	$0.0870	$/kWhr
Annual electricity cost [2]:	$1,396	$/yr

(c) Refrigeration Electricity Consumption Calculations:

Parameter	Value	Units
Refrigeration Capacity:	2.2	tons
Electricity Requirement[1]:	1.3	kW/ton
Operating scenario:	6000	hr/yr
Combined fan-motor efficiency:	0.75	
Electricity price [2]:	$0.0870	$/kWhr
Annual electricity cost [3]:	$2,022	$/yr

Sources:
[1] EPA Air Pollution Control Cost Manual, Section 3.1, Chapter 2, Table 2.5
[1] WestRock Lithia Springs Utility Cost Projection
[2] EPA Air Pollution Control Cost Manual (Report 452/B-02-001), Sect 1, Eqn 1.46

Indirect Annual Costs:	Carbon/Condenser	*Basis / Source / Comment*
Overhead* =	$3,015	EPA Air Pollution Control Cost Manual, Section 3.1, Chapter 2, Table 2.10
Property Tax (1% TCI) =	$1,093	EPA Air Pollution Control Cost Manual, Section 3.1, Chapter 2, Part 2.5.2.2
Insurance (1% TCI) =	$1,093	EPA Air Pollution Control Cost Manual, Section 3.1, Chapter 2, Part 2.5.2.2
General & Administrative (2% TCI) =	$2,186	EPA Air Pollution Control Cost Manual, Section 3.1, Chapter 2, Part 2.5.2.2
Indirect Annual Operating Cost - RTO	**$7,387**	
	Ductwork	***Basis / Source / Comment***
Property Tax (1% TCI) =	$180	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
Insurance (1% TCI) =	$180	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
General & Administrative (2% TCI) =	$370	EPA Air Pollution Control Cost Manual, Section 2, Chapter 1, Table 1.13
Indirect Annual Operating Cost - Duct Work	**$730**	
Total Indirect Annual Operating Cost	**$8,100**	

*Since labor costs are loaded with employee benefits costs, the nominal 60% multiplier for plantwide overhead was reduced by 33%. Overhead costs besides employee benefits can include any of the following: Hospital and medical services, General engineering, Safety services, Cafeteria and recreation facilities, General plant maintenance and overhead, Control laboratories, Packaging, Plant protection, Janitor and similar services, Employment offices, Distribution of utilities, Shops, Lighting, Interplant communications and transportation, Warehouses, Shipping and receiving facilities

D.7.3-5 Derivation of Environmental Impacts

Environmental Impact Summary
Carbon Adsorbtion
Printing Plate Processor
WestRock - Lithia Springs, GA

Secondary Emissions Summary

Annual Secondary Emissions of Key Pollutants		
SO_2	**0.067**	**tons/yr**
NO_x	**0.029**	**tons/yr**
Hg	**0.001**	**kg/yr**
CO_{2eq}	**15.8**	**tons/yr**

Secondary Emissions Calculations

Electricity Generation

Electricity Demand	39	MWh/yr

Avg Coal Power Plant Emissions[1]		
SO_2	3.79	kg/MWh
NO_x	1.66	kg/MWh
Hg	2.30E-05	kg/MWh
CO_{2eq}	893	kg/MWh

Secondary Emissions, Electricity Generation		
SO_2	148	kg/yr
NO_x	65	kg/yr
Hg	0.001	kg/yr
CO_{2eq}	34,899	kg/yr

Notes:
[1] "North American Power Plant Air Emissions", Commission for Environmental Cooperation of North America (CEC), 2004, Table 1.3

D.8. Good Operating Practices

D.8.1. RBLC Examples

Good Work Pratice or Low VOC Ink Control Facilities						
RBLC ID	Facility Name	Process Name	Control Method Description	Emission Limit 1	Emission Limit 2	Standard Emmision Limit
CA-1043	Coyle Reproductions Inc.	Graphic Arts Printing and Coating Operation: Screen Printing and Drying	Ultra low VOC curable ink with VOC< 0.49 Lb/Gal. No thinner is used and the low vapor pressure (0.04mmHg) cleanup materials have a VOC content of 2 Lb/Gal	47.62 Lb/hr Hourly Maximum	160.43 T/yr Annual Maximum	NA
CA-1064	Melin Enterprises, Direct Color	Graphic Arts Printing and Coating Operation: Lithographic Offset Printing-Non-Heatset	VOC content of Fountain Solution is not to exceed 0.2 Lb/Gal VOC. Current fountain solution contains 0.0725 Lb/Gal VOC.	0.49 Lb/Gal	NA	NA
CA-1063	Los Angeles Times Communications, Llc	Graphic Arts Printing and Coating Operation: Lithographic Offset Printing-Non-Heatset	VOC content of fountain solution is not to exceed 0.17 Lb/Gal VOC. Ink VOC = <300 g/L. Current fountain solution containing 0.003 Lb/Gal VOC. Current blanket and roller wash contains from 78 to 136 g/L VOC.	2730 Lb/Mo	NA	NA
CA-1039	International Paper Co.	Graphic Arts Printing and Coating Operation: Flexographic Printing Line	This is an example of flexographic facility using water based inks. VOC content is not to exceed 1.5 Lb/Gal	309 Lb/Day	NA	NA
LA-0185	West Monroe Packaging Plant	Rotogravure Press (No. 11, 103A&Amp;B)	Use of water based inks and varnishes. Former rates were 20.82 Lb/hr VOC and the emission limit was 33.57 Lb/hr VOC	136 Lb/Day	NA	NA
LA-0186	West Monroe Packaging Plant	Rotogravure Press (No. 12, 104A&Amp;B)	Use of water based inks and varnishes. Under the emission limit of 47.62 Lb/hr VOC	33.569 Lb/hr Hourly Maximum	113.1010 T/yr Annual Maximum	0.5 Lb VOC/Lb Solids Annual Average
IA-0097	American Packaging	Laminator #4	Water based materials with <5% VOC	119 Tons 12 Month Total	NA	NA
OK-0054	Quad Graphics Okc Facility	Rotogravure Drum Proof Press	BACT was determined to be limits on inks and solvents. Emission limit of 12.07 T/yr VOC	12.07 T/yr	NA	NA
OK-0097	Quad Graphics Okc Facility	Cylinder Washing System	Cleaning solvent emission and usage limitations in combination with compliance MACT standards. Emission limit of 9.4 T/yr VOC	9.4 T/yr	NA	NA
OK-0108	Nomaco Oklahoma City Facility	Printing	Limited ink usage	NA	NA	NA

D.9. Vendor Quote

ANGUIL

June 22, 2016

Alex Tichy
Ramboll Environ
1807 Park 270 Drive
Suite 320
St. Louis, MO 63146

T: 314.590.2959

SUBJECT: BUDGETARY PROPOSAL AES-167856 FOR VOC CONTROL EQUIPMENT

Dear Mr. Tichy:

We welcome the opportunity to provide you with a technology comparison for VOC control technologies including operating costs and budgetary equipment prices. Your project consists of treating emissions from a new press with the following data:

Volume:	50,000 scfm
Temperature:	223 F
VOC load:	7.8 lb/hr

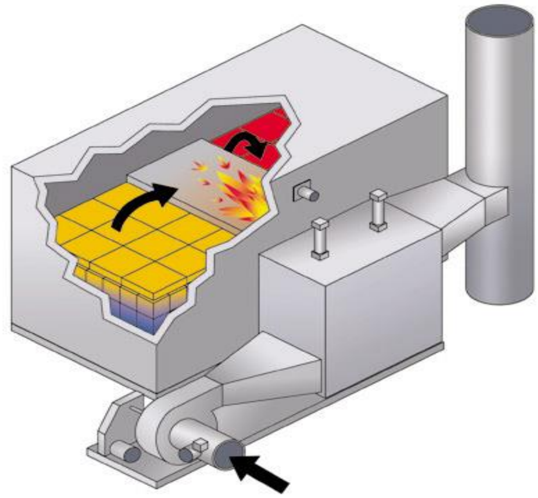
Based on your inquiry, we have looked at multiple technologies. These technology choices reviewed here are:

- Regenerative Thermal Oxidizer (RTO)
- Regenerative Catalytic Oxidizer (RCO)

Description – Regenerative Thermal Oxidizer (RTO)

An RTO consists of reinforced, insulated chambers filled with high temperature ceramic energy recovery media. A burner is located at the top of the RTO, between the two energy recovery chambers. The burner maintains the oxidizer above the oxidation temperature. Located beside the energy recovery chambers are diverter valves and air duct plenum passages, which allow the process airflow to be diverted into and out of the oxidizer in either a clockwise or counter-clockwise mode. The directional mode is controlled by a PLC, which changes the direction of airflow at regular intervals to optimize system efficiency. The VOC destruction efficiency is 98% with higher values expected.

In operation, solvent laden air (SLA) enters the oxidizer via an energy recovery chamber where the high temperature ceramic heat transfer media preheats the SLA prior to introduction into the oxidation chamber. As the SLA passes up through the bed, its temperature rapidly increases. After the chemical oxidation purification reaction occurs, the hot, clean, outgoing gas heats the exit energy recovery bed. In order to maintain optimum heat recovery efficiency of the bed, the SLA flow direction is switched at regular intervals by the automatic diverter valves on demand from the PLC control system. This periodic flow direction shift provides a uniform temperature distribution throughout the entire oxidizer.

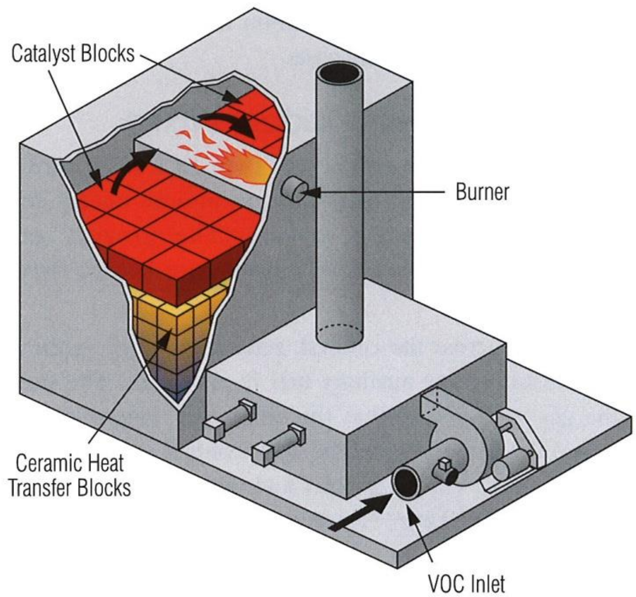


Description – Regenerative Catalytic Oxidizer (RCO)

VOC and HAP laden process gas enters the oxidizer through an inlet manifold to flow control, poppet valves then direct this gas into energy recovery chambers where it is preheated. The process gas and contaminants are progressively heated in the ceramic media beds as they move toward the catalyst in the combustion chamber. The RCO design is very similar to the RTO with the exception that catalyst is located above the ceramic media beds. Because of the presence of catalyst, the VOC destruction efficiency of 95-97% is slightly lower than the RTO described earlier.

In operation, the solvent laden air (SLA) enters the oxidizer into one of the energy recovery chambers where the ceramic heat transfer media preheats the SLA prior to introduction into the catalyst in the combustion chamber. As the SLA passes up through the beds its temperature increases. After the chemical oxidation purification reaction occurs through the catalyst, the hot, clean, outgoing gas heats the outlet energy recovery beds. In order to maintain optimum heat recovery efficiency of the beds, the SLA flow direction is switched at regular intervals by the automatic diverter valves on demand from the PLC control system. This periodic shift in flow direction provides a uniform temperature distribution throughout the entire oxidizer.

With sufficient concentration of hydrocarbons in the process air stream, the heat energy content of the hydrocarbons will self-sustain the oxidation process, and no additional heat energy will be required. The exhaust air from the RCO will then be released to atmosphere.



ANGUIL

VOC Control Technology Comparison
Capital and Operating Cost Summary

TECHNOLOGY COMPARISON							
Option	**Equipment Type**	**Destruction Efficiency**	**Total Airflow (SCFM)**	**VOC Loading* (lb/hr)**	**Equipment Cost**	**Electricity Usage kWh**	**Gas Usage MMBTU/hr**
1	Model 500 RTO	98%	50,000	7.8	$ 775,000	189	6.0
2	Model 500 RTO with 97% TER	98%	50,000	7.8	$ 850,000	217	3.9
3	Model 500 RCO	98%	50,000	7.8	$ 1,050,000	208	2.7

*Refers to VOC loading at 15,000 BTU/lb
**Operating Cost Assumptions:
Process Temperature: Assumed 223F

Some advantages of working with Anguil:

- Over 30 years of experience in various industries addressing VOC, HAP, NOx and odor control applications
- A full-capability, engineering and manufacturing service firm with over 1,700 satisfied customers
- Turnkey capability for single source responsibility, assuring professional installation, minimizing downtime, and assuring successful process integration and start-up
- Regulatory compliance guaranteed
- Cost-effective, energy-efficient equipment
- Custom or standard
- Service capabilities, regardless of original equipment manufacturer

Our goal is to provide pollution control and energy solutions today to help our customers remain profitable tomorrow.

Thank you for the opportunity to assist with your project. If you have any questions, please contact me at 630.818.5958. Let us know how we can be of service.

Kind Regards,

Jim Stone
Senior Sales Manager

Calgon Carbon Corporation

The way the service program works is there is a placement fee which will take place each time a new unit will be brought to your site and there is a monthly fee that will occur every 30 days the unit is on site. So when you need an exchange we will bring in a new unit and pick up the spent unit. Essentially just a swap out program. In order for us to take the spent carbon back there is a Carbon acceptance testing fee, just to make sure we are within our emission limits. If the carbon is non-hazardous the fee is $400 if it is RCRA hazardous the fee is $1,000 and a $0.25 / lb reactivation fee. After testing is completed (normally takes 3-4 weeks) You will be assigned a carbon acceptance number which is good for 5 years. We can take back all the spent carbon for as long as the same process is active. You would only be responsible for the freight.

So for a budgetary number:

Placement fee per unit(each time a new unit is brought to site): $4,700
Monthly fee per unit (takes place every 30 days): $1,050

This does not include any freight

If you have questions please feel free to give me a call.

Thank you,

Brandon Hamilton
Calgon Carbon Corporation
Industrial and Food Business Unit
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PRODUCT BULLETIN

Calgon Carbon

VAPOR-PAC®

Carbon Adsorption Service

Description

Calgon Carbon’s VAPOR-PAC carbon adsorption service meets industrial and remediation needs for cost-effective removal of volatile organic compounds (VOCs) at air emission sources.

Calgon Carbon’s VAPOR-PAC series adsorbers are individual, compact and transportable vapor phase adsorbers containing 1,800 lbs of granular activated carbon (GAC) to treat air flows up to 1,000 cfm. The VAPOR-PAC adsorbers are designed for use in Calgon Carbon’s convenient carbon adsorption service. The adsorber is used as the shipping container to be returned to Calgon Carbon for reactivation of the spent GAC and can be replaced with another VAPOR-PAC adsorber containing fresh GAC for continuing operation. If the VAPOR-PAC is owned by the site, it can either be sent to Calgon Carbon for carbon exchange or have the carbon replaced onsite. Calgon Carbon offers many types of GAC which can be selected for the specific treatment

application.

The VAPOR-PAC adsorbers are available in two designs to accommodate most process conditions. The Plastic VAPOR-PAC canister is a polyethylene canister with PVC fittings for enhanced corrosion resistance. All parts exposed to air flow in the Stainless Steel VAPOR-PAC adsorber vessel are stainless steel and the unit is capable of treating applications up to 15 psig or under vacuum conditions.

The VAPOR-PAC adsorption service is ideal for short term projects and for low volume air flows that contain low to moderate VOC concentrations. The VAPOR-PAC service is also used in applications that rely on Calgon Carbon’s ongoing management of the spent carbon and resupply of fresh GAC. Common applications of the VAPOR-PAC service might include treatment of process vessel, tank or enclosure vents, soil remediation or venting, air stripper off-gases, and industrial odor control.

Under the carbon adsorption service, the user will provide for any fans or ductwork to deliver the air emission source to the VAPOR-PAC unit. Calgon Carbon will provide the VAPOR-PAC adsorber with initial fill of GAC. The user will install the VAPOR-PAC unit. When the GAC is fully utilized, disconnect the VAPOR-PAC unit and return it to Calgon Carbon for management of the spent carbon; install a new VAPOR-PAC unit if operation is to continue. This service will simplify the user’s operation by having Calgon Carbon manage the carbon supply and removal of spent carbon in the VAPOR-PAC units and eliminate the need for the site to handle the GAC media, often minimizing the site’s operating costs associated with treatment of the air emission.

