UltraTemp Filters Operate at Temperatures as High as 1650°F

UltraCat Filters Remove NO_X at Temperatures as Low as 350°F

Remove PM, SO_2, HCl, NO_X, Dioxins and More in ONE Cost-effective System

Tri-Mer Corporation, specializing in advanced technologies for the control of fine particulate and pollutant gases, offers the UltraTemp and UltraCat systems for hot gas filtration, compliance with Boiler MACT, Incinerator MACT, Cement MACT, and emerging glass industry regulations. A new generation of very efficient light weight fiber-based ceramic filters is the heart of the UltraTemp and UltraCat systems.

- ***UltraTemp filters can operate at temperatures up to 1650°F.***

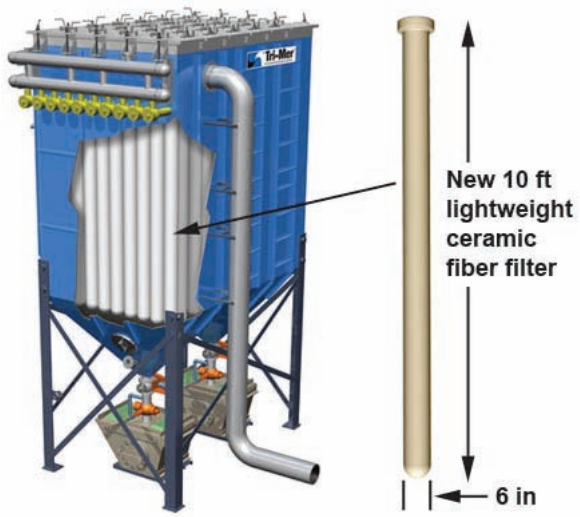
UltraCat catalyst filters are identical to the UltraTemp filters except they have embedded nanobits of NO_X catalyst in the walls of the filters that remove high levels of NO_X and dioxins at temperatures as low as 350°F. Up to 95% removal of NO_X with UltraCat filters.

Both UltraTemp and UltraCat have very high particulate removal efficiency.

- ***Typical PM removal to less than 0.001 grains/dscf (2 mg/Nm³).***

Both UltraTemp and UltraCat can remove acid gases like SO_2 and HCl by incorporating dry sorbent injection.

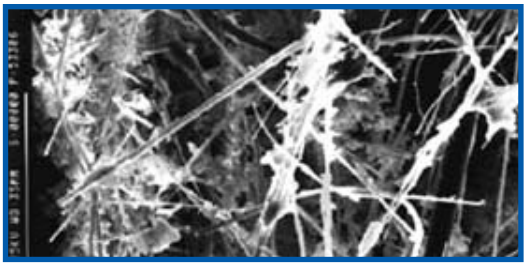
- ***Typical SO_2 results of 90-98% removal.***



Applications of the Tri-Mer UltraTemp and UltraCat filter systems include glass production, waste incineration, and biomass pyrolysis. They are also an excellent way to achieve ICI boiler MACT compliance for coal, biomass, and wood. Other applications include metal smelting, mineral processing and chemical production.

The heart of the filter technology is a new generation of ceramic filter tubes. Earlier generations of ceramic filters – sometimes called "candle" filters – were manufactured from high-density granular powders similar to common ceramic products. While effective, they were brittle, with low thermal shock resistance, and were prone to cracking and breakage from thermal shock. Surface porosity also made cleaning of the filters difficult because of their tendency to "blind."

Now, with advances in ceramic technology, these limitations have been overcome. The filter tubes in the Tri-Mer systems are manufactured from a new generation of low-density ceramic fibers that provide exceptionally high resistance to thermal shock. This makes the filters very ductile and resistant to crack formation.



Micrograph of filter elements composition.

CHARACTERISTICS OF (LOW-DENSITY) CERAMIC ELEMENTS	
Form	Monolithic rigid tube
Composition	Refractory fibers plus organic and inorganic binding agents
Porosity	About 80-90%
Density	About 0.3 - 0.4 g/cc
Support	Self supporting from integral flange
Geometry	Outer diameter up to 150 mm (6 in.) Length up to 3 m (10 ft.)

Characteristics of the fibrous ceramic filter elements.

Other unique properties of the fibers give the filters an exceptional ability to capture fine particulate at the surface, without blinding. This makes them easy to clean using standard pulse jet techniques. Being fibrous, rather than granular, the filter elements are also lightweight, and have a low resistance to flow, which minimizes the number of elements required for a given application.

