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VOC Emissions Requirements and Measurement Techniques:

Volatile Organic Compounds (VOCs) have many adverse health effects and as a result are considered to be a Hazardous Air Pollutant (HAPs) by the EPA. The EPA is particularly concerned about VOCs in stationary power applications as they significantly contribute to the formation of ground level ozone (smog). Ground level ozone is created when VOCs react with oxygen in the presence of sunlight.

The EPA has a complex definition for VOCs that's described under 40 CFR 51.100(s). Simplifying this definition for stationary engines; VOCs are considered to be any hydrocarbon that is present in the exhaust stream with the exception of Methane and Ethane. Methane and Ethane emissions are excluded as they have negligible photochemical reactivity (don't significantly contribute to smog formation).

The presence of VOCs emissions in stationary engine applications are generally the result of un-combusted fuel (undetonated fuel often stored in the crevices of the combustion chamber during engine operation) and the formation of post combustion formaldehydes. Lube oils that "blow by" the cylinder rings can also contribute to the presence of VOCs. The recent advent of low cost natural gas has made VOC reductions a topic of particular interest.

VOC emissions are reduced in the field utilizing oxidation catalysts. Oxidation catalyst are very effective at destroying large chain hydrocarbons at lower temperatures. In most stationary sources, it's possible to significantly reduce the VOC emissions by utilizing an oxidation catalyst. VOC reduction rates are highly dependent on the oxidation catalyst composition and on process factors such as incoming fuel composition, and engine combustion characteristics such as exhaust temperature and the concentrations of large chain hydrocarbons (these two properties determine the maximum achievable VOC reduction rates). When seeking an oxidation catalyst supplier ensure that they understand all of the factors that influence VOC reduction rates – otherwise your air permit conditions may not be met. Because oxidation catalysts contain costly precious metals there can be a significant price difference between an oxidation catalyst that meets permit conditions and one which does not.

The recent advent of the RICE NESHAP regulation has mandated the use of oxidation catalysts on prime power stationary engines to reduce both CO and VOC emissions. For non-Title V facilities, VOC reductions are typically measured periodically using stack tests. VOC emissions can be very difficult to measure accurately, as a result stack testers generally report the CO reduction levels across the catalyst (CO reduction levels are used to infer VOC emission rates).

For larger Title V power plants (typically greater than 20 MW) a CEMS system is generally required to directly measure the VOC emission rates. There are several methods that can be utilized to measure VOC emission rates, two of the most common techniques employ FID's or FTIR detectors.

Flame Ionization Detectors (FID's) are the most common in field measurement technology presently utilized for Title V permit facilities. FID's use a hydrogen flame to ionize VOC compounds allowing electric current detecting plates to measure the carbon radicals (carbon radicals were formerly part of the incoming hydrocarbons before interacting with the hydrogen flame).

FID analyzers are presently the most popular technology utilized to directly measure VOCs emissions. The technology has been around for several years and is particularly advantageous as measurements aren't significantly affected by the H_2O present in the exhaust stream. The big disadvantage of FID analyzers is that they can't differentiate between VOC exhaust constituents; as a result VOC measurements are typically reported as methane (since methane is the gas that is used to calibrate the FID). Methane cutters are than utilized to separate the methane molecules from the exhaust stream ensuring that VOC measurements aren't skewed by high methane concentrations present in most exhaust streams (particularly prevalent with natural gas engines). The specific measurement process is outlined in EPA Method 25A which is the most applicable measurement technique used for FID measurements of stationary engine plants.

Fourier Transform Infrared (FTIR) is an emerging technology that can also be utilized to measure VOCs concentrations using EPA methods 320 and 310. FTIR devices measure the spectroscopic effect that occurs when ultraviolet visible light interacts with gas compounds. The advantage of FTIR technology is that it can measure a wide spectrum of VOC compounds