VAPOR-PAC Stainless *VAPOR-PAC Plastic*

Features / Benefits

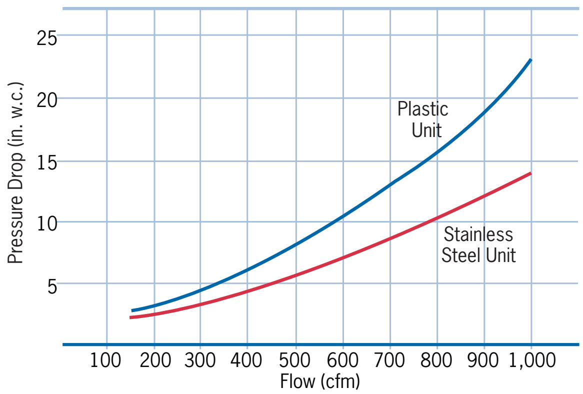
- The VAPOR-PAC adsorbers are designed for ease of transportation, installation, and operation.
- The VAPOR-PAC adsorbers are available in Plastic or Stainless Steel models to accommodate a range of applications.
- VAPOR-PAC units can be manifolded in multiple units for higher air flows.
- Management of carbon replacement using VAPOR-PAC unit exchange eliminates the need for on-site carbon handling
- Calgon Carbon manages the spent carbon and assures ongoing supply of fresh carbon.

VAPOR-PAC	(Plastic) Specifications
Vessel Dimensions	$44\frac{1}{4}$” x $44\frac{1}{4}$” x $89\frac{3}{8}$”
Inlet & Discharge Connections	6” PS 15-69 duct flanges
Carbon Volume	60 cu. ft. (1,800 lbs.)
System Shipping Weight	Empty - 2,400 lbs., Drained - 4,200 lbs.
Temperature Rating	150°F (max)
Static Pressure Rating above Carbon Level	20” w.c. (max)
Vacuum Pressure Rating above Carbon Level	2” w.c. (max)

VAPOR-PAC	(Stainless Steel) Specifications
Vessel Diameter	5’
Vessel Height	7’ 1”
Inlet & Discharge Connections	8’ PS 15-69 duct flanges
Carbon Volume	60 cu. ft. approx. (1,800 lbs.)
System Shipping Weight	Empty - 2,800 lbs., Drained - 4,600 lbs.

Pressure Drop Curve

(upflow with 1,800 lbs., 4x10 mesh carbon)



Materials of Construction	(Plastic)
Vessel	Polyethylene
Frame	Expoxy coated carbon steel
Inlet Flanges, Elbow, Septum	PVC
Discharge Flange	Polyethylene
Fasteners & Bottom Valve Support Plate	Steel, plated
Sample Fittings & Sample Canister	PVC

Materials of Construction	(Stainless Steel)
Vessel	316L stainless steel
Skid and Support Frame	304 stainless steel
Inlet Flanges, Elbow, Septum	316L stainless steel
Discharge Flange	316L stainless steel
Fasteners & Bottom Valve	300 series stainless steel
Sample Fittings & Sample Canister	PVC

Installation

VAPOR-PAC adsorbers are shipped ready for installation with the dry activated carbon fill installed in the unit. The canisters are self supporting and should be set on a level accessible area as near as possible to the emission source. Standard installation does not utilize any anchoring devices. Installation is simple, requiring a flexible hose, duct or pipe to connect the vent or emission source to the flanged bottom inlet of the canister.

The VAPOR-PAC absorber's treated air discharge is a flanged connection on the top of the vessel and can be left open or equipped with a flexible hose, duct or pipe to direct the treated air to a desired discharge point. If the canister is located outside and to be vented directly, then a U-shaped outlet pipe or rain hat (such as a pipe tee) is recommended to be installed to prevent precipitation from entering the unit.

The recommended air flow for the VAPOR-PAC adsorbers are listed in the pressure drop curve figure. If higher flows are anticipated, then either a larger canister should be utilized or two or more VAPOR-PAC adsorbers can be placed in parallel operation.

The recommended maximum static pressure and vacuum capabilities are also listed. These ratings should not be exceeded, as the canister could be irreparably damaged.

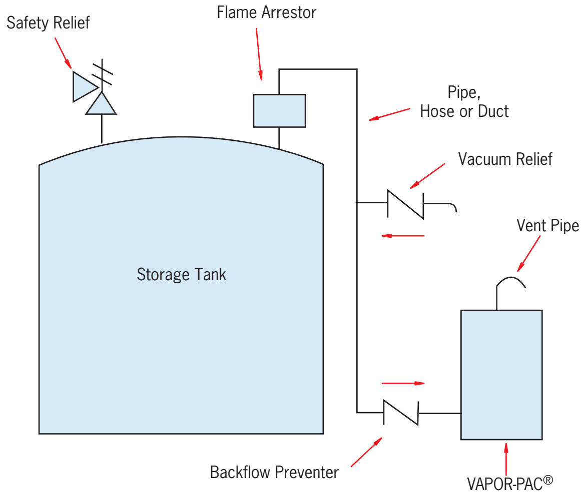
VAPOR-PAC adsorbers can be used to treat vents directly from storage tank or other process vessels. The motive force for the air or vapor can be produced by either a blower or by using the positive pressure inside the tank or process vessel. In many cases, the pressure or surge of pressure within the tank or vessel is sufficient to overcome the pressure drop across the canister, eliminating the need for a blower. Please consult the pressure drop data in this bulletin for more information.

When VAPOR-PAC adsorbers are used to control vapors from organic solvent storage tanks, refer to the typical installation drawing in the bulletin and the following recommended precautions:

- A safety relief valve must be provided on the storage tank. This protects the storage tank should the canister become plugged or blocked in any fashion. Such a vent would open in an emergency situation, thereby relieving pressure within the storage tank.
- Under appropriate conditions, a flame arrestor and/or backflow preventer must be installed as shown in the typical installation drawing. This prevents backflow of air through the canister when the storage tank is being emptied.
- High organic compound concentration in the vented air or vapor – defined as being greater than 0.5 to 1.0 volume % - may cause an elevated heat of adsorption in the carbon bed. This effect can be dissipated by pre-wetting the carbon to provide a heat sink, adding dilution air to the vented air or vapor to reduce the concentration, or by adding water spray to the vented air or vapor to provide an ongoing heat sink.

If VAPOR-PAC adsorbers are used to control organic compound emissions from air-strippers, soil venting, or other high moisture content air or vapor streams, then it is recommended that the humidity in the air stream be reduced to under 50%. High humidity may cause water vapor to condense within the carbon pores, filling the pores with water and preventing the air or vapor with organic contamination from accessing the internal surface of the activated carbon where adsorption takes place. Therefore, lower humidity will optimize the adsorptive capacity of the activated carbon. Also, for applications that may carry condensed water, it is recommended to install a drain or condensate trap on the inlet duct or piping.

Typical Installation



Operation and Monitoring

Once installed, the air can be introduced to the VAPOR-PAC adsorber; entering the bottom of the adsorber and flowing upward through the carbon bed and exiting the top of the unit. This upflow operation aids in the distribution of flow across the carbon bed.

The rate of flow to the VAPOR-PAC adsorbers is typically determined by the pressure drop curve; however, it is recommended that the air flow not exceed 1,000 cfm. The VAPOR-PAC adsorbers are not provided with pressure relief devices, so it is the responsibility of the user to assure that either the pressure rating of the VAPOR-PAC adsorbers is not exceeded or a relief device is provided. Any damage to the unit while on the user's site will be the responsibility of the user.

VAPOR-PAC adsorbers require on periodic monitoring, most likely determined by the need to monitor treated air quality. The following items may need to be monitored:

- Pressure: check inlet and outlet air pressures to be sure that air is flowing freely through the carbon bed
- Temperature: temperature may be needed to be checked if there is a concern that heat of adsorption may cause a temperature rise of concern.
- Samples: inlet and outlet air samples to determine treatment effectiveness and continued capability of the carbon to remove the contaminants

Safety Considerations

While complying with the recommended installation instructions, plant operators should also be aware of these additional heat-related safety considerations:

- When in contact with activated carbon, some types of organic chemical compounds, such as those from the ketone and aldehyde families and some organic acids or organic sulfur compounds, may react on the carbon surface causing severe exotherms or temperature excursions. If you are unaware or unsure of the reaction of an organic compound on activated carbon, appropriate tests should be performed before placing VAPOR-PAC adsorbers in service.
- Heat of adsorption can lead to severe temperature excursions at high concentrations of organic compounds in the inlet air or vapor. Heating may be controlled by diluting the inlet air or adding water vapor as a heat sink, by time weighting the inlet concentration to allow heat to dissipate, or by pre-wetting the carbon.
- Do not use VAPOR-PAC adsorbers with ST1-X carbon in petrochemical or chemical industry applications.
- ST1-X carbon can liberate heat by reacting chemically with oxygen. To prevent heat buildup within a canister, the carbon must not be confined without adequate air flow to dissipate the heat. In situations where there is insufficient or disrupted air flow through the vessel, the chemical reaction can be prevented by sealing the inlet and outlet connections to the canister.

Spent Carbon Acceptance

Prior to return of either the VAPOR-PAC unit or spent GAC to Calgon Carbon, the spent GAC must undergo acceptance testing. The VAPOR-PAC adsorbers are provided with a carbon acceptance canister and instructions for sampling the air source and returning the canister to Calgon Carbon. The air source is introduced to the carbon acceptance canister to exhaust a small amount of GAC for testing. The canister is then removed, sealed and returned to Calgon Carbon with the appropriate documentation for testing.

Carbon Exchange

Carbon exchange can be managed by replacement of the entire VAPOR-PAC adsorber, using the adsorber as a shipping container to return the spent carbon to Calgon Carbon. Prior to the return of a VAPOR-PAC adsorber, the spent carbon acceptance testing must be satisfactorily completed and the user provided with instructions to schedule return of the VAPOR-PAC unit.

The VAPOR-PAC adsorber is disconnected from the process (with a new VAPOR-PAC adsorber installed in its place if operation is ongoing), all connections are sealed, and the unit is shipped back to Calgon Carbon with the spent GAC.

Carbon can be exchanged onsite for the VAPOR-PAC adsorber if the unit is owned by the site or if this is the preferred method of carbon exchange. The VAPOR-PAC adsorber is either isolated from the air flow or physically moved to another location. The spent GAC can be removed by disconnecting the bottom flange or opening the bottom valve and allowing the GAC to flow out. It may be necessary to add water to facilitate the carbon removal. The spent carbon can also be removed via vacuum from the top outlet flange. Once the VAPOR-PAC adsorber is thoroughly cleaned of spent GAC, fresh carbon can be added using the top outlet flange. Once the fresh carbon is installed, and the inlet and outlet connections are reestablished, follow the procedures under the Installation section.

Calgon Carbon Air Purification Systems

The VAPOR-PAC adsorbers are designed for a variety of air or vapor applications at low air flows and using the carbon adsorption service for ongoing operation. Calgon Carbon Corporation offers a wide range of carbon adsorption systems and services for a range of air or vapor flow rates and carbon usages to meet specific applications.

Safety Message

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable federal and state requirements. Please refer to the MSDS for all up to date product safety information.

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D.10. RBLC Summary Tables

RBLC ID	Facility Name	Facility County	Facility State	SIC Code	NAICS Code	Permit Issurance Date	Facility Description	Process Name	Pollutant	Control Method Description	Emission Limit	Emission Limit Unit	Emission Limit 1 Average Time Condition	Case-by-Case Basis	Emission Limit 2	Emission Limit 2 Unit	Emission Limit 2 Average Time Condition
PA-0165	Procter & Gamble Paper Products Company	Wyoming	PA	2676	322291	02/24/2000	This Latest Modification Updates Changes To Plant Which Includes Generation Of Ercs From The Shut Down Of Sources As Approved By Ract Permit.	Rotagravure Printing Operation With Dryer	VOC	Total Enclosure With Retox 3.0 Regenerative Thermal Oxidizer(RTO). Limits Are Presented For Informational Purposes Only.	3.04	T/YR		Other Case-by-Case	0	0	
WI-0153	Quad Graphics - Sussex	Waukesha	WI	2752	323110	04/25/2000	Printing	Heatset Web Offset Press, P34, S34 One M-3000	VOC	Thermal Oxidizer	13.783	T/YR		Other Case-by-Case	0	0	
CA-1033	Poly Pak America, Inc.		CA	2752	323110	04/28/2000		Graphic Arts Printing And Coating Operation: Flexographic Printing Line	VOC	Permanent Total Enclosure And Regenerative Thermal Oxidizer	95	% CONTROL		BACT-PSD	0	0	
WI-0176	Quad Graphics - West	Waukesha	WI	2759		08/14/2000	Web Offset Printing Plant	Heatset - Offset Press, M-110, Po7 So7	VOC	Thermal Oxidizer. No Emission Rate Limits.	97.5	% REDUCTION		BACT-PSD	0	0	
OK-0054	Quad Graphics Okc Facility	Oklahoma	OK	2754	323111	08/21/2001	Print Shop	Printing Press, Offset (Ink)	VOC	Total Enclosure (100% Capture) And Thermal Oxidizer (97.5%). See Pollutant Notes.	74.05	T/YR		BACT-PSD	0	0	
WV-0013	Martinsburg Plant	Berkeley	WV	2754		08/30/2001	Company Operates a Printing And Publishing Facility In Martinsburg, WV. The Plant Prints Catalogs, Magazines, And Inserts For Periodicals. It Utilizes Web-Fed Publication	Offset Presses (M3000)	VOC	Thermal Oxidation. Permit Limit Is Control, Lb/H Emission Limit.	4.79	LB/H		BACT-PSD	0	0	
WV-0013	Martinsburg Plant	Berkeley	WV	2754		08/30/2001	Company Operates a Printing And Publishing Facility In Martinsburg, WV. The Plant Prints Catalogs, Magazines, And Inserts For Periodicals. It Utilizes Web-Fed Publication	Offset Presses (M1000)	VOC	Thermal Oxidation. Permit Limit Is Control, Lb/H Emission Rate.	4.37	LB/H		BACT-PSD	0	0	
CA-1115	Madison-Graham Colorgraphics, Inc.	Los Angeles	CA	2752	323110	12/18/2002		Graphic Arts Printing And Coating Operation: Lithographic Offset Printing-	VOC	Regenerative Thermal Oxidizer (RTO)	95	%	Control	BACT-PSD	0	0	
WI-0219	Quad-Graphics Sussex	Waukesha	WI	2752	323110	04/09/2003	Heatset Web Offset Printing	Heatset Web Offset Press, One M-600, P36, S56	VOC	Thermal Oxidizer Controlling Emissions From Press Dryer	97.5	% REDUCTION	Destruction	BACT-PSD	0	0	
WI-0218	Quad-Graphics Sussex	Waukesha	WI	2752	323110	05/27/2003	Heatset Web Offset Printing	Heatset Offset Press, Process P54, S34, M91	VOC	Thermal Oxidizer Controlling Emissions From Press Dryer	97.5	% REDUCTION	Destruction	BACT-PSD	0	0	
CA-1003	Hydranautics	San Diego	CA	3599	333319	01/01/2004	Manufacturer Of Membranes For Reverse Osmosis	Manufacturing Line, High Performance Water Treatment Equip	VOC	Ce Air Pre-Heater Thermal Oxidizer	95	% REDUCTION		BACT-PSD	0	0	
OK-0097	Quad Graphics Okc Fac	Oklahoma	OK	2754	323111	02/03/2004	Commercial Printing	Printing Presses, Offset (Ink)	VOC	Thermal Or Catalytic Incineration At 97.5% Control With A 100% Capture Efficiency For The Heatset Inks	74.05	T/YR	Nonmethane Hydrocarbons	BACT-PSD	0	0	
PA-0270	R.R. Donnelley & Sons Co.	Lancaster	PA	2752	323110	04/04/2005	Pa Is For Installation Of Heidelberg S-3000 Heatset Offset Web Press With 8 Printing Units. There Is A Natural Gas Fired Internal Dryer And Vocs From Unit Controlled By	Offset Web Press M3000	VOC	L&E RTO - 7.7 Mmbtu/Hr 97% Efficiency	17	T/YR	Est After 97 % Control,Fugitives	Other Case-by-Case	0	0	
PA-0261	R.R. Donnelley & Sons Co.	Lancaster	PA	2754	323110	01/03/2006	Major Rotgravure And Web Offset Printer. Nsr Was Tripped With Installation Of Goss S-2000 Heatset Offset Lithographic Press. Increase Of 27.29 Stack Emissions And 19 Fugitive.	Lgm963 Press	VOC	Hes Thermal Oxidizer (RTO) & L&E Thermal Oxidizer	27.3	T/YR		Other Case-by-Case	0	0	
OK-0112	Muskogee Mill	Muskogee	OK	2656	322121	03/27/2006	Sanitary Paper Products Manufacturing	Polyethylene Flexographic Printing Press #2-4	VOC	Permanent Enclosure, RTO	48.5	T/YR		BACT-PSD	0	0	
CO-0065	Rocky Mountain Metal Container	Jefferson	CO	3411	332431	10/11/2006	Can Manufacturing Facility For Coors.	C24 Can Line	VOC	Regenerative Thermal Oxidizers	0.5	LB LB VOC/GAL - H20	Overvarnish (Controlled)	BACT-PSD	0.86	LB LB VOC/GAL - H20	Internal Coating (Controlled)
PA-0268	Graphic Pkg Intl Inc	Montgomery	PA	2752	323110	12/07/2008	Pa For Installation Of A New Lithographic Printing Press. 1O Year Voc Change Is 49.76 Tons, Offsets Required.	No 3 Press	VOC	VOCs Controlled By Content In Fountain Solution, Blanket And Roller Solutions	36.26	T/YR		Other Case-by-Case	0	0	
IA-0097	American Packaging	Story	IA	2759	323112	06/24/2010	Facility Prints Packaging For Food And Non-Food Items.	Flexographic Press #6	VOC	Thermal Oxidizer 6 Mmbtu/Hr	98	%	1 Hour Average	BACT-PSD	119	T	12 Month Total
IN-0130	Courier Kendallville, Inc.	Noble	IN	2752	323110	01/03/2011	A Commerical Printing Plant That Manufacture Adhesive Bound And Saddlewire Bound Books	Printing Press	VOC	Integrated Recuperative Thermal Oxidizer	98	% DESTRUCTION EFF	Three Hours	OTHER CASE-BY-CASE	10	PPMV OF VOC	Three Hours