CHARACTERISTICS OF HIGH- AND LOW-DENSITY CERAMIC-FILTER ELEMENTS		
	High Density	Low Density
Structure	Granular	Fibrous
Density	High	Low
Filter Drag	High	Low
Porosity, % (Inverse of resistance to flow)	0.3 - 0.4	0.8 - 0.9
Tensile strength	High	Low
Fracture mechanism	Brittle	Ductile
Thermal shock resistance	Low	High
Cost	High	Low

Contrast between types of ceramic filter elements. UltraTemp low-density filter tubes reflect a new generation of ceramic technology.

TEMPERATURE RANGE OF OPERATION		
Filter Name	**Pollutants Removed**	**Temperature Range**
UltraTemp	Particulate Matter (PM)	300°F to 1650°F
UltraTemp	PM + SO_2 , HCl, or other Acid Gases	300°F to 1200°F
UltraCat	PM + NO_X – Dioxins also destroyed	350°F to 700°F
UltraCat	PM + NO_X (+Dioxins) + SO_2 , Acid Gases	350°F to 700°F

POLLUTANT CONTROL

The typical level of PM at the outlet of the ceramic filters is less than 0.001 grains/dscf (2.0 mg/Nm^3). This is true even with very heavy inlet loadings of several thousand milligrams per cubic meter. PM is captured on the face of the filter and does not penetrate deeply into the filter body, thus allowing for repetitive and complete cleaning. This is an engineered feature of the filter surface. The filter does not "blind" or "fill up" with particulate as ordinary filters will. As a result, over the life of the filter, there is very little increase in pressure drop, which averages about 6˝ water gauge depending on the application. Pressure drop can be lowered by adding more filter elements or footprint, and capital cost can be reduced by decreasing the filter count at the expense of fan horsepower.

The filter construction also means that standard reverse pulse jet methods, which send a pulse of compressed air down the center of the tube, can thoroughly clean the accumulated PM from the outer surface of the tube. Filters are cleaned on-line, with no need to isolate each housing module.

Typical filter life is five to ten years. The filters are effective across the range of particle sizes, but are most often used when there is a large fraction of PM2.5 and submicron particulate. *See table below.*

EFFICIENCY OF FIBROUS CERAMIC FILTER ELEMENTS IN VARIOUS APPLICATIONS						
PROCESS	**PARTICLE SIZE**	**INLET PM LOADING**		**OUTLET PM LOADING**		**INFERRED EFFICIENCY**
	d_{50}[1] , µm	mg/Nm^3	gr/dscf	mg/Nm^3	gr/dscf	%
Aluminum powder production	**<50**	**550**	**0.24**	**<1**	**<0.0004**	**99.99**
Nickel refining	**<10**	**11,800**	**5.16**	**<1**	**<0.0004**	**>99.8**
Smokeless fuel production	**4.8**	**1000**	**0.44**	**1.5**	**0.0007**	**99.9**
Zirconia production	**1.2**	**8000**	**3.5**	**0.8**	**0.0003**	**99.85**
Secondary aluminum	**<1.0**	**870**	**0.38**	**0.5**	**0.0002**	**>99.99**

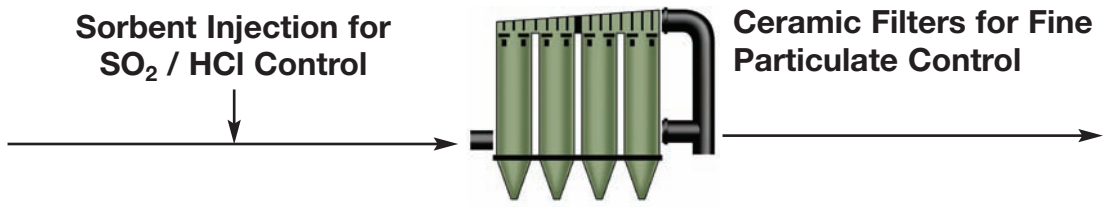
1. Diameter of median size particle

SO_2 AND ACID GAS CONTROL

The Tri-Mer UltraTemp and UltraCat filter systems feature an option for dry injection of calcium or sodium-based sorbents for the capture of acid gases. Sodium bicarbonate *(baking soda)* and trona are typical sodium-based sorbents. Trona is the naturally-occurring ore from which soda ash and sodium bicarbonate are produced and is mined exclusively in Wyoming. When properly milled, Trona can be used as a dry sorbent with no other processing required and is available throughout North America.

