UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Office of Air Quality Planning and Standards

Air Quality Assessment Division

Ambient Air Monitoring Group

Technical Note: The Ethylene Oxide (EtO) Canister Effect

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The chemical mechanism of EtO formation and growth in a subset of canisters remains unclear and merits further investigation. The U.S. Environmental Protection Agency (EPA)'s Office of Air Quality Planning and Standards (OAQPS) is currently working collaboratively with the Office of Research and Development (ORD) and our national contract lab, as well as canister manufacturers, to better understand, mitigate, and resolve these canister EtO issues.

Evaluation of current measurement method TO-15, using canisters as the sampling media and Gas Chromatography/Mass Spectrometry (GC/MS) as the analytical instrument for EtO, has revealed positive sampling bias introduced by certain canisters to various degrees (see explainer document and EtO technical webinar slides here https://www.epa.gov/hazardous-air-pollutants-ethylene-oxide/epas-work-understand-background-levels-ethylene-oxide; https://www.epa.gov/sites/production/files/2021-05/documents/eto-technical-webinar-041521-w-qandas.pdf).

For those canisters with above detection level EtO concentrations, a continued formation and growth of EtO in the canisters (the EtO canister effect) was found in two sets of studies over time (within typical laboratory sample holding times) with humid air as the sample matrix. While examining for the EtO canister effect with different types of canisters, it was discovered that the canister inner surface lining characteristics play an important role in the EtO canister effect. Based on a cleanliness study recently conducted by EPA's ORD on small number of brand new canisters from multiple vendors (https://www.epa.gov/sites/production/files/2021-05/documents/ord-eto-canister-background-memo-05072021.pdf), canisters with a silicon-ceramic lined inner surface appear to be less affected by the EtO canister effect than those passivated with an electropolished inner surface for typical laboratory sample holding times (~30 days). In addition, further studies examining the EtO canister effect by our national contract lab for a variety of canister types (i.e., canister interior surfaces passivated with silicon-ceramic, electropolished and discontinued SUMMA linings) have revealed that even within the same type of canisters, some individual canisters exhibited distinctive characteristics not consistent with that particular canister type. Also, canister age and how thorough the canisters were cleaned before use were a factor in determining the extent of detectable EtO concentrations. Based on current understanding, the observed EtO

canister effect will generally diminish to some extent over time with multiple and repeated cleanings.

Further, certain aspects (e.g., canister blank certification) in method TO-15 might not be sufficient in identifying problematic canisters which are not appropriate for low concentration EtO sampling. However, the newly released TO-15A[1] method has updated requirements which are more relevant by using humidified zero air rather than nitrogen for canister zero certifications, as well as a more stringent cleanliness criterion (≤0.02 ppbv per target VOC when a canister is filled to standard ambient pressure (101.3 kPa absolute or 14.7 psia)). Most importantly, appropriate and sufficient canister cleaning and canister blank certification processes will be necessary before any canisters should be put in use for ambient EtO sampling. Such processes will allow for a better understanding of representative EtO concentrations in ambient air using the canister-based GC/MS measurement technique.

[1] Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography–Mass Spectrometry (GC-MS) https://www.epa.gov/sites/production/files/2019-12/documents/to-15a_vocs.pdf