RBLC ID	Facility Name	Facility County	Facility State	SIC Code	NAICS Code	Permit Issurance Date	Facility Description	Process Name	Pollutant	Control Method Description	Emission Limit	Emission Limit Unit	Emission Limit 1 Average Time Condition	Case-by-Case Basis	Emission Limit 2	Emission Limit 2 Unit	Emission Limit 2 Average Time Condition
IN-0193	Color-Box Llc - Richmond Division	Wayne	IN	2752	323110	11/13/2013	Stationary Lithographic Printing Source That Prints Shipping And Display Containers	Web Heatset Offset Lithographic Printing Press, Identified As Web Press	VOC	Thermal Oxidizer	98	PERCENT	3 Hour Average	OTHER CASE-BY-CASE	10	PPMV AS HEXANE	3 Hour Average
*WI-0254	Bemis Wisconsin LLC - Appleton	Outagamie	WI	2671	326112	11/26/2013	Flexible Packaging Manufacturing	P29 - Flexographic Press #12	VOC	Permanent Total Enclosure (PTE) With Pressure Differential Monitoring And A Regenerative Thermal Oxidizer (RTO)	98	% OVERALL REDUCTIO	None	BACT-PSD	0	0	
*WI-0254	Bemis Wisconsin LLC - Appleton	Outagamie	WI	2671	326112	11/26/2013	Flexible Packaging Manufacturing	P30 - Flexographic Press #13	VOC	Permanent Total Enclosure (PTE) With Pressure Differential Monitoring And A Regenerative Thermal Oxidizer (RTO)	98	% OVERALL REDUCTIO	None	BACT-PSD	0	0	
*WI-0254	Bemis Wisconsin LLC - Appleton	Outagamie	WI	2671	326112	11/26/2013	Flexible Packaging Manufacturing	P31A - Flexographic Press #14	VOC	Permanent Total Enclosure (PTE) With Pressure Differential Monitoring And A Regenerative Thermal Oxidizer (RTO)	98	% OVERALL REDUCTIO	None	BACT-PSD	0	0	
*WI-0254	Bemis Wisconsin LLC - Appleton	Outagamie	WI	2671	326112	11/26/2013	Flexible Packaging Manufacturing	P31B - Flexographic Press #14 Outboard Deck	VOC	Permanent Total Enclosure (PTE) With Pressure Differential Monitoring And A Regenerative Thermal Oxidizer (RTO)	98	% OVERALL REDUCTIO	None	BACT-PSD	0	0	
*IN-0207	R.R. Donnelley & Sons Company	Kosciusko	IN	2752	323110	11/26/2014	Stationary Publication Rotogravure And Lithographic Printing Operation.	Goss Heatset Web Offset Lithographic Printing Press (Id: Wm-402)	VOC	Recuperative Thermal Oxidizer	98	% DESTRUCT ION EFFICI	3-Hours	OTHER CASE-BY-CASE	50	PPMV AS C1	3-Hours
*IN-0211	Ep Graphics, Inc.	Adams	IN	2752	323110	06/12/2015	Lithographic Printing	Printing Press 70	VOC	Regenerative Thermal Oxidizer	0	0		OTHER CASE-BY-CASE	0	0	
*IA-0112	American Packaging Corporation	Story	IA	2759	323111	04/04/2016	Food And Non-Food Packaging And Printing Facility	Flexographic Press Printing Line	VOC	Regenerative Thermal Oxidizer	238	TONS/YR	Combined Limit For Ep Dc And Ep Dd	BACT-PSD	98	% REDUCTIO N	Limit For Control Device

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WI-0143	Bemis Films	Winnebago	WI	2671	322221	06/01/2001	Flexible Packaging Manufacturer (Film Manufacture And Printing)	Flexographic Press	VOC	Total Enclosure Of Control Impression Section Of Flexographic Press. 95% Destruction Of VOC'S Using Catalytic Oxidizer System.	95	% REDUCTIO N		BACT-PSD	0	0	
OK-0054	Quad Graphics Okc Facility	Oklahoma	OK	2754	323111	08/21/2001	Print Shop	Ink Jet Units	VOC	Solvent Recovery System	32.78	T/YR		BACT-PSD			
WI-0189	Curwood, Inc.	Outagamie	WI	2671	326112	06/11/2002	Curwood Is A Manufacturer Or Flexible Packaging Materials, Primarily For Use In The Food And Medical Industries.	Printing Press, Flexographic	VOC	Total Enclosure And Existing Catalytic Oxidation System. Enclosure Provides 100% Capture.	95	% REDUCTIO N		BACT-PSD	0	0	
WI-0192	Bemis Films - Bsf Facility	Winnebago	WI	2671	326112	08/21/2002		Flexographic Press	VOC	Catalytic Oxidation	5	% BY WT	% Total Mass Voc	BACT-PSD	5	% BY WT	% Total Mass Voc
WI-0217	Banner Packaging	Winnebago	WI	2673	326111	09/09/2002	Flexible Packaging	Press 2 (Flexographic Press)	VOC	Total Enclosure Of Central Impression Area. Catalytic Oxidizer System (Multiple Catalytic Oxidizers Shared Among Multiple Presses)	95	% REDUCTIO N	Destruction	BACT-PSD	0	0	
WI-0193	Pechiney Menasha Plant, Canal Street Building	Winnebago	WI	2671	326112	09/25/2002		Flexographic Printing Presses (P81 - P85)	VOC	Catalytic Or Regenerative Oxidizer	5	% BY WT	% Total Mass Voc	BACT-PSD	5	% BY WT	% Total Mass Voc
PA-0206	C-P Converters	York	PA	2673	322223	01/09/2003	Facility Makes Flexible Packages For Various Products	Flexographic Printer	VOC	Catalytic Incinerator, Permanent Enclosure With 100% Capture Efficiency	24	T/YR		Other Case-by-Case	0	0	
OK-0097	Quad Graphics Okc Facility	Oklahoma	OK	2754	323111	02/03/2004	Commercial Printing	Ink Jet Fugitives	VOC	Closed-Loop Solvent Recovery System	32.78	T/YR	Nonmethane Hydrocarbons	BACT-PSD			
WI-0213	Banner Packaging	Winnebago	WI	2673	326111	08/06/2004	Flexible Packaging Mfr. And Printing (Flexo Printing)	Flexographic Printing Press 7 (P47)	VOC	Total Enclosure Around Central Impression Section (100% Capture) And Catalytic Oxidizer (95% Destruction)	95	% REDUCTIO N		BACT-PSD	0	0	
*IN-0223	Bemis Company Inc.	Vigo	IN	2673	326111	03/05/2015	Stationary Polyethylene Film Plant	Cyrel Platemaking Process	VOC	Catalytic And Regenerative Thermal Oxidizers	95	% DESTRUCT ION EFF.		OTHER CASE-BY-CASE	140160	X10^3SQI N/12 CONS MO	

RBLC ID	Facility Name	Facility County	Facility State	SIC Code	NAICS Code	Permit Issurance Date	Facility Description	Process Name	Pollutant	Control Method Description	Emission Limit	Emission Limit Unit	Emission Limit 1 Average Time Condition	Case-by-Case Basis	Emission Limit 2	Emission Limit 2 Unit	Emission Limit 2 Average Time Condition
OK-0054	Quad Graphics Okc Facility	Oklahoma	OK	2754	323111	08/21/2001	Print Shop	Printing Presses Rotogravure	VOC	Carbon Adsorbers Followed By A Solvent Recovery System For A System Efficiency Of 98%. Estimated That 3% Of Voc Retained In Web And Emitted Later. Therefore, Overall Efficiency = 95%	2071	T/YR		BACT-PSD	0	0	
WV-0013	Martinsburg Plant	Berkeley	WV	2754		08/30/2001	Company Operates A Printing And Publishing Facility In Martinsburg, WV. The Facility Is Located In The Cumbo Yard Industrial Park Adjacent To I-81 And Is North Of Downtown Martinsburg. The Plant Prints Catalogs, Magazines, And Inserts For Periodicals. It Utilizes Web-Fed Publication Rotogravure Printing And Heatset Web Offset Lithographic Printing Presses To Achieve This End. Also Present At The Plant Are An Ink Blending Facility, Ink Storage Tanks, Natural-Gas Boilers, Chrome Plating Operations, A Solvent Recovery System, Proof Presses, Label Making Ink-Jet Printers, And A Cylinder Washer That Are Supportive Parts Of The Martinsburg Plant.	Rotogravure Press (133 In)	VOC	Permanent Total Enclosure & Carbon Adsorption Solvent Recovery System To Achieve Overall Annual Collection Eff Of 96.0%. Min Eff Of Sr Is 98.25%. Permit Limit Is Use Of Controls, Emission Limit In Lb/H	24.26	LB/H		BACT-PSD	70.81	T/YR	
WV-0013	Martinsburg Plant	Berkeley	WV	2754		08/30/2001	Company Operates A Printing And Publishing Facility In Martinsburg, WV. The Facility Is Located In The Cumbo Yard Industrial Park Adjacent To I-81 And Is North Of Downtown Martinsburg. The Plant Prints Catalogs, Magazines, And Inserts For Periodicals. It Utilizes Web-Fed Publication Rotogravure Printing And Heatset Web Offset Lithographic Printing Presses To Achieve This End. Also Present At The Plant Are An Ink Blending Facility, Ink Storage Tanks, Natural-Gas Boilers, Chrome Plating Operations, A Solvent Recovery System, Proof Presses, Label Making Ink-Jet Printers, And A Cylinder Washer That Are Supportive Parts Of The Martinsburg Plant.	Rotogravure Press (108 In)	VOC	Total Enclosure, Carbon Adsorption System Minimum Efficiency Of 98.25% With Overall Rotogravure Minimum Collection Set At 96% On An Annual Basis. Permit Limit Is Use Of Controls And Emission Rate In Lb/H.	19.7	LB/H		BACT-PSD	0	0	
GA-0106	Quebecor World Kri - Augusta	Columbia	GA	2754	323111	04/24/2002	Commercial Printing	Rotogravure Printer	VOC	Carbon Adsorption/Solvent Recovery System	6.1	T/YR		BACT-PSD	0	0	
KY-0087	Quebecor World Franklin	Simpson	KY	2754	323111	07/12/2002	Rotogravure Printing Plant	Rotogravure Printing Press	VOC	Total Enclosure And Carbon Adsorption System	0	0	See Note	BACT-PSD	0	0	
SC-0076	R. R. Donnelley & Sons Company	Spartanburg	SC	2754	323111	07/16/2002	Facility Prints And Binds Publication Materials, Primarily Catalogs And Advertisments, Using Rotogravure Printing.	Production Process, 11 Each	VOC	(15) Bed Carbon Adsorption And Recovery Of Solvent, 100% Capture, 98% Solvent Recovered.	98	% REDUCTION		BACT-PSD	0	0	
SC-0076	R. R. Donnelley & Sons Company	Spartanburg	SC	2754	323111	07/16/2002	Facility Prints And Binds Publication Materials, Primarily Catalogs And Advertisments, Using Rotogravure Printing.	Proof Presses, 2 Each	VOC	90% Capture And (15) Bed Carbon Adsorption And 98% Recovery Of Solvent	88	% REDUCTION		BACT-PSD	0	0	
SC-0103	R.R. Donnelley & Sons Company	Spartanburg	SC	2754	323111	07/16/2002		Production Presses	VOC	VOC Captured (100%) And Routed To Carbon Bed Adsorption For Recovery Of Solvent	1149.369	T/YR	12 Month Rolling Sum	BACT-PSD	0	0	
GA-0124	Quebecor World Kri - Augusta	Columbia	GA	2754	323111	01/07/2004	Publication Rotogravure And Lithographic Web Printing	Rotogravure Web Press #311	VOC	Fixed Be Carbon Adsorption/Solvent Recovery	95	%	Removal	BACT-PSD	235	T/YR	Press 311
OK-0097	Quad Graphics Okc Fac	Oklahoma	OK	2754	323111	02/03/2004	Commercial Printing	Printing Presses Rotogravure	VOC	Carbon Adsorbers Followed By A Solvent Recovery System	2071	T/YR	Nonmethane Hydrocarbons	BACT-PSD	0	0	

RBLC ID	Facility Name	Facility County	Facility State	SIC Code	NAICS Code	Permit Issurance Date	Facility Description	Process Name	Pollutant	Control Method Description	Emission Limit	Emission Limit Unit	Emission Limit 1 Average Time Condition	Case-by-Case Basis	Emission Limit 2	Emission Limit 2 Unit	Emission Limit 2 Average Time Condition
CA-1043	Coyle Reproductions, Inc.	Los Angeles	CA	2711	323000	03/23/2000		Graphic Arts Printing And Coating Operation: Screen Printing And Drying	VOC	Ultra Low VOC Uv Curable Ink With VOC< 0.49 Lb/Gal	0.49	LB/GAL		BACT-PSD	0	0	
CA-1069	Metromedia Technologies	Los Angeles	CA	2759	323110	05/18/2000		Ink Jet Printing	VOC	85.5% Min. VOC Removal	2	LB/MO		Other Case-by-Case	2	LB/MO	
IL-0069	Quebecor World - Effingham Division	Effingham	IL	2752		09/06/2000	Lithographic Printing Source	Printing Press, Heatset Web Offset, 3 Each	VOC	Afterburner System. Low VOC Materials (See Pollutant Notes). Standard Emission Units Not Available	92.06	T/YR		BACT-PSD	0	0	
CA-1064	Melin Enterprises, Direct Color	Los Angeles	CA	2711	323110	12/01/2000		Graphic Arts Printing And Coating Operation: Lithographic Offset Printing-Non-Heatset	VOC	Low VOC, Fountain Solution<0.2Lb/Gal VOC-See Note	2730	LB/MO		BACT-PSD	0	0	
MI-0352	Pollard (U.S) Ltd	Washtenaw	MI	2752	323110	11/03/2000	Gravure And Offset Lithographic Printing Of Various Lottery Tickets	Lithographic Lines, With Flexo-Coaters (2)	VOC	VOC Content Limits For Inks, Coatings And Fountain Solution. Pte And Catalytic Oxidizer.	98	% REDUCTION		Other Case-by-Case	25	%	Volatiles & Water
MI-0352	Pollard (U.S) Ltd	Washtenaw	MI	2752	323110	11/03/2000	Gravure And Offset Lithographic Printing Of Various Lottery Tickets	Gravure Line, With 4-Station Flexographic Line	VOC	VOC Content Limits, Pte And Catalytic Oxidizer	98	% REDUCTION		Other Case-by-Case	25	%	Volatiles & Water
MI-0352	Pollard (U.S) Ltd	Washtenaw	MI	2752	323110	11/03/2000	Gravure And Offset Lithographic Printing Of Various Lottery Tickets	Flexographic Printer, 14-Station	VOC	VOC Limits For Inks And Coatings, Pte And Catalytic Oxidizer.	98	% REDUCTION		Other Case-by-Case	25	%	Volatiles & Water
CA-1063	Los Angeles Times Communications , Llc	Los Angeles	CA	2711	511110	12/26/2000		Graphic Arts Printing And Coating Operation: Lithographic Offset Printing-Non-Heatset	VOC	Low VOC, Fountain Solutions, Press Wash And Clean Up Materials	309	LB/D		BACT-PSD	0	0	
CA-1039	International Paper Co.		CA	2653	322211	01/03/2001		Graphic Arts Printing And Coating Operation: Flexographic Printing Line	VOC	Clean Up Solvent Contains No VOC	136	LB/DAY		BACT-PSD	0	0	
IL-0070	Quebecor World, Chicago Division	Cook	IL	2752		03/14/2001	Lithographic Printing	Printing Press, Heatset Web Offset	VOC	Oxidizer System Has 3 Afterburners; Low VOC Materials (See Pollutant Notes). Standard Emission Units Not Available	32.9	T/YR		LAER	0	0	
CA-0967	Garden Prints	Los Angeles County	CA	2759	323113	06/05/2001	Print On Textiles	Textile Printing	VOC	Low VOC Inks (50 G/L)	15	LB/D	From Press	LAER	127	LB/D	From Facility
OK-0054	Quad Graphics Okc Facility	Oklahoma	OK	2754	323111	08/21/2001	Print Shop	Printing Press, Offset (Fugitive)	VOC	VOC Limits On Inks And Thermal Oxidizer. (See Pollutant Notes For Details.)	112.89	T/YR		BACT-PSD	0	0	
OK-0054	Quad Graphics Okc Facility	Oklahoma	OK	2754	323111	08/21/2001	Print Shop	Cylinder Washing System	VOC	Cleaning Solvent Usage Limits	9.4	T/YR		BACT-PSD	0	0	
MN-0044	3M Hutchinson Tape Manufacturing Plant	Mcleod	MN	2671	322221	09/27/2001	Produces Pressure Sensitive Tapes, And Magnetic Tapes	Pressure Sensitive Tapes And Labels Coating	VOC	Combination Of Compliant Coatings (Limits On Organic Hap Content) & Thermal Oxidizer (Solvent Reducer Is Part Of The Coating Line). Permit Limit Is % Reduction And Annual Cap, No Lb/Lb Limit On Coating VOC Content.	96	% REDUCTION		BACT-PSD	92.6	T/YR	
CA-1114	Quebecor World Great Western Publishing	Riverside	CA	2752	323110	08/01/2002		Graphic Arts Printing And Coating Operation: Lithographic Offset Printing-Heatset	VOC	VOC Limits In Inks & Fountain Solution, And Thermal Oxidizer	98.5	%	Control	BACT-PSD	0	0	
CA-0992	Sierra Office Systems	Sacramento County	CA	2752	323110	01/11/2003	Commercial Printing Facility	Lithographic Printing Press And Infrared Dryer	VOC	Low VOC Inks	3900	LB/QTR	Quarter	LAER	0	0	
WI-0218	Quad-Graphics Sussex	Waukesha	WI	2752	323110	05/27/2003	Heatset Web Offset Printing	Heatset Offset Press, Process P35, S35; M-96	VOC	Thermal Oxidizer Controlling Emissions From Press Dryer, VOC Content And Usage Limits. See Pollutant Notes.	97.5	% REDUCTION		BACT-PSD	0	0	