Injected in the duct, upstream of the filter modules, the additional sorbent particulate is easily captured along with its pollutant gas. The sorbent must be milled to small particle size in order to maximize surface area for maximum reactivity. The reaction occurs within the duct prior to the filter and on the filter cake that builds up on the surface of the filters. The chemical reaction of the sorbent with the acid gas creates a solid particle that is also captured on the filters alongside the unreacted sorbent and other particulate in the pollutant stream.

With sorbent injection, SO_2 removal is typically 90% or better, with removal efficiencies as high as 97%. HCl removal is typically 95%, and often as high as 99%. The temperature range for effective removal is 300°F to 1200°F.



UltraTemp Filtration system for control of particulate, SO_2, HCl, and other gases.

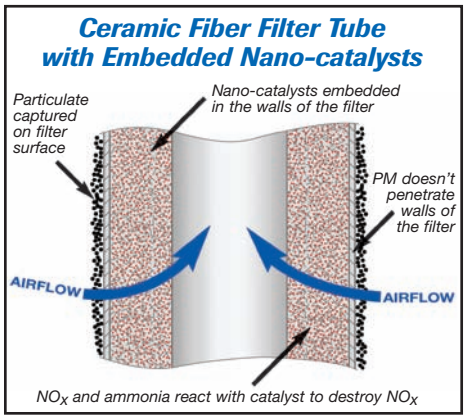
ULTRACAT CATALYST FILTERS: HIGH NO_X CONTROL, EFFECTIVE ON DIOXIN

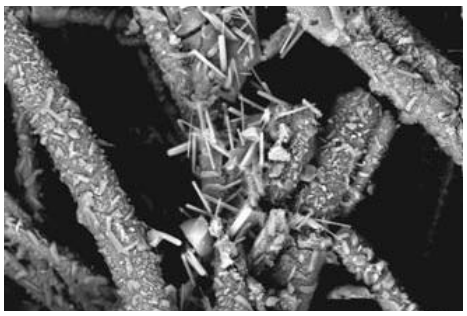
For NO_X or dioxin removal, UltraCat catalyst filter elements are available with nanobits of SCR catalyst embedded in the walls. The filter walls that contain the catalyst are about 3/4″ *(20mm)*, as represented in the graphic on page 5. Urea or ammonia is injected upstream of the filters. The catalyst embedded in the filters destroys the NO_X with up to 95% removal efficiency. *(Note the lower operating temperature required for high NO_X destruction: 350°F to 400°F, compared to 600°F to 650°F for conventional SCR.)*

Besides the need for high temperature, a common problem with traditional SCR is that the catalyst becomes poisoned and ineffective, necessitating early replacement. Typical poisons are ordinary PM, metals, and HCl. The UltraCat catalyst itself has a proprietary formulation with a fraction of the conversion rate of SO_2 to SO_3 of traditional SCR catalysts. The catalyst is not poisoned by SO_2.

The increased reactivity at lower temperatures shown by the UltraCat filters results, in part, from their micronized form. The diffusion restriction is very low, and, most significantly, the catalyst is almost completely protected from blinding by particulate matter, since it is inside the filter itself. UltraTemp filtration can incorporate PM removal, sorbent injection for SO_2 *(and other acid gases)* and catalytic reduction for NO_X in a single system.

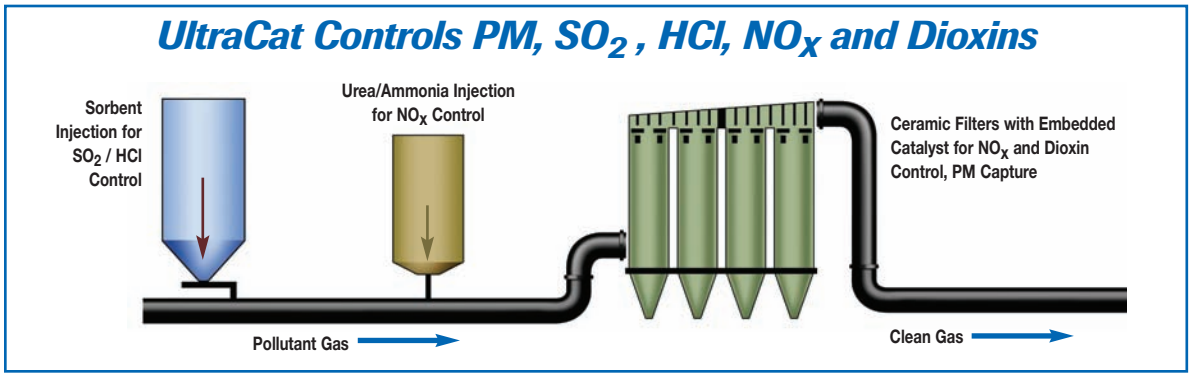
Dioxin removal is also exceptionally high, generally 97-99%. The dioxins are broken down by the catalyst. Tri-Mer supplies and installs the complete system and all components. *(**Note:** Operating temperature for high NO_X removal must be kept at 350°F to 700°F to achieve NO_X removal of 95%.)*