RBLC ID	Facility Name	Facility County	Facility State	SIC Code	NAICS Code	Permit Issurance Date	Facility Description	Process Name	Pollutant	Control Method Description	Emission Limit	Emission Limit Unit	Emission Limit 1 Average Time Condition	Case-by-Case Basis	Emission Limit 2	Emission Limit 2 Unit	Emission Limit 2 Average Time Condition
WI-0218	Quad-Graphics Sussex	Waukesha	WI	2752	323110	05/27/2003	Heatset Web Offset Printing	Heatset Offset Press, Process P53, S53, M94	VOC	Thermal Oxidizer Controlling Emissions From Press Dryer, VOC Content Limits, Usage Limits, See Pollutant Notes.	97.5	% REDUCTION		BACT-PSD	0	0	
WI-0221	Quad-Graphics West Allis	Milwaukee	WI	2752	323110	10/08/2003	Heatset Web Offset Printing	Heatset Offset Press, M-110; P07, S07 (1)	VOC	Thermal Oxidizer Controlling Emissions From Press Dryer, VOC Content Limits, Work Practices (See Notes)	97.5	% REDUCTION		BACT-PSD	0	0	
WI-0221	Quad-Graphics West Allis	Milwaukee	WI	2752	323110	10/08/2003	Heatset Web Offset Printing	Heatset Offset Press, Man Roland, P08, S08 (1)	VOC	Thermal Oxidizer Used To Control Emissions From Press Dryer, VOC Content Limit, Work Practices (See Notes).	97.5	% REDUCTION		BACT-PSD	0	0	
WI-0220	Quad-Graphics Sussex	Waukesha	WI	2752	323110	01/13/2004	Heatset Web Offset Printing	Heatset Web Offset Press, M-3000; P58, S58	VOC	Thermal Oxidizer Controlling Emissions From Press Dryer, VOC Limits, And Work Practices (See Notes)	97.5	% REDUCTION		BACT-PSD	0	0	
WI-0220	Quad-Graphics Sussex	Waukesha	WI	2752	323110	01/13/2004	Heatset Web Offset Printing	Heatset Web Offset Press, M-3000; P59, S59	VOC	Thermal Oxidizer Controlling Emissions From The Press Dryer, VOC Limits, And Work Practices (See Notes)	97.5	% REDUCTION		BACT-PSD	0	0	
OK-0097	Quad Graphics Okc Fac	Oklahoma	OK	2754	323111	02/03/2004	Commercial Printing	Printing Press, Offset (Fugitive)	VOC	VOC Limits On Inks And Thermal Oxidizer. (See Pollutant Notes For Details.)	112.89	T/YR	Nonmethane Hydrocarbons	BACT-PSD	0	0	
NC-0104	Hooker Furniture Company	Catawba	NC	2511	112511	04/02/2004	Wood Furniture-Manufacturing Facility	Wood Furniture Finishing	VOC	ProductLimit (Minus H2O And Exempt Solvents) Stains/Colorcoats 7.5 Lbs VOC/Gallon As Applied Topcoats/Sealers6.5 Lbs VOC/Gallon As Applied Filler/Glaze6.2 Lbs VOC/Gallon As Applied Boothcoater4.0 Lbs VOC/Gallon As App	500	T/YR		BACT-PSD	0	0	
WI-0223	Louisiana-Pacific Hayward	Sawyer	WI	2493	321219	06/17/2004	Osb Mill	Finishing Line (Paint / Ink), P17 -	VOC	Use Of Inks And Paints Having A Maximum VOC Content Of 1.0 Pounds Of VOC Per Gallon.	1	LB/GAL	Lb VOC/Gal	BACT-PSD	0	0	
IA-0073	American Packaging Corporation	Story	IA	2759	323112	09/13/2004	American Packaging Corporation (APC) Owns And Operates A Food Packaging Printing Operation In Story City, Story County, Iowa. The Facility Is Classified Under Sic Code 2759 (Flexographic Printing And Lamination And Manufacturing Of Preformed Products).	Printing Press Lines	VOC	Thermal Oxidizers (2). Each Oxidizer Has Its Own Emission Point. 100% Capture. The Limits Are The Same On Each Emission Point. Coating VOC Limit	373	T/YR		BACT-PSD	0	0	
NV-0042	Capital Cabinet Corporation	Clark County	NV	2434	337110	11/05/2004	A Wood Cabinets And Counter Tops Manufacturing Plant	Wood Kitchen Cabinet And Countertop Surface Coating	VOC	Record Keeping Is Maintained Limiting The Use Of Low-VOC Materials To A Cumulative Total VOC Emission For The Specified Period Below The Emission Limit. All Sealers Shall Have A Restricted Ultra-Low VOC Content.	3	T/MO		LAER	25	T/YR	
GA-0111	Williams Printing Co	Fulton	GA	2752	323110	04/26/2005	Offset Lithographic Printing 2 Heatset Presses 4 Coldset Presses	Heatset Offset Lithographic Presses (2)	VOC	Thermal Oxidizer And Permanent Total Enclosure, And Low VOC/Vapor Pressure Materials	97	% REDUCTION	% Dre	LAER	44.3	T/YR	Plantwide
GA-0111	Williams Printing Co	Fulton	GA	2752	323110	04/26/2005	Offset Lithographic Printing 2 Heatset Presses 4 Coldset Presses	Coldset Offset Lithographic Presses (4)	VOC	Low VOC Content Inks, Fountain Solution, And Wash	2.5	LB/GAL	Lb/VOC Gal Inks, Coatings, Varnishes	LAER	44.3	T/YR	

RBLC ID	Facility Name	Facility County	Facility State	SIC Code	NAICS Code	Permit Issurance Date	Facility Description	Process Name	Pollutant	Control Method Description	Emission Limit	Emission Limit Unit	Emission Limit 1 Average Time Condition	Case-by-Case Basis	Emission Limit 2	Emission Limit 2 Unit	Emission Limit 2 Average Time Condition
WI-0222	Quad-Graphics Sussex	Waukesha	WI	2752	323110	03/03/2005	Heatset Web Offset Printing	Web Offset Presses, Heatset (3)	VOC	Thermal Oxidizer Controlling Emissions From Each Press Dryer, VOC Content Limits, Work Practices (See Notes)	97.5	% REDUCTION		BACT-PSD	2440	LB/MO	12 Mo Average
WI-0222	Quad-Graphics Sussex	Waukesha	WI	2752	323110	03/03/2005	Heatset Web Offset Printing	Heatset Web Offset Presses, M-3000; P60, S60; P61, S61, P62, S62	VOC	Thermal Oxidizer Controlling Emissions From Press Dryers (All 3 Presses Have Identical Requirements), VOC Content Limits, And Work Pratices (See Notes)	97.5	% REDUCTION		BACT-PSD	2440	LB/MO	12 Mo Average, Each
OR-0045	Country Coach, Inc.	Lane	OR	3716	336213	08/04/2005	Activites At The Facility Include Fiberglass Lamination And Finishing, Coach, Chassis, And Coach Parts Surface Coating, And Cabinet Manufacturing And Finishing. The Facility Has The Ability To Manufacture Approximately 1,200 Coaches Per Year.	Cabinet Finishing	VOC	California VOC Content Limits Were Used As The Basis For This Bact-Psd Determination.	0	0	See Notes	BACT-PSD	0	0	
WI-0242	Banner Packaging	Winnebago	WI	2671	326112	07/05/2006	Flexible Packaging (Film Mfr., Printing, Coating)	Flexo Press, Two Outboard Stations	VOC	Use Of Permanent Total Enclosures And Oxidizer System (95% Control) When Applying Solvent Based Materials. Pollution Prevention (Bypass Of Oxidizer), When Applying Materials That Are Solvent Free (< 1% VOC)	95	% REDUCTION	Overall Control	BACT-PSD	0	0	
NC-0115	Nc Communication Tech		NC	2711	511110	01/06/2007		Graphic Arts Printing And Coating Operation	VOC	Low VOC	0	0	See Note	BACT-PSD	0	0	
DC-0007	Bureau Of Engraving & Printing	Washington	DC	2893	325910	07/22/2008	The Bureau Of Engraving And Printing (Bep) Produces United States Currency And Other Government Securities. The Currency Printing Operations Performed At Bep Include: Intaglio, Offset, And Letter Press Printing; Trimming, Cutting, Examining, And Packaging Of Printing Products; Ink Manufacturing, Roller Recovery, Engineering, Electroplating, Plate Making, Photoengraving, Photoprocessing, Computer To Image Processing, Graphic Design, Laboratory Services, And Various Maintenance Support Services. The Primary Printing Operations Occur In The Main Building. Plate Making, Ink Manufacturing, And Related Support Services Are Located In The Annex Building.	Printing Process - Super Orlof Intaglio (Soi) Non-Heatset Sheet Feed	VOC	1. Indirect Application Of Ink To Engraved Plates. 2. Low Vapor Pressure Cleaning Solvent (< 10 Mm Hg). 3. Automatic Plate Washer. 4. Good Houskeeping Practices.	0.88 (or 0.8)	LB/H	From Ink (or solvents)	LAER	6.44	T/YR	Over 7665 Hours Per Year
IN-0164	Ep Graphics, Inc.	Adams	IN	2752	323110	06/28/2013	A Stationary Commercial Lithographic Printing Facility.	One (1) Five-Color Web Fed Heatset Lithographic Goss Press	VOC	Regenerative Thermal Oxidizer	10	PPMV OR LESS HEXANE	3 Hours	OTHER CASE-BY-CASE	15	% VOC CONTENT	
IN-0164	Ep Graphics, Inc.	Adams	IN	2752	323110	06/28/2013	A Stationary Commercial Lithographic Printing Facility.	One (1) Six-Color Web Fed Heatset Lithographic Heidelburg Press	VOC	Regenerative Thermal Oxidizer	10	PPMV OR LESS HEXANE	3 Hours	OTHER CASE-BY-CASE	15	% VOC CONTENT	

RBLC ID	Facility Name	Facility County	Facility State	SIC Code	NAICS Code	Permit Issurance Date	Facility Description	Process Name	Pollutant	Control Method Description	Emission Limit	Emission Limit Unit	Emission Limit 1 Average Time Condition	Case-by-Case Basis	Emission Limit 2	Emission Limit 2 Unit	Emission Limit 2 Average Time Condition	Standard Emission Limit	Standard Emission Limit Unit	Standard Emission Limit Average Time Condition
CA-1084	Anderson Lithograph	Los Angeles	CA		323110	06/01/2000		Graphic Arts Printing And Coating Operation: Lithographic Offset Printing-Non-Heatset	VOC	Voc In Fountain Solution Not To Exceed 0.7 Lb/Gal Including Water And Exempt Solvents. Voc Composite Vapor Pressures In Blanket And Roller Washes At 20 C Not To Exceed 10 And 6 Mmhg, Resp.;Overall Control Of Voc From Web Pres	98	%	Control	Other Case-by-Case	0	0		0	0	
MI-0263	International Paper	Kalamazoo	MI	2656		06/30/2000	Carton Making Plant: Printing, Folding, Sealing	Flexographic Press D&Amp;H	VOC	Water Based Inks. Add On Not Feasible. 7.3 T/Y Limit Only Applies To Each Newer Press D And H. Plantwide Total 75 T/Y. Primary Limit Is Lb Voc/Lb Solids. Permit Limit Is Not Given In % Mass Voc + H2O.	1.04	LB/LB		Other Case-by-Case	7.3	T/Y		0	0	
LA-0185	West Monroe Packaging Plant	Ouachita	LA	2657	322212	11/05/2003	Facility Manufactures Beverage Carriers From Paperboard. Processes Consist Of Printing, Cutting, Folding, And Gluing. Project Involves Installation Of One Packaging Rotogravure Press And Associated Dryer.	Rotogravure Press (No. 11, 103A&Amp;B)	VOC	Use Of Water-Based Inks And Varnishes	33.569	LB/H	Hourly Maximum	BACT-PSD	113.101	T/YR	Annual Maximum	0.5	LB VOC/LB SOLIDS	Annual Average
LA-0186	West Monroe Packaging Plant	Ouachita	LA	2657	322212	09/14/2004	Facility Manufactures Beverage Carriers From Paperboard. Processes Consist Of Printing, Cutting, Folding, And Gluing. Project Involves Installation Of One Packaging Rotogravure Press And Associated Dryer.	Rotogravure Press (No. 12, 104A&Amp;B)	VOC	Use Of Water-Based Inks And Varnishes	47.62	LB/H	Hourly Maximum	BACT-PSD	160.43	T/YR	Annual Maximum	0	0	
IA-0097	American Packaging	Story	IA	2759	323112	06/24/2010	Facility Prints Packaging For Food And Non-Food Items.	Laminator #4	VOC	Water-Based Materials < 5% Voc	119	T	12 Month Total	BACT-PSD	0	0		0	0	
*IA-0112	American Packaging Corporation	Story	IA	2759	323111	04/04/2016	Food And Non-Food Packaging And Printing Facility	Adhesive Laminator #6 - Water Based	VOC	The Facility Will Use Water-Based Adhesives, When The Emissions Are Not Vented To The Rto.	37.25	TONS PER YEAR		BACT-PSD	0	0		0	0	

RBLC ID	Facility Name	Facility County	Facility State	SIC Code	NAICS Code	Permit Issurance Date	Facility Description	Process Name	Pollutant	Control Method Description	Emission Limit	Emission Limit Unit	Emission Limit 1 Average Time Condition	Case-by-Case Basis	Emission Limit 2	Emission Limit 2 Unit	Emission Limit 2 Average Time Condition
CA-0968	Solution Unlimited		CA	2759	323111	01/01/2000	Screen Printing	Coating Sources	VOC	Limited To The Use Of UV Inks.	0	0	See Pollutant Notes	LAER	0	0	
CA-0966	Creating Mailings Inc.	Los Angeles County	CA	2752	323110	06/21/2000	Lithographic Press/Uv Dryer Used To Print Inserts And Brochures	Lithographic W/ Uv Dryer	VOC		30	LB/D	From Lithograph	LAER	930	LB/MO	From Facility
KY-0080	Dart Container Of Ky	Hart	KY	3086	326140	04/26/2001	Foam Cups And Containers Are Produced By Eps Molding, Cold Cups And Impact Plates And Containers Are Produced By Extrusion And Thermoforming, And Plastic Cutlery Through Injection Molding.	Printers, Uv Ink &Amp; Off Line	VOC	Throughput Limits	9.346	T/YR	Combined	Other Case-by-Case	0	0	
OK-0054	Quad Graphics Okc Facility	Oklahoma	OK	2754	323111	08/21/2001	Print Shop	Rotogravure Drum Proof Press	VOC	Bact Was Determined To Be Limits On Usage Of Inks And Solvents	12.07	T/YR		BACT-PSD	0	0	
VA-0286	Merillat Corporation Plant 14	Smyth	VA	2434	337110	01/05/2004	Equipment To Be Constructed At This Facility Consists Of 1 Wood Sanding System Rated At 4,000 Square Ft/Hr; 1 Wood Brushing System Rated At 4,000 Square Ft/Hr; 3 Fixed Roof Storage Tanks Each With Less Than 10,000 Gallons Capacity; And 1 Wood Furniture Finishing System Rated At 48 Gallons/Hr Including 24 Production Systems, Or Equivalent Spray Booths; 12 Productions Systems Or Equivalent Natural Gas Fired Curing Ovens Rated Between 0.5 And 4.5 Mmbtu/Hr Each.	Wood Finishing	VOC	Good Control Practices For Minimizing Emissions	288	LB/H		MACT	240	T/YR	
OK-0097	Quad Graphics Okc Fac	Oklahoma	OK	2754	323111	02/03/2004	Commercial Printing	Rotogravure Drum Proof Press	VOC	Bact Was Determined To Be Limits On Usage Of Inks And Solvents	12.07	T/YR	Nonmethane Hydrocarbons	BACT-PSD	0	0	
OK-0097	Quad Graphics Okc Fac	Oklahoma	OK	2754	323111	02/03/2004	Commercial Printing	Cylinder Washing System	VOC	Emission And Usage Limitations In Combination With Compliance With Mact Standards	9.4	T/YR	Nonmethane Hydrocarbons	BACT-PSD	0	0	
OH-0249	Sauder Woodworking Company	Fulton	OH	2511	337122	06/03/2004	Wood Furniture And Products. Facility Has 23 Wood Waste Handling Systems, And Includes Lamination Processes, Cutting, Sanding, Counter Banding, Edging, Staining Etc.	Laminator	VOC		0.39	LB/H		N/A	1.71	T/YR	
OK-0108	Nomaco Oklahoma City Facility	Canadian	OK	3086	326150	12/03/2004	Polyethylene Foam Extrusion Plant	Printing	VOC	Limited Ink Usage	0	0	See Note	BACT-PSD	0	0	
VA-0295	Yorktowne Cabinetry Inc	Pittsylvania	VA	2434	337110	05/23/2005	Wood Furniture Manufacturing Facility	Wood Finishing	VOC	Good Work Practices	245	T/YR		MACT	0	0	
CO-0060	Coors Brewing Company	Jefferson	CO	2082	312120	03/31/2006	Brewery	Videojets	VOC	Good Operating Practices	0	0	See Note	BACT-PSD	0	0	
OH-0312	Kenworth Truck Co.	Ross	OH	3713	336112	01/29/2008	Truck Production	Drying Ovens And Flash Tunnes For Cab Booths	VOC		9.63	LB/H		BACT-PSD	42.18	T/YR	Per Rolling 12-Months
*WI-0257	Oshkosh Corporation - Main Plant	Winnebago	WI	3711	336120	07/21/2011	Manufacturer Of Heavy Duty Specialized Trucks And Transportation Equipment	P51 - Two Electrodeposition Pretreatment Lines	VOC		0	0		BACT-PSD	0	0	
*WI-0257	Oshkosh Corporation - Main Plant	Winnebago	WI	3711	336120	07/21/2011	Manufacturer Of Heavy Duty Specialized Trucks And Transportation Equipment	P52 - Two Electrodeposition Primer Coating Lines	VOC		3.5	LBS VOC/GALL ON	As Applied/Excluding Water	BACT-PSD	0.8	LBS VOC/GALL ON	Of Applied Coatings Solids
*IN-0224	Forest River Inc., Plant 6	Elkhart	IN	3792		11/10/2014	Stationary Custom Rv Mfg	Assembly Operation (Eu-01)	VOC		99.08	T/YR		OTHER CASE-BY-CASE	6.5	LB/GALLO N OF COATING	
*IA-0112	American Packaging Corporation	Story	IA	2759	323111	04/04/2016	Food And Non-Food Packaging And Printing Facility	Emergency Bypass Stack	VOC		1	TON PER YEAR		BACT-PSD	0	0	

APPENDIX E: AIR QUALITY ANALYSIS SUPPORTING DOCUMENTS

Acceptable Ambient Concentrations
Toxic Air Pollutant Emissions Screening
SCREEN3 Data Files
Material Data Sheets

Table E-1. Derivation of Long-term Acceptable Ambient Concentrations (AAC) for Georgia EPD

Pollutant	CAS No.	Formula	Mol. Wt. (g/mol)	Unit Risk[1] $(\mu g/m^3)^{-1}$	Weight of Evidence[1]	Inhalation RfC[1] (mg/m^3)	Annual AAC[2] $(\mu g/m^3)$	24-hour AAC Required?
Ethanolamine	141-43-5	C_2H_7NO	61.1	None	N/A	None	**None**	Need 24-hr TWA
Propylene Glycol	57-55-6	$C_3H_8O_2$	76.1	None	N/A	None	**None**	Need 24-hr TWA
Isopropanol	67-63-0	C_3H_8O	60.1	None	N/A	None	**None**	Need 24-hr TWA
1-Propanol	71-23-8	C_3H_8O	60.1	None	N/A	None	**None**	Need 24-hr TWA
Styrene	100-42-5	C_8H_8	104.2	None	N/A	1.00E+00	**1.00E+03**	Not Required
Diethylene Glycol Ethyl Ether	111-90-0	$C_6H_{14}O_3$	134.2	None	N/A	None	**None**	Need 24-hr TWA
Acrylic Acid	79-10-7	$C_3H_4O_2$	72.1	None	N/A	1.00E-03	**1.00E+00**	Not Required
Triethylamine	121-44-8	$C_6H_{15}N$	101.2	None	N/A	7.00E-03	**7.00E+00**	Not Required
Propionaldehyde	123-38-6	C_3H_6O	58.1	None	N/A	8.00E-03	**8.00E+00**	Not Required
Diethylene Glycol	111-46-6	$C_4H_{10}O_3$	106.1	None	N/A	None	**None**	Need 24-hr TWA
Ethyl Acrylate	140-88-5	$C_5H_8O_2$	100.1	None	N/A	None	**None**	Need 24-hr TWA
Ethyl Benzene	100-41-4	C_8H_{10}	106.2	None	N/A	1.00E+00	**1.00E+03**	Not Required
Maleic Anhydride	108-31-6	$C_4H_2O_3$	98.1	None	N/A	None	**None**	Need 24-hr TWA
Benzyl Alcohol	100-51-6	C_7H_8O	108.1	None	N/A	None	**None**	Need 24-hr TWA

1. Unit risk, weight of evidence, and Inhalation RfC values obtained from EPA IRIS database.
2. Acceptable Ambient Concentrations (AACs) were developed based on Georgia EPD's Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions. Revised June 21, 1998. Annual AAC for toxics with both Unit Risk $(\mu g/m^3)^{-1}$ and Inhalation RfC (mg/m^3) data conservatively derived as minimum of the two.

Table E-2. Derivation of 24-hr Acceptable Ambient Concentrations (AAC) for Georgia EPD

Pollutant	24-hr AAC Required?	CAS No.	Formula	Mol. Wt. (g/mol)	24-hr Rating: Rating Source	24-hr Rating: (ppm)	24-hr Rating: (mg/m^3)	Rating Available 24-hour TWA (mg/m^3)	24-hour AAC[4] (ug/m^3)
Ethanolamine	Need 24-hr TWA	141-43-5	C_2H_7NO	61.1	OSHA TWA[1]	3	7.5	7	**18**
Propylene Glycol	Need 24-hr TWA	57-55-6	$C_3H_8O_2$	76.1	AIHA WEEL[3]	10	31.1	31	**74**
Isopropanol	Need 24-hr TWA	67-63-0	C_3H_8O	60.1	OSHA TWA[1]	400	983	983	**2,341**
1-Propanol	Need 24-hr TWA	71-23-8	C_3H_8O	60.1	OSHA TWA[1]	200	492	492	**1,170**
Styrene	Not Required	100-42-5	C_8H_8	104.2	OSHA TWA[1]	100	426	426	**None**
Diethylene Glycol Ethyl Ether	Need 24-hr TWA	111-90-0	$C_6H_{14}O_3$	134.2	AIHA WEEL[3]	25	137	137	**327**
Acrylic Acid	Not Required	79-10-7	$C_3H_4O_2$	72.1	ACGIH TWA[2]	2	5.9	6	**None**
Triethylamine	Not Required	121-44-8	$C_6H_{15}N$	101.2	OSHA TWA[1]	25	103	103	**None**
Propionaldehyde	Not Required	123-38-6	C_3H_6O	58.1	ACGIH TWA[2]	20	47.5	48	**None**
Diethylene Glycol	Need 24-hr TWA	111-46-6	$C_4H_{10}O_3$	106.1	AIHA WEEL[3]	10	43.4	43	**103**
Ethyl Acrylate	Need 24-hr TWA	140-88-5	$C_5H_8O_2$	100.1	OSHA TWA[1]	25	102.4	102	**244**
Ethyl Benzene	Not Required	100-41-4	C_8H_{10}	106.2	OSHA TWA[1]	100	434.2	434	**None**
Maleic Anhydride	Need 24-hr TWA	108-31-6	$C_4H_2O_3$	98.1	OSHA TWA[1]	0.25	1.0	1	**2**
Benzyl Alcohol	Need 24-hr TWA	100-51-6	C_7H_8O	108.1	AIHA WEEL[3]	10	44	44	**105**

1. OSHA TWA values obtained from 29 CFR 1910 Subpart Z.
2. ACGIH 8-hr time weighted average.
3. AIHA Workplace Environmental Exposure Limit (WEEL) 8-hr time weighted average obtained from https://www.aiha.org/get-involved/AIHAGuidelineFoundation/WEELs/Documents/2011WEELValues.pdf
4. TWA rating converted from 40 hr/wk std to 168 hr/wk. As none of the toxics addressed in this analysis are known carcinogens, a safety factor of 100 was applied to all air toxics.

Table E-3. Derivation of 15-minute Acceptable Ambient Concentrations (AAC) for Georgia EPD

Pollutant	CAS No.	Formula	Mol. Wt. (g/mol)	ACGIH STEL[1] (ppm)	ACGIH STEL[1] (mg/m^3)	NIOSH STEL[2] (ppm)	NIOSH STEL[2] (mg/m^3)	Ceiling or STEL (mg/m^3)	15-minute AAC (ug/m^3)
Ethanolamine	141-43-5	C_2H_7NO	61.1	6	15	6	15.0	15.0	**1,499**
Propylene Glycol	57-55-6	$C_3H_8O_2$	76.1	None	None	None	None	None	**None**
Isopropanol	67-63-0	C_3H_8O	60.1	400	983	500	1,229	983.2	**98,323**
1-Propanol	71-23-8	C_3H_8O	60.1	None	None	250	614	614.5	**61,447**
Styrene	100-42-5	C_8H_8	104.2	40	170	100	426	170	**17,039**
Diethylene Glycol Ethyl Ether	111-90-0	$C_6H_{14}O_3$	134.2	None	None	None	None	None	**None**
Acrylic Acid	79-10-7	$C_3H_4O_2$	72.1	None	None	None	None	None	**None**
Triethylamine	121-44-8	$C_6H_{15}N$	101.2	3	12.4	None	None	12.4	**1,242**
Propionaldehyde	123-38-6	C_3H_6O	58.1	None	None	None	None	None	**None**
Diethylene Glycol	111-46-6	$C_4H_{10}O_3$	106.1	None	None	None	None	None	**None**
Ethyl Acrylate	140-88-5	$C_5H_8O_2$	100.1	15	61	None	None	61	**6,142**
Ethyl Benzene	100-41-4	C_8H_{10}	106.2	None	None	125	543	None	**None**
Maleic Anhydride	108-31-6	$C_4H_2O_3$	98.1	None	None	None	None	None	**None**
Benzyl Alcohol	100-51-6	C_7H_8O	108.1	None	None	None	None	None	**None**

1. ACGIH STEL values obtained from www.cdc.gov/niosh/idlh.
2. NIOSH STEL values obtained from www.cdc.gov/niosh/npg.

Table E-4. SCREEN3 Model Inputs and Results

Stack Description	Stack Height (m)	Stack Temp (K)	Airflow (m^3/s)	Stack Diameter (m)	Modeled Emissions (g/s)	Height of Nearest Building (m)	Min. Horizontal Building Dimension (m)	Max. Horizontal Building Dimension (m)	Max. 1-hr Impact ($\mu g/m^3$)	Max. Impact Distance (m)
	SCREEN3 Model Inputs								Model Results	
Between Color Dryer	12.50	359.82	7.50	0.46	1.0	N/A	N/A	N/A	66.44	87
Final Dryer 1	12.50	381.48	3.98	0.46	1.0	N/A	N/A	N/A	90.27	84
Final Dryer 2	12.50	388.71	7.30	0.46	1.0	N/A	N/A	N/A	54.49	97
Final Dryer 3	12.50	388.71	7.30	0.46	1.0	N/A	N/A	N/A	54.49	97
Printing Plate Processor	12.50	293.00	0.17	0.14	1.0	N/A	N/A	N/A	684.5	80

Table E-5. Modeled Impacts by Source

Pollutant	Potential Emissions (lb/hr)[2]					Potential Emissions (g/s)					Max. 1-hr Impact ($\mu g/m^3$)[1]					Total Max. 1-hr Impacts
	Between Color Dryer	Final Dryer 1	Final Dryer 2	Final Dryer 3	Printing Plate Processor[3]	Between Color Dryer	Final Dryer 1	Final Dryer 2	Final Dryer 3	Printing Plate Processor	Between Color Dryer	Final Dryer 1	Final Dryer 2	Final Dryer 3	Printing Plate Processor	($\mu g/m^3$)
Ethanolamine	1.32E+00	7.00E-01	1.28E+00	1.28E+00	--	1.66E-01	8.82E-02	1.62E-01	1.62E-01	--	1.11E+01	7.97E+00	8.82E+00	8.82E+00	--	3.67E+01
Propylene Glycol	7.22E-03	3.83E-03	7.02E-03	7.02E-03	--	9.10E-04	4.82E-04	8.85E-04	8.85E-04	--	6.05E-02	4.35E-02	4.82E-02	4.82E-02	--	2.00E-01
Isopropanol	2.19E-03	1.16E-03	2.13E-03	2.13E-03	--	2.76E-04	1.46E-04	2.68E-04	2.68E-04	--	1.83E-02	1.32E-02	1.46E-02	1.46E-02	--	6.08E-02
1-Propanol	3.43E-04	1.82E-04	3.33E-04	3.33E-04	--	4.32E-05	2.29E-05	4.20E-05	4.20E-05	--	2.87E-03	2.07E-03	2.29E-03	2.29E-03	--	9.51E-03
Styrene	1.18E-03	6.24E-04	1.15E-03	1.15E-03	--	1.48E-04	7.87E-05	1.44E-04	1.44E-04	--	9.86E-03	7.10E-03	7.86E-03	7.86E-03	--	3.27E-02
Diethylene Glycol Ethyl Ether	2.69E-02	1.43E-02	2.62E-02	2.62E-02	--	3.39E-03	1.80E-03	3.30E-03	3.30E-03	--	2.25E-01	1.62E-01	1.80E-01	1.80E-01	--	7.47E-01
Acrylic Acid	9.81E-03	5.20E-03	9.53E-03	9.53E-03	--	1.24E-03	6.55E-04	1.20E-03	1.20E-03	--	8.21E-02	5.91E-02	6.55E-02	6.55E-02	--	2.72E-01
Triethylamine	1.34E-05	7.11E-06	1.30E-05	1.30E-05	--	1.69E-06	8.96E-07	1.64E-06	1.64E-06	--	1.12E-04	8.09E-05	8.96E-05	8.96E-05	--	3.72E-04
Propionaldehyde	3.44E-07	1.82E-07	3.34E-07	3.34E-07	--	4.33E-08	2.29E-08	4.21E-08	4.21E-08	--	2.88E-06	2.07E-06	2.29E-06	2.29E-06	--	9.54E-06
Diethylene Glycol	1.58E-02	8.36E-03	1.53E-02	1.53E-02	--	1.99E-03	1.05E-03	1.93E-03	1.93E-03	--	1.32E-01	9.51E-02	1.05E-01	1.05E-01	--	4.38E-01
Ethyl Acrylate	1.66E-02	8.79E-03	1.61E-02	1.61E-02	--	2.09E-03	1.11E-03	2.03E-03	2.03E-03	--	1.39E-01	1.00E-01	1.11E-01	1.11E-01	--	4.60E-01
Ethyl Benzene	1.66E-02	8.79E-03	1.61E-02	1.61E-02	--	2.09E-03	1.11E-03	2.03E-03	2.03E-03	--	1.39E-01	1.00E-01	1.11E-01	1.11E-01	--	4.60E-01
Maleic Anhydride	8.29E-03	4.40E-03	8.07E-03	8.07E-03	--	1.05E-03	5.54E-04	1.02E-03	1.02E-03	--	6.94E-02	5.00E-02	5.54E-02	5.54E-02	--	2.30E-01
Benzyl Alcohol	--	--	--	--	1.06	--	--	--	--	0.13	--	--	--	--	91.29	9.13E+01

1. 1-Hour impacts equal the emission rate (g/s) times the total unit impact from Table E-4.
2. Potential emission rates for each pollutant emitted by the preprint press were divided between each of the four (4) stacks based on the percentage of the total airflow of each stack.
3. Printing plate processor total TAP emissions modeled from one single stack.