Micrograph of nano-catalysts embedded in ceramic-coated fibers.

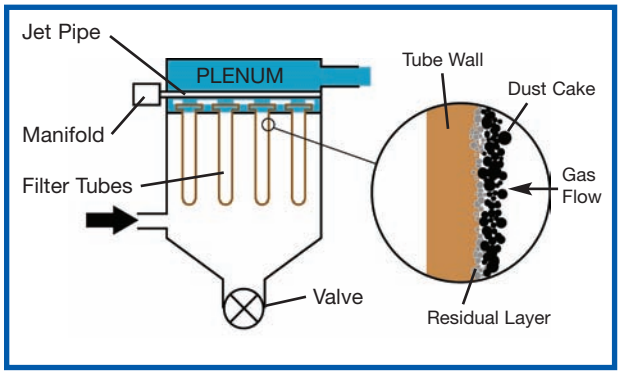
Multi-pollutant capability creates a powerful, all-in-one-solution that is superior, in terms of both performance and economics, to having a separate pollution control device for each pollutant. Particularly with NO_X, there are many circumstances where there is insufficient temperature to operate traditional SCR. Low temperature NO_X removal capability opens a new direction in NO_X control for operators of a wide range of boilers, and other industrial processes requiring NO_X control.



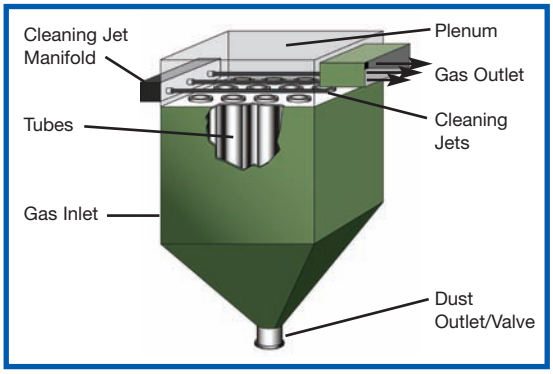
OPERATION OF THE ULTRATEMP FILTRATION SYSTEM

Tri-Mer's UltraTemp and UltraCat hot gas filter systems use baghouse configurations with a reverse pulse jet cleaning action. The filters are back-flushed with air, inert gas, syngas, or other appropriate gases. A reliable sealing mechanism is easy to access, and the design has been engineered for easy installation and maintenance. Filter elements are manufactured in various sizes, the largest of which is ten feet long and six inches in diameter, including an integral mounting flange.