Table E-6. Toxic Air Pollutants Impacts Analysis

Pollutant	Max. 1-hr Impact ($\mu g/m^3$)	Max. 15-min Average Impact[1] ($\mu g/m^3$)	15-min Average AAC ($\mu g/m^3$)	Max. 15-min Average Impact (% of AAC)	Max. 24-hour Average Impact[2] ($\mu g/m^3$)	24-hour Average AAC ($\mu g/m^3$)	Max. 24-hour Average Impact (% of AAC)	Max. Annual Impact[3] ($\mu g/m^3$)	Annual Average AAC ($\mu g/m^3$)	Max. Annual Impact (% of AAC)
Ethanolamine	3.67E+01	4.84E+01	1,499	3%	1.47E+01	17.8	82%	2.93E+00	None	-
Propylene Glycol	2.00E-01	2.65E-01	None	-	8.02E-02	74.1	0.11%	1.60E-02	None	-
Isopropanol	6.08E-02	8.03E-02	98,323	<0.01%	2.43E-02	2,341	<0.01%	4.86E-03	None	-
1-Propanol	9.51E-03	1.25E-02	61,447	<0.01%	3.80E-03	1,170	<0.01%	7.61E-04	None	-
Styrene	3.27E-02	4.32E-02	17,039	<0.01%	1.31E-02	None	-	2.62E-03	1,000	<0.01%
Diethylene Glycol Ethyl Ether	7.47E-01	9.87E-01	None	-	2.99E-01	327	0.09%	5.98E-02	None	-
Acrylic Acid	2.72E-01	3.59E-01	None	-	1.09E-01	None	-	2.18E-02	1.0	2%
Triethylamine	3.72E-04	4.91E-04	1,242	<0.01%	1.49E-04	None	-	2.98E-05	7.0	<0.01%
Propionaldehyde	9.54E-06	1.26E-05	None	-	3.81E-06	None	-	7.63E-07	8.0	<0.01%
Diethylene Glycol	4.38E-01	5.78E-01	None	-	1.75E-01	103	0.17%	3.50E-02	None	-
Ethyl Acrylate	4.60E-01	6.08E-01	6.14E+03	<0.01%	1.84E-01	244	0.08%	3.68E-02	None	-
Ethyl Benzene	4.60E-01	6.08E-01	None	-	1.84E-01	None	-	3.68E-02	1.00E+03	<0.01%
Maleic Anhydride	2.30E-01	3.04E-01	None	-	9.21E-02	2	3.86%	1.84E-02	None	-
Benzyl Alcohol	9.13E+01	1.21E+02	None	-	3.65E+01	105	34.7%	7.30E+00	None	-

1. 15-minute impacts equal the 1-hour impact times a factor of 1.32 per Georgia EPD's Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions, page 8.
2. 24-hour impacts equal the 1-hour impact times a factor of 0.4 per Georgia EPD's Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions, page 8.
3. Annual impacts equal the 1-hour impact times a factor 0.08 per Georgia EPD's Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions, page 8.

Between Color Dryer

06/17/16
20:27:00

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 13043 ***

Between Color Dryer

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000000
STACK HEIGHT (M)	=	12.4968
STK INSIDE DIAM (M)	=	0.4572
STK EXIT VELOCITY (M/S)	=	46.5039
STK GAS EXIT TEMP (K)	=	359.8170
AMBIENT AIR TEMP (K)	=	293.0000
RECEPTOR HEIGHT (M)	=	0.0000
URBAN/RURAL OPTION	=	URBAN
BUILDING HEIGHT (M)	=	0.0000
MIN HORIZ BLDG DIM (M)	=	0.0000
MAX HORIZ BLDG DIM (M)	=	0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

STACK EXIT VELOCITY WAS CALCULATED FROM
VOLUME FLOW RATE = 16177.000 (ACFM)

BUOY. FLUX = 4.425 M**4/S**3; MOM. FLUX = 92.027 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
80.	65.51	3	5.0	5.2	1600.0	25.00	17.63	16.33	NO
100.	65.72	3	4.0	4.2	1280.0	28.13	21.95	20.41	NO
200.	56.69	4	3.0	3.2	960.0	33.11	31.35	27.83	NO
300.	45.39	4	2.0	2.1	640.0	43.41	46.21	41.19	NO
400.	43.30	6	1.0	1.1	10000.0	52.10	42.39	27.71	NO
500.	48.73	6	1.0	1.1	10000.0	52.10	51.47	32.28	NO
600.	48.97	6	1.0	1.1	10000.0	52.10	60.34	36.61	NO
700.	46.74	6	1.0	1.1	10000.0	52.10	68.99	40.72	NO
800.	43.58	6	1.0	1.1	10000.0	52.10	77.43	44.61	NO
900.	40.23	6	1.0	1.1	10000.0	52.10	85.64	48.31	NO
1000.	37.01	6	1.0	1.1	10000.0	52.10	93.65	51.85	NO
1100.	34.05	6	1.0	1.1	10000.0	52.10	101.47	55.23	NO
1200.	31.38	6	1.0	1.1	10000.0	52.10	109.09	58.48	NO
1300.	29.00	6	1.0	1.1	10000.0	52.10	116.54	61.60	NO
1400.	26.89	6	1.0	1.1	10000.0	52.10	123.82	64.61	NO
1500.	25.01	6	1.0	1.1	10000.0	52.10	130.93	67.52	NO
1600.	23.33	6	1.0	1.1	10000.0	52.10	137.90	70.33	NO
1700.	21.84	6	1.0	1.1	10000.0	52.10	144.72	73.06	NO
1800.	20.50	6	1.0	1.1	10000.0	52.10	151.40	75.71	NO
1900.	19.30	6	1.0	1.1	10000.0	52.10	157.95	78.29	NO
2000.	18.21	6	1.0	1.1	10000.0	52.10	164.37	80.80	NO
2100.	17.23	6	1.0	1.1	10000.0	52.10	170.67	83.24	NO
2200.	16.34	6	1.0	1.1	10000.0	52.10	176.86	85.63	NO

```
  2300.    15.53        6     1.0    1.1 10000.0   52.10  182.94   87.96    NO
  2400.    14.78        6     1.0    1.1 10000.0   52.10  188.91   90.23    NO
  2500.    14.10        6     1.0    1.1 10000.0   52.10  194.78   92.46    NO
  2600.    13.48        6     1.0    1.1 10000.0   52.10  200.56   94.64    NO
  2700.    12.90        6     1.0    1.1 10000.0   52.10  206.24   96.78    NO
  2800.    12.37        6     1.0    1.1 10000.0   52.10  211.84   98.88    NO
  2900.    11.88        6     1.0    1.1 10000.0   52.10  217.35  100.94    NO
  3000.    11.42        6     1.0    1.1 10000.0   52.10  222.77  102.96    NO
  3500.    9.552        6     1.0    1.1 10000.0   52.10  248.77  112.57    NO
  4000.    8.185        6     1.0    1.1 10000.0   52.10  273.11  121.48    NO
  4500.    7.148        6     1.0    1.1 10000.0   52.10  296.04  129.81    NO
  5000.    6.336        6     1.0    1.1 10000.0   52.10  317.74  137.66    NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND    80. M:
    87.    66.44        3     5.0    5.2  1600.0   25.00   19.30   17.90    NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

      ***************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ***************************************

 CALCULATION         MAX CONC    DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   ---------   -------
SIMPLE TERRAIN       66.44          87.        0.


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Final Dryer 1

06/17/16
20:36:32

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 13043 ***

Final Dryer 1

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000000
STACK HEIGHT (M)	=	12.4968
STK INSIDE DIAM (M)	=	0.4572
STK EXIT VELOCITY (M/S)	=	24.6534
STK GAS EXIT TEMP (K)	=	381.4830
AMBIENT AIR TEMP (K)	=	293.0000
RECEPTOR HEIGHT (M)	=	0.0000
URBAN/RURAL OPTION	=	URBAN
BUILDING HEIGHT (M)	=	0.0000
MIN HORIZ BLDG DIM (M)	=	0.0000
MAX HORIZ BLDG DIM (M)	=	0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

STACK EXIT VELOCITY WAS CALCULATED FROM
VOLUME FLOW RATE = 8576.0000 (ACFM)

BUOY. FLUX = 2.930 M**4/S**3; MOM. FLUX = 24.395 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
80.	89.90	3	4.0	4.2	1280.0	23.97	17.57	16.26	NO
100.	89.60	3	3.0	3.1	960.0	27.79	22.01	20.47	NO
200.	77.49	4	2.0	2.1	640.0	35.19	31.47	27.96	NO
300.	61.58	4	1.5	1.6	480.0	42.75	46.17	41.15	NO
400.	58.27	6	1.0	1.1	10000.0	47.01	42.03	27.15	NO
500.	61.35	6	1.0	1.1	10000.0	47.01	51.17	31.80	NO
600.	58.89	6	1.0	1.1	10000.0	47.01	60.08	36.19	NO
700.	54.42	6	1.0	1.1	10000.0	47.01	68.77	40.34	NO
800.	49.55	6	1.0	1.1	10000.0	47.01	77.23	44.26	NO
900.	44.92	6	1.0	1.1	10000.0	47.01	85.46	47.99	NO
1000.	40.76	6	1.0	1.1	10000.0	47.01	93.49	51.55	NO
1100.	37.09	6	1.0	1.1	10000.0	47.01	101.31	54.95	NO
1200.	33.88	6	1.0	1.1	10000.0	47.01	108.95	58.21	NO
1300.	31.08	6	1.0	1.1	10000.0	47.01	116.41	61.35	NO
1400.	28.64	6	1.0	1.1	10000.0	47.01	123.69	64.37	NO
1500.	26.50	6	1.0	1.1	10000.0	47.01	130.82	67.29	NO
1600.	24.61	6	1.0	1.1	10000.0	47.01	137.79	70.11	NO
1700.	22.95	6	1.0	1.1	10000.0	47.01	144.61	72.85	NO
1800.	21.47	6	1.0	1.1	10000.0	47.01	151.30	75.51	NO
1900.	20.15	6	1.0	1.1	10000.0	47.01	157.85	78.09	NO
2000.	18.97	6	1.0	1.1	10000.0	47.01	164.27	80.61	NO
2100.	17.90	6	1.0	1.1	10000.0	47.01	170.58	83.06	NO
2200.	16.94	6	1.0	1.1	10000.0	47.01	176.77	85.45	NO

2300.	16.07	6	1.0	1.1	10000.0	47.01	182.85	87.78	NO
2400.	15.28	6	1.0	1.1	10000.0	47.01	188.83	90.06	NO
2500.	14.55	6	1.0	1.1	10000.0	47.01	194.70	92.29	NO
2600.	13.89	6	1.0	1.1	10000.0	47.01	200.48	94.48	NO
2700.	13.28	6	1.0	1.1	10000.0	47.01	206.17	96.62	NO
2800.	12.71	6	1.0	1.1	10000.0	47.01	211.77	98.72	NO
2900.	12.19	6	1.0	1.1	10000.0	47.01	217.28	100.79	NO
3000.	11.71	6	1.0	1.1	10000.0	47.01	222.70	102.81	NO
3500.	9.756	6	1.0	1.1	10000.0	47.01	248.71	112.43	NO
4000.	8.335	6	1.0	1.1	10000.0	47.01	273.05	121.35	NO
4500.	7.263	6	1.0	1.1	10000.0	47.01	295.98	129.69	NO
5000.	6.426	6	1.0	1.1	10000.0	47.01	317.70	137.55	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 80. M:

84.	90.27	3	4.0	4.2	1280.0	23.97	18.64	17.27	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	90.27	84.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

Final Dryer 2/Final Dryer 3

06/17/16
20:47:11

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 13043 ***

Final Dryers 2 and 3

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE              =        POINT
   EMISSION RATE (G/S)      =     1.000000
   STACK HEIGHT (M)         =      12.4968
   STK INSIDE DIAM (M)      =       0.4572
   STK EXIT VELOCITY (M/S)=        45.2218
   STK GAS EXIT TEMP (K)    =     388.7060
   AMBIENT AIR TEMP (K)     =     293.0000
   RECEPTOR HEIGHT (M)      =       0.0000
   URBAN/RURAL OPTION       =        URBAN
   BUILDING HEIGHT (M)      =       0.0000
   MIN HORIZ BLDG DIM (M) =         0.0000
   MAX HORIZ BLDG DIM (M) =         0.0000
```

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

STACK EXIT VELOCITY WAS CALCULATED FROM
VOLUME FLOW RATE = 15731.000 (ACFM)

BUOY. FLUX = 5.706 M**4/S**3; MOM. FLUX = 80.555 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
80.	53.56	3	8.0	8.4	2560.0	21.95	17.43	16.12	NO
100.	54.37	3	5.0	5.2	1600.0	27.63	21.83	20.28	NO
200.	46.98	4	3.5	3.7	1120.0	33.87	31.39	27.87	NO
300.	37.83	4	2.0	2.1	640.0	49.90	46.60	41.62	NO
400.	35.20	6	1.0	1.1	10000.0	55.60	42.67	28.14	NO
500.	41.38	6	1.0	1.1	10000.0	55.60	51.70	32.65	NO
600.	42.89	6	1.0	1.1	10000.0	55.60	60.54	36.94	NO
700.	41.87	6	1.0	1.1	10000.0	55.60	69.16	41.01	NO
800.	39.69	6	1.0	1.1	10000.0	55.60	77.58	44.87	NO
900.	37.11	6	1.0	1.1	10000.0	55.60	85.78	48.56	NO
1000.	34.48	6	1.0	1.1	10000.0	55.60	93.78	52.07	NO
1100.	31.97	6	1.0	1.1	10000.0	55.60	101.58	55.44	NO
1200.	29.66	6	1.0	1.1	10000.0	55.60	109.20	58.68	NO
1300.	27.56	6	1.0	1.1	10000.0	55.60	116.64	61.79	NO
1400.	25.66	6	1.0	1.1	10000.0	55.60	123.91	64.79	NO
1500.	23.96	6	1.0	1.1	10000.0	55.60	131.02	67.69	NO
1600.	22.43	6	1.0	1.1	10000.0	55.60	137.98	70.50	NO
1700.	21.05	6	1.0	1.1	10000.0	55.60	144.80	73.22	NO
1800.	19.81	6	1.0	1.1	10000.0	55.60	151.48	75.87	NO
1900.	18.68	6	1.0	1.1	10000.0	55.60	158.02	78.44	NO
2000.	17.67	6	1.0	1.1	10000.0	55.60	164.44	80.94	NO
2100.	16.74	6	1.0	1.1	10000.0	55.60	170.74	83.38	NO
2200.	15.90	6	1.0	1.1	10000.0	55.60	176.93	85.76	NO

```
  2300.    15.13        6     1.0     1.1 10000.0   55.60  183.00   88.09    NO
  2400.    14.43        6     1.0     1.1 10000.0   55.60  188.97   90.36    NO
  2500.    13.78        6     1.0     1.1 10000.0   55.60  194.84   92.59    NO
  2600.    13.18        6     1.0     1.1 10000.0   55.60  200.62   94.77    NO
  2700.    12.63        6     1.0     1.1 10000.0   55.60  206.30   96.90    NO
  2800.    12.12        6     1.0     1.1 10000.0   55.60  211.89   99.00    NO
  2900.    11.65        6     1.0     1.1 10000.0   55.60  217.40  101.06    NO
  3000.    11.21        6     1.0     1.1 10000.0   55.60  222.83  103.07    NO
  3500.    9.402        6     1.0     1.1 10000.0   55.60  248.82  112.68    NO
  4000.    8.075        6     1.0     1.1 10000.0   55.60  273.15  121.57    NO
  4500.    7.063        6     1.0     1.1 10000.0   55.60  296.08  129.90    NO
  5000.    6.269        6     1.0     1.1 10000.0   55.60  317.78  137.75    NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND    80. M:
    97.    54.49        3     5.0     5.2  1600.0   27.63   21.41   19.88    NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

      ***************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ***************************************

 CALCULATION          MAX CONC    DIST TO   TERRAIN
  PROCEDURE          (UG/M**3)    MAX (M)    HT (M)
--------------     -----------   ---------   -------
SIMPLE TERRAIN        54.49           97.         0.


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
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```

Print Plate Processor

06/18/16
15:53:09

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 13043 ***

Print Plate Processor

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE            =        POINT
   EMISSION RATE (G/S)    =     1.000000
   STACK HEIGHT (M)       =      12.4968
   STK INSIDE DIAM (M)    =       0.1400
   STK EXIT VELOCITY (M/S)=      10.8290
   STK GAS EXIT TEMP (K)  =     293.0000
   AMBIENT AIR TEMP (K)   =     293.0000
   RECEPTOR HEIGHT (M)    =       0.0000
   URBAN/RURAL OPTION     =        URBAN
   BUILDING HEIGHT (M)    =       0.0000
   MIN HORIZ BLDG DIM (M) =       0.0000
   MAX HORIZ BLDG DIM (M) =       0.0000
```

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

STACK EXIT VELOCITY WAS CALCULATED FROM
VOLUME FLOW RATE = 0.16670001   (M**3/S)

BUOY. FLUX =   0.000 M**4/S**3; MOM. FLUX =   0.575 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF   0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
80.	684.5	4	1.0	1.1	320.0	16.80	12.66	11.14	NO
100.	661.9	4	1.0	1.1	320.0	16.80	15.74	13.85	NO
200.	512.3	6	1.0	1.1	10000.0	16.25	21.20	14.07	NO
300.	343.2	6	1.0	1.1	10000.0	16.25	31.20	19.96	NO
400.	234.1	6	1.0	1.1	10000.0	16.25	40.87	25.32	NO
500.	169.6	6	1.0	1.1	10000.0	16.25	50.22	30.26	NO
600.	129.3	6	1.0	1.1	10000.0	16.25	59.28	34.84	NO
700.	102.5	6	1.0	1.1	10000.0	16.25	68.07	39.13	NO
800.	83.88	6	1.0	1.1	10000.0	16.25	76.60	43.16	NO
900.	70.31	6	1.0	1.1	10000.0	16.25	84.90	46.98	NO
1000.	60.10	6	1.0	1.1	10000.0	16.25	92.97	50.61	NO
1100.	52.19	6	1.0	1.1	10000.0	16.25	100.84	54.07	NO
1200.	45.94	6	1.0	1.1	10000.0	16.25	108.51	57.38	NO
1300.	40.88	6	1.0	1.1	10000.0	16.25	115.99	60.56	NO
1400.	36.73	6	1.0	1.1	10000.0	16.25	123.30	63.62	NO
1500.	33.28	6	1.0	1.1	10000.0	16.25	130.45	66.57	NO
1600.	30.36	6	1.0	1.1	10000.0	16.25	137.44	69.43	NO
1700.	27.87	6	1.0	1.1	10000.0	16.25	144.28	72.19	NO
1800.	25.73	6	1.0	1.1	10000.0	16.25	150.98	74.87	NO
1900.	23.86	6	1.0	1.1	10000.0	16.25	157.54	77.47	NO
2000.	22.23	6	1.0	1.1	10000.0	16.25	163.98	80.01	NO
2100.	20.79	6	1.0	1.1	10000.0	16.25	170.30	82.47	NO
2200.	19.51	6	1.0	1.1	10000.0	16.25	176.50	84.88	NO

2300.	18.37	6	1.0	1.1	10000.0	16.25	182.59	87.23	NO
2400.	17.35	6	1.0	1.1	10000.0	16.25	188.57	89.53	NO
2500.	16.42	6	1.0	1.1	10000.0	16.25	194.46	91.77	NO
2600.	15.59	6	1.0	1.1	10000.0	16.25	200.24	93.97	NO
2700.	14.83	6	1.0	1.1	10000.0	16.25	205.94	96.12	NO
2800.	14.13	6	1.0	1.1	10000.0	16.25	211.54	98.24	NO
2900.	13.50	6	1.0	1.1	10000.0	16.25	217.05	100.31	NO
3000.	12.91	6	1.0	1.1	10000.0	16.25	222.49	102.34	NO
3500.	10.58	6	1.0	1.1	10000.0	16.25	248.52	112.01	NO
4000.	8.939	6	1.0	1.1	10000.0	16.25	272.88	120.95	NO
4500.	7.721	6	1.0	1.1	10000.0	16.25	295.82	129.32	NO
5000.	6.786	6	1.0	1.1	10000.0	16.25	317.54	137.20	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 80. M:

80.	684.5	4	1.0	1.1	320.0	16.80	12.66	11.14	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	684.5	80.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

SAFETY DATA SHEET

1. Identification

Product identifier PROCESS BLACK

Other means of identification

Product code PI-3192

Recommended use Printing Inks and Coatings

Recommended restrictions Industrial Use Only

Manufacturer/Importer/Supplier/Distributor information

Manufacturer

Company name American Inks & Coatings

Address 3400 North Hutchinson Street
Pine Bluff, AR 71602
United States

Telephone Customer Service 1 (870) 247-2080

Website www.americaninks.com

E-mail SDS@americaninks.com

Contact person Regulatory

Emergency phone number Chemtrec in USA and Canada 1 (800) 424-9300

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards Skin corrosion/irritation Category 1

Serious eye damage/eye irritation Category 1

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement Causes severe skin burns and eye damage. Causes serious eye damage.

Precautionary statement

Prevention Do not breathe mist or vapor. Wash thoroughly after handling. Wear protective gloves/protective clothing/eye protection/face protection. Wear eye protection/face protection.

Response If swallowed: Rinse mouth. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. Wash contaminated clothing before reuse.

Storage Store locked up.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) None known.

Supplemental information None.

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
Glycerine		56-81-5	3 - < 5

Chemical name	Common name and synonyms	CAS number	%
Ethanolamine		141-43-5	1 - < 3
Other components below reportable levels			90 - 100

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. First-aid measures

Inhalation
If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.

Skin contact
Take off immediately all contaminated clothing. Rinse skin with water/shower. Call a physician or poison control center immediately. Chemical burns must be treated by a physician. Wash contaminated clothing before reuse.

Eye contact
Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a physician or poison control center immediately.

Ingestion
Call a physician or poison control center immediately. Rinse mouth. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.

Most important symptoms/effects, acute and delayed
Burning pain and severe corrosive skin damage. Causes serious eye damage. Permanent eye damage including blindness could result. Symptoms may include stinging, tearing, redness, swelling, and blurred vision.

Indication of immediate medical attention and special treatment needed
Provide general supportive measures and treat symptomatically. Chemical burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital. Keep victim under observation. Symptoms may be delayed.

General information
Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media
Powder. Foam. Carbon dioxide (CO2).

Unsuitable extinguishing media
Do not use water jet as an extinguisher, as this will spread the fire.

Specific hazards arising from the chemical
During fire, gases hazardous to health may be formed.

Special protective equipment and precautions for firefighters
Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

Fire fighting equipment/instructions
Move containers from fire area if you can do so without risk.

Specific methods
Use standard firefighting procedures and consider the hazards of other involved materials.

General fire hazards
No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures
Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Wear appropriate protective equipment and clothing during clean-up. Do not breathe mist or vapor. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up
Use water spray to reduce vapors or divert vapor cloud drift.

Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water.

Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.

Environmental precautions
Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling
Provide adequate ventilation. Do not breathe mist or vapor. Do not get in eyes, on skin, or on clothing. Avoid prolonged exposure. Wear appropriate personal protective equipment. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities Store locked up. Store in original tightly closed container. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Ethanolamine (CAS 141-43-5)	PEL	6 mg/m3	
		3 ppm	
Glycerine (CAS 56-81-5)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. ACGIH Threshold Limit Values

Components	Type	Value
Ethanolamine (CAS 141-43-5)	STEL	6 ppm
	TWA	3 ppm

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
Ethanolamine (CAS 141-43-5)	STEL	15 mg/m3
		6 ppm
	TWA	8 mg/m3
		3 ppm

Biological limit values No biological exposure limits noted for the ingredient(s).

Appropriate engineering controls Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles) and a face shield.

Skin protection

Hand protection Wear appropriate chemical resistant gloves. Suitable gloves can be recommended by the glove supplier.

Other Wear appropriate chemical resistant clothing.

Respiratory protection In case of insufficient ventilation, wear suitable respiratory equipment.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance

Physical state Liquid.

Form Liquid.

Color Black

Odor Mild

Odor threshold Not available.

pH 9.6 - 10

Melting point/freezing point 270.86 °F (132.7 °C) estimated

Initial boiling point and boiling range 212 °F (100 °C) estimated

Flash point Not available.

Evaporation rate Not available.

Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	0.00001 hPa estimated
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	
Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Other information	
Density	8.99
Explosive properties	Not explosive.
Oxidizing properties	Not oxidizing.
Specific gravity	1.08

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause irritation to the respiratory system. Prolonged inhalation may be harmful.
Skin contact	Causes severe skin burns. Prolonged or repeated exposure may cause liver and kidney damage. These effects have not been observed in humans.
Eye contact	Causes serious eye damage.
Ingestion	Causes digestive tract burns.
Symptoms related to the physical, chemical and toxicological characteristics	Burning pain and severe corrosive skin damage. Causes serious eye damage. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result.

Information on toxicological effects

Acute toxicity

Components	Species	Test Results
Ethanolamine (CAS 141-43-5)		
<u>Acute</u>		
Dermal		
LD50	Rabbit	1025 mg/kg

Components		Species	Test Results
Oral			
LD50		Guinea pig	620 mg/kg
		Mouse	700 mg/kg
		Rat	10.2 g/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation Causes severe skin burns and eye damage.

Serious eye damage/eye irritation Causes serious eye damage.

Respiratory or skin sensitization

Respiratory sensitization Not a respiratory sensitizer.

Skin sensitization This product is not expected to cause skin sensitization.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not available.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

US. National Toxicology Program (NTP) Report on Carcinogens

Not available.

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure Not classified.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard Not an aspiration hazard.

Chronic effects May be harmful if absorbed through skin. Prolonged inhalation may be harmful.

Prolonged or repeated exposure may cause liver and kidney damage. These effects have not been observed in humans.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components		Species	Test Results
Ethanolamine (CAS 141-43-5)			
Aquatic			
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	114 - 196 mg/l, 96 hours
Glycerine (CAS 56-81-5)			
Aquatic			
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	51000 - 57000 mg/l, 96 hours

* Estimates for product may be based on additional component data not shown.

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential

Partition coefficient n-octanol / water (log Kow)

Ethanolamine	-1.31
Glycerine	-1.76

Mobility in soil No data available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not established.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. California Controlled Substances. CA Department of Justice (California Health and Safety Code Section 11100)

Not listed.

US. Massachusetts RTK - Substance List

Ethanolamine (CAS 141-43-5)
Glycerine (CAS 56-81-5)

US. New Jersey Worker and Community Right-to-Know Act

Ethanolamine (CAS 141-43-5)
Glycerine (CAS 56-81-5)

US. Pennsylvania Worker and Community Right-to-Know Law

Ethanolamine (CAS 141-43-5)
Glycerine (CAS 56-81-5)

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

WARNING: This product contains a chemical known to the State of California to cause cancer. WARNING: This product contains a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

a Methyl Styrene (CAS 98-83-9) Listed: November 2, 2012

16. Other information, including date of preparation or last revision

Issue date 07-01-2015

Revision date 05-05-2016

Version # 03

Disclaimer American Inks & Coatings cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

Revision Information Regulatory information: California Prop 65

The MSDS format adheres to the standards and regulatory requirements of the United States and may not meet regulatory requirements in other countries.

CYLOSOL AND CYLOSOL I IN LINE SOLUTION
P0000296 Revised 12-MAY-2010

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Company Identification

MANUFACTURER/DISTRIBUTOR
DuPont "Cyrel" Packaging Graphics Products
Chestnut Run Plaza, Building 702
Wilmington
DE
19880-0702

PHONE NUMBERS
Product Information : 800-345-9999 - press 1
Transport Emergency : 800-424-9300 (CHEMTREC)
Medical Emergency : 800-441-3637

COMPOSITION/INFORMATION ON INGREDIENTS

Components

Material	CAS Number	%
Benzyl Alcohol	100-51-6	15-40
Synthetic hydrocarbons		
Aliphatic esters		

Components (Remarks)

Material is not known to contain Toxic Chemicals under Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR part 372.

The specific identity and exact concentration of the hydrocarbon and ester components are withheld as trade secrets.

HAZARDS IDENTIFICATION

Potential Health Effects

THIS PRODUCT CAN BE USED SAFELY WHEN USED AS DIRECTED AND WHEN APPLICABLE SAFETY PRECAUTIONS ARE FOLLOWED.

(HAZARDS IDENTIFICATION - Continued)

INHALATION

High vapor concentrations may cause: Eye irritation with tearing, pain or blurred vision. Irritation of nose, throat, and lungs with cough, difficulty breathing or shortness of breath. Central nervous system depression with dizziness, confusion, incoordination, drowsiness or unconsciousness. Non-specific effects such as headache, nausea and weakness.

SKIN CONTACT

Short-term overexposure may cause: Irritation with itching, burning, redness, swelling or rash.

Benzyl alcohol may cause allergic skin rashes. Evidence suggests that benzyl alcohol may be absorbed through the skin producing the effects of systemic toxicity.

EYE CONTACT

Contact with liquid may cause: Severe eye irritation with tearing, pain or blurred vision.

INGESTION

The major ingestion hazard is aspiration (liquid entering the lungs during ingestion or vomiting) which may result in "chemical pneumonia". Symptoms include coughing, gasping, choking, shortness of breath, bluish discoloration of the skin, rapid breathing and heart rate, and fever. Pulmonary edema or bleeding, drowsiness, confusion, coma and seizures may occur in more serious cases. Symptoms may develop immediately or as late as 24 hours after exposure, depending on how much chemical entered the lungs.

Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

FIRST AID MEASURES

First Aid

INHALATION

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT

(FIRST AID MEASURES - Continued)

Flush skin with water after contact. Wash contaminated clothing before reuse.

EYE CONTACT

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION

If swallowed, do not induce vomiting. Immediately give 2 glasses of water. Never give anything by mouth to an unconscious person. Call a physician.

Notes to Physicians

No antidote or specific treatment regimens known. Use supportive measures as needed.

FIRE FIGHTING MEASURES

Flammable Properties

Flash Point	: >144 F (>62 C)
Flammable limits in Air, % by Volume	
LEL	: 2.3
UEL	: 7.9

Combustible liquid. Can form combustible mixtures at or above the flashpoint. Can accumulate static charges which can cause an incendiary electrical discharge.

Extinguishing Media

Water Spray, Foam, Dry Chemical.

Fire Fighting Instructions

Keep personnel removed and upwind of fire. Wear self-contained breathing apparatus. Wear full protective equipment. Cool tank/container with water spray.

ACCIDENTAL RELEASE MEASURES

Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

(ACCIDENTAL RELEASE MEASURES - Continued)

Initial Containment

Remove source of heat, sparks, flame, impact, friction or electricity. Dike spill. Prevent material from entering sewers, waterways, or low areas.

Spill Clean Up

Soak up with sand, oil dry, or other noncombustible absorbent materials. Dispose of in an approved container.

HANDLING AND STORAGE

Handling (Personnel)

Avoid breathing vapors or mist. Avoid contact with eyes, skin, or clothing. Wash thoroughly after handling. Wash contaminated clothing prior to reuse.

Handling (Physical Aspects)

Keep away from heat, sparks and flames. Ground container when pouring.

Storage

Keep container tightly closed. Store in a cool, dry, well-ventilated area.

EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Use sufficient ventilation to keep employee exposure below recommended limits.

Personal Protective Equipment

EYE/FACE PROTECTION

Wear coverall chemical splash goggles and face shield when possibility exists for eye and face contact due to splashing or spraying materials.

RESPIRATORY PROTECTION

PROTECTIVE CLOTHING

Wear impervious clothing, such as gloves, apron, boots, or whole bodysuit as appropriate.

(EXPOSURE CONTROLS/PERSONAL PROTECTION - Continued)

Where airborne concentrations are expected to exceed exposure limits, a NIOSH approved respirator should be selected based on the form and concentration of the contaminant in air and in accordance with OSHA Respiratory Protection Standard CFR 1910.134.

Exposure Guidelines

Applicable Exposure Limits

Benzyl Alcohol

PEL (OSHA)	: None Established
TLV (ACGIH)	: None Established
AEL * (DuPont)	: 10 ppm, 8 Hr. TWA
WEEL (AIHA)	: 10 ppm, 8 Hr. TWA

Synthetic hydrocarbons

PEL (OSHA)	: None Established
TLV (ACGIH)	: None Established
AEL * (DuPont)	: 100 ppm, 8 Hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

PHYSICAL AND CHEMICAL PROPERTIES

Physical Data

Boiling Point	: 370-410 F (188-210 C) @ 760 mm Hg
Vapor Pressure	: <1 mbar
Vapor Density	: 3.7 (Air=1.0) for Benzyl Alcohol 5.9 (Air=1.0) for 2-Ethylhexyl Acetate
Solubility in Water	: Negligible
pH	: Not Applicable (organic liquid)
Specific Gravity	: 0.877
% Volatiles	: 100 %
Volatile Organic Content	: 7.314 lb/gal (calculated)
Odor	: Sweet.
Form	: Liquid
Color	: Colorless.

STABILITY AND REACTIVITY

Chemical Stability

Stable at normal temperatures and storage conditions.

Incompatibility with Other Materials

Incompatible or can react with strong oxidizers, strong acids, bases.

(STABILITY AND REACTIVITY - Continued)

Decomposition

Decomposition temperature: Not Available

Polymerization

Polymerization will not occur.

TOXICOLOGICAL INFORMATION

Animal Data

For toxicity information, contact "Cyrel" Packaging Graphics Products at 1-800-345-9999.

ECOLOGICAL INFORMATION

Ecotoxicological Information

For information, contact "Cyrel" Packaging Graphics Products at 1-800-345-9999.

DISPOSAL CONSIDERATIONS

Waste Disposal

Treatment, storage, transportation, and disposal must be in accordance with applicable Federal, State/Provincial, and Local regulations. Do not flush to surface water or sanitary sewer system.