- ***Pressure drop across the system is approximately 6-8 inches w.g.***



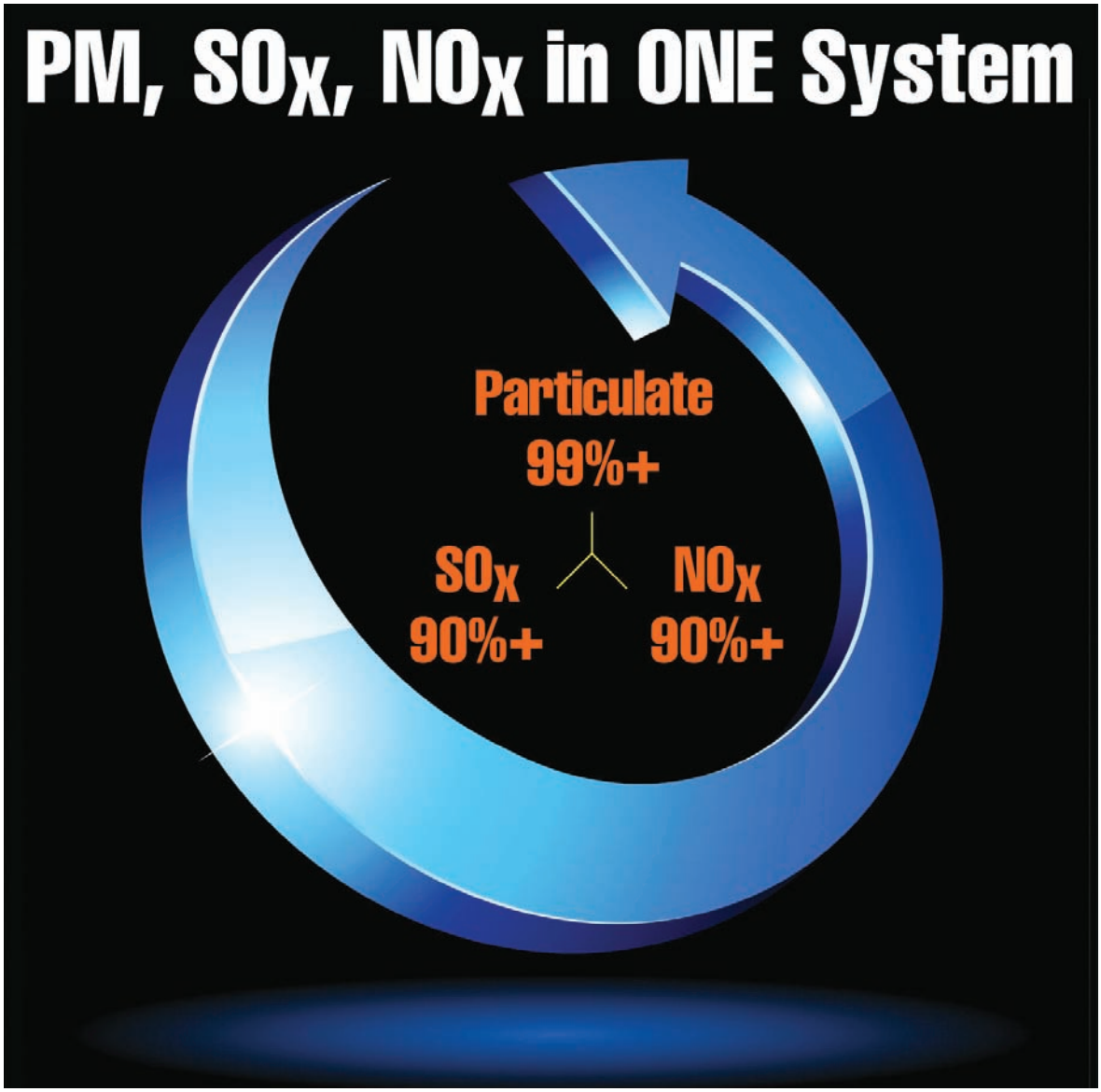
Reverse pulse jet cleaning mechanism for the filter tubes. Filter tube wall 3/4˝ thick. NO_X control option includes catalyst embedded in tube wall.



Filter element housing module of the Tri-Mer UltraTemp filtration system.

The UltraTemp and UltraCat filter systems are an efficient, cost-effective approach to hot gas filtration. With over 400 applications worldwide that use the fibrous ceramic filter elements, this proven technology is now commercially available throughout the US, with full technical and start-up support.

Low Cost Solution:



Recent advancements in fiber and ceramic technology have led to the implementation of Tri-Mer filter systems, the hot gas filtration systems that provide exceptionally versatile and efficient emissions control for processes as diverse as glass production, waste incineration, the production of metal powders, and boiler MACT compliance.

Primary Applications

- **Boiler MACT** compliance for coal, biomass, wood
- Glass furnaces
- Waste incineration
- Waste pyrolysis
- Metal smelting, mineral processing
- Chemical production
- Many specialized high temperature applications

Waste incineration facility incorporating new ceramic filter elements.

More Applications

Air Pollution Control

- Cement production
- Medical waste
- Soil cleaning
- Foundry processes
- Fluidized beds
- Energy production
- Fire testing

Product Collection/Recovery

- Titanium dioxide production
- Fumed silica production
- Carbon black production
- Catalyst manufacturing
- Platinum smelting
- Metal powder production
- Activated carbon production

Tri-Mer Corporation, a technology leader in air pollution control, provides turnkey engineering, manufacturing, installation, and service for the UltraTemp and UltraCat filter systems through its Michigan factory headquarters.

For more information, contact Kevin Moss,
Tri-Mer Business Development Director, Advanced Technologies.
Direct line: (801) 294-5422, or kevin.moss@tri-mer.com