TRANSPORTATION INFORMATION

Shipping Information

Check the current Bill of Lading for proper shipping information.

Limited quantities of combustible liquids are excepted from DOT labeling requirements, unless offered for transportation or transported by aircraft.

REGULATORY INFORMATION

U.S. Federal Regulations

TSCA Inventory Status : In compliance with TSCA Inventory requirements for commercial purposes.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute	: Yes
Chronic	: No
Fire	: Yes
Reactivity	: No
Pressure	: No

OTHER INFORMATION

NFPA, NPCA-HMIS

NPCA-HMIS Rating

Health	: 2
Flammability	: 2
Reactivity	: 0

Additional Information

For additional Material Data Safety Sheets, contact your DuPont dealer or the DuPont marketing service center which serves your area.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsibility for MSDS : DuPont "Cyrel" Packaging Graphics Products

Address : Chestnut Run Plaza - 702
Wilmington, DE 19880-0702

Telephone : 800-345-9999 (Press 1)

This information is based upon technical information believed to be reliable. It is subject to revision as additional knowledge and experience is gained.

End of MSDS

APPENDIX F: LETTERS TO FLM

3495 Piedmont Road | Building 10, Suite 905 | Atlanta, GA 30305 | P (678) 441-9977 | F (678) 441-9978
trinityconsultants.com

Trinity Consultants

June 30, 2016

Ms. Susan Johnson
Air Resources Division
National Park Service
P.O. Box 25287
Denver, CO 80225

RE: WestRock Lithia Springs Preprint Plant – Greenfield Construction
Notification of NSR Project in Reference to NPS Class I Areas – Great Smoky Mountains National Park

Dear Ms. Reed:

Trinity Consultants (Trinity) is submitting this letter to your attention on behalf of our client, WestRock for proposed construction of a greenfield preprint plant to be located in an existing building in Lithia Springs, Douglas County, Georgia. Douglas County is presently designated as nonattainment for the 8-hour ozone standard, with a reduced major source threshold for oxides of nitrogen (NO_X) and volatile organic compounds (VOC), ozone precursors, of 25 tons per year. The proposed flexographic printing operations and ancillary sources require submittal of a New Source Review (NSR) major source construction permit application for VOC only, and will be a minor NSR source with respect to all other regulated pollutants.

Expected emissions from the proposed project include VOC, NO_X, greenhouse gases (GHG) in the form of carbon dioxide equivalents (CO_2e)[1], particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), hazardous air pollutants (HAP), and all other combustion emissions associated with natural gas.

As part of the NSR application process, WestRock has qualitatively evaluated its impacts on federally-protected Class I areas. The purpose of this letter is to provide the Federal Land Manager (FLM) with preliminary information on the proposed project and to request concurrence from the FLM on the findings presented.

Q/D SCREENING ANALYSIS

A Q/D screening analysis was performed in a manner consistent with the approach discussed in the most recent Federal Land Managers' Air Quality Related Values Work Group (FLAG) guidance document (FLAG 2010), which compares the ratio of visibility affecting pollutant emissions to the distance from the Class I area (i.e., referenced herein as the FLAG 2010 Approach).[2] "Q" is the sum of the annual NO_X, PM_{10}, SO_2, and H_2SO_4 emissions, in tons

[1] CO_2e is carbon dioxide equivalents calculated as the sum of the six well-mixed GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) with applicable global warming potentials per 40 CFR 98 applied.

[2] Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised 2010, *October 7, 2010*.

per year (tpy)[3] and "D" is the distance, in kilometers (km), from the proposed facility to the corresponding Class I area. The total emissions for this "project" will include emissions from the proposed preprint press, including natural gas burners, a plate-processor, and storage tanks.

A summary of the visibility-affecting pollutant (VAP) emissions resulting from the proposed project are shown in Table 1 using the FLAG 2010 Approach.

Table 1. Summary of Visibility-Affecting Pollutant Emissions

Pollutant	Project Maximum 24-Hr Emissions[2] (lb/hr)	FLAG 2010 Approach Annual Emissions[2] (Q, tpy)
NO_X	1.25	5.46
Direct Particulate[1]	0.09	0.41
SO_2	0.01	0.03
Sum of Emissions	1.35	5.91

1. Direct particulate includes all filterable and condensible PM_{10}, such as EC, PMC, PMF, H_2SO_4, SOA, NO_3, etc.

2. FLAG 2010 Approach: Q = [SO_2 + NO_2 + SO_4 + EC + PMC + PMF + SOA + NO_3 (maximum 24-hr basis)]

As shown in Table 2, there are no Class I areas within 100 km of the proposed project in Douglas County, Georgia. There are five (5) Class I areas are located within 300 km of the proposed project. Four of the Class I areas within 300 km of the proposed facility, the Cohutta Wilderness, Joyce Kilmer, Shining Rock, and Sipsey Wilderness areas, are managed by the Forest Service (FS); The Great Smoky Mountains National Parks is managed by the National Park Service (NPS). This letter is being sent to your attention as you are the designated primary contact for the Great Smoky Mountains National Park.[4]

[3] It is specified within the Flag 2010 Report that "Q" be calculated as the sum of the worst-case 24-hour emissions converted to an annual basis.

[4] Per http://www.scdhec.gov/Environment/AirQuality/FederalLandManagers/

Table 2. Summary of Class I Areas within 300 km of the Proposed Project

Class I Area	Responsible FLM	Minimum Distance from Site (km)	Sum of Annualized VAP Emissions - Q (tpy)	FLAG 2010 Approach Q/D
Cohutta Wilderness	FS	123		0.05
Joyce Kilmer Slickrock Wilderness	FS	188		0.03
Great Smoky Mountains National Park	NPS	202	5.91	0.03
Shining Rock	FS	236		0.03
Sipsey Wilderness Area	FS	263		0.02

Table 2 shows the results of the Q/D screening analysis for the FLAG 2010 Approach. As shown, all of the Class I areas within 300 km of the project (considering source-wide emissions) have a Q/D well below ten. This suggests that the proposed project will have no adverse impacts to any AQRVs at near-by Class I areas; therefore, WestRock plans no AQRV analyses for the proposed project.

Based on our finding of no adverse impact on the Class I areas from the proposed project as summarized in Table 2, WestRock requests that the NPS provide written concurrence of this finding of no impact.

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WestRock greatly appreciates your feedback on this conclusion regarding no presumptive impacts to AQRVs at the Great Smoky Mountains National Park Class I area under management of the NPS. Please feel free to contact me at 678-441-9977 with any questions that you have.

Sincerely,

TRINITY CONSULTANTS

Justin Fickas
Managing Consultant

cc: Mr. Eric Cornwell (Georgia Environmental Protection Division)
~~~~~~

3495 Piedmont Road | Building 10, Suite 905 | Atlanta, GA 30305 | P (678) 441-9977 | F (678) 441-9978
trinityconsultants.com

Trinity Consultants

June 30, 2016

Mr. Bill Jackson
USDA Forest Service
160A Zillicoa Drive
Asheville, NC 28801

RE: WestRock Lithia Springs Preprint Plant – Greenfield Construction
Notification of NSR Project in Reference to FS Class I Areas

Dear Mr. Jackson:

Trinity Consultants (Trinity) is submitting this letter to your attention on behalf of our client, WestRock for proposed construction of a greenfield preprint plant to be located in an existing building in Lithia Springs, Douglas County, Georgia. Douglas County is presently designated as nonattainment for the 8-hour ozone standard, with a reduced major source threshold for oxides of nitrogen (NO_X) and volatile organic compounds (VOC), ozone precursors, of 25 tons per year. The proposed flexographic printing operations and ancillary sources require submittal of a New Source Review (NSR) major source construction permit application for VOC only, and will be a minor NSR source with respect to all other regulated pollutants.

Expected emissions from the proposed project include VOC, NO_X, greenhouse gases (GHG) in the form of carbon dioxide equivalents (CO_2e)[1], particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), hazardous air pollutants (HAP), and all other combustion emissions associated with natural gas.

As part of the NSR application process, WestRock has qualitatively evaluated its impacts on federally-protected Class I areas. The purpose of this letter is to provide the Federal Land Manager (FLM) with preliminary information on the proposed project and to request concurrence from the FLM on the findings presented.

Q/D SCREENING ANALYSIS

A Q/D screening analysis was performed in a manner consistent with the approach discussed in the most recent Federal Land Managers' Air Quality Related Values Work Group (FLAG) guidance document (FLAG 2010), which compares the ratio of visibility affecting pollutant emissions to the distance from the Class I area (i.e., referenced herein as the FLAG 2010 Approach).[2] "Q" is the sum of the annual NO_X, PM_{10}, SO_2, and H_2SO_4 emissions, in tons

[1] CO_2e is carbon dioxide equivalents calculated as the sum of the six well-mixed GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) with applicable global warming potentials per 40 CFR 98 applied.

[2] Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised 2010, *October 7, 2010*.

per year (tpy)[3] and "D" is the distance, in kilometers (km), from the proposed facility to the corresponding Class I area. The total emissions for this "project" will include emissions from the proposed preprint press, including natural gas burners, a plate-processor, and storage tanks.

A summary of the visibility-affecting pollutant (VAP) emissions resulting from the proposed project are shown in Table 1 using the FLAG 2010 Approach.

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Pollutant	Project Maximum 24-Hr Emissions[2] (lb/hr)	FLAG 2010 Approach Annual Emissions[2] (Q, tpy)
NO_X	1.25	5.46
Direct Particulate[1]	0.09	0.41
SO_2	0.01	0.03
Sum of Emissions	1.35	5.91

1. Direct particulate includes all filterable and condensible PM_{10}, such as EC, PMC, PMF, H_2SO_4, SOA, NO_3, etc.

2. FLAG 2010 Approach: Q = [SO_2 + NO_2 + SO_4 + EC + PMC + PMF + SOA + NO_3 (maximum 24-hr basis)]

As shown in Table 2, there are no Class I areas within 100 km of the proposed project in Douglas County, Georgia. There are five (5) Class I areas are located within 300 km of the proposed project. Four of the Class I areas within 300 km of the proposed facility, the Cohutta Wilderness, Joyce Kilmer, Shining Rock, and Sipsey Wilderness areas, are managed by the Forest Service (FS); The Great Smoky Mountains National Parks is managed by the National Park Service (NPS). This letter is being sent to your attention as you are the designated primary contact for Cohutta Wilderness, Joyce-Kilmer, and Shining Rock.[4]

[3] It is specified within the Flag 2010 Report that "Q" be calculated as the sum of the worst-case 24-hour emissions converted to an annual basis.

[4] Per http://webcam.srs.fs.fed.us/contact.shtml

Table 2. Summary of Class I Areas within 300 km of the Proposed Project

Class I Area	Responsible FLM	Minimum Distance from Site (km)	Sum of Annualized VAP Emissions - Q (tpy)	FLAG 2010 Approach Q/D
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Sipsey Wilderness Area	FS	263		0.02

Table 2 shows the results of the Q/D screening analysis for the FLAG 2010 Approach. As shown, all of the Class I areas within 300 km of the project (considering source-wide emissions) have a Q/D well below ten. This suggests that the proposed project will have no adverse impacts to any AQRVs at near-by Class I areas; therefore, WestRock plans no AQRV analyses for the proposed project.

Based on our finding of no adverse impact on the Class I areas from the proposed project as summarized in Table 2, WestRock requests that the FS provide written concurrence of this finding of no impact.

~~~~~~

WestRock greatly appreciates your feedback on this conclusion regarding no presumptive impacts to AQRVs at the Cohutta Wilderness, Joyce-Kilmer, and Shining Rock Class I areas under management of the FS. Please feel free to contact me at 678-441-9977 with any questions that you have.

Sincerely,

TRINITY CONSULTANTS

Justin Fickas
Managing Consultant

cc: Mr. Eric Cornwell (Georgia Environmental Protection Division)
~~~~~~

3495 Piedmont Road | Building 10, Suite 905 | Atlanta, GA 30305 | P (678) 441-9977 | F (678) 441-9978
trinityconsultants.com

Trinity Consultants

June 30, 2016

Ms. Shannon Reed
USDA Forest Service
2946 Chestnut Street
Montgomery, AL 36107

RE: WestRock Lithia Springs Preprint Plant – Greenfield Construction
Notification of NSR Project in Reference to FS Class I Areas – Sipsey Wilderness

Dear Ms. Reed:

Trinity Consultants (Trinity) is submitting this letter to your attention on behalf of our client, WestRock for proposed construction of a greenfield preprint plant to be located in an existing building in Lithia Springs, Douglas County, Georgia. Douglas County is presently designated as nonattainment for the 8-hour ozone standard, with a reduced major source threshold for oxides of nitrogen (NO_X) and volatile organic compounds (VOC), ozone precursors, of 25 tons per year. The proposed flexographic printing operations and ancillary sources require submittal of a New Source Review (NSR) major source construction permit application for VOC only, and will be a minor NSR source with respect to all other regulated pollutants.

Expected emissions from the proposed project include VOC, NO_X, greenhouse gases (GHG) in the form of carbon dioxide equivalents (CO_2e)[1], particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), hazardous air pollutants (HAP), and all other combustion emissions associated with natural gas.

As part of the NSR application process, WestRock has qualitatively evaluated its impacts on federally-protected Class I areas. The purpose of this letter is to provide the Federal Land Manager (FLM) with preliminary information on the proposed project and to request concurrence from the FLM on the findings presented.

Q/D SCREENING ANALYSIS

A Q/D screening analysis was performed in a manner consistent with the approach discussed in the most recent Federal Land Managers' Air Quality Related Values Work Group (FLAG) guidance document (FLAG 2010), which compares the ratio of visibility affecting pollutant emissions to the distance from the Class I area (i.e., referenced herein as the FLAG 2010 Approach).[2] "Q" is the sum of the annual NO_X, PM_{10}, SO_2, and H_2SO_4 emissions, in tons

[1] CO_2e is carbon dioxide equivalents calculated as the sum of the six well-mixed GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) with applicable global warming potentials per 40 CFR 98 applied.

[2] Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised 2010, *October 7, 2010*.

per year (tpy)[3] and "D" is the distance, in kilometers (km), from the proposed facility to the corresponding Class I area. The total emissions for this "project" will include emissions from the proposed preprint press, including natural gas burners, a plate-processor, and storage tanks.

A summary of the visibility-affecting pollutant (VAP) emissions resulting from the proposed project are shown in Table 1 using the FLAG 2010 Approach.

Table 1. Summary of Visibility-Affecting Pollutant Emissions

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NO_X	1.25	5.46
Direct Particulate[1]	0.09	0.41
SO_2	0.01	0.03
Sum of Emissions	1.35	5.91

1. Direct particulate includes all filterable and condensible PM_{10}, such as EC, PMC, PMF, H_2SO_4, SOA, NO_3, etc.

2. FLAG 2010 Approach: Q = [SO_2 + NO_2 + SO_4 + EC + PMC + PMF + SOA + NO_3 (maximum 24-hr basis)]

As shown in Table 2, there are no Class I areas within 100 km of the proposed project in Douglas County, Georgia. There are five (5) Class I areas are located within 300 km of the proposed project. Four of the Class I areas within 300 km of the proposed facility, the Cohutta Wilderness, Joyce Kilmer, Shining Rock, and Sipsey Wilderness areas, are managed by the Forest Service (FS); The Great Smoky Mountains National Parks is managed by the National Park Service (NPS). This letter is being sent to your attention as you are the designated primary contact for Sipsey Wilderness.[4]

[3] It is specified within the Flag 2010 Report that "Q" be calculated as the sum of the worst-case 24-hour emissions converted to an annual basis.

[4] Per http://webcam.srs.fs.fed.us/contact.shtml

Table 2. Summary of Class I Areas within 300 km of the Proposed Project

Class I Area	Responsible FLM	Minimum Distance from Site (km)	Sum of Annualized VAP Emissions - Q (tpy)	FLAG 2010 Approach Q/D
Cohutta Wilderness	FS	123		0.05
Joyce Kilmer Slickrock Wilderness	FS	188		0.03
Great Smoky Mountains National Pa	NPS	202	5.91	0.03
Shining Rock	FS	236		0.03
Sipsey Wilderness Area	FS	263		0.02

Table 2 shows the results of the Q/D screening analysis for the FLAG 2010 Approach. As shown, all of the Class I areas within 300 km of the project (considering source-wide emissions) have a Q/D well below ten. This suggests that the proposed project will have no adverse impacts to any AQRVs at near-by Class I areas; therefore, WestRock plans no AQRV analyses for the proposed project.

Based on our finding of no adverse impact on the Class I areas from the proposed project as summarized in Table 2, WestRock requests that the FS provide written concurrence of this finding of no impact.

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WestRock greatly appreciates your feedback on this conclusion regarding no presumptive impacts to AQRVs at the Sipsey Wilderness Class I area under management of the FS. Please feel free to contact me at 678-441-9977 with any questions that you have.

Sincerely,

TRINITY CONSULTANTS

Justin Fickas
Managing Consultant

cc: Mr. Eric Cornwell (Georgia Environmental Protection Division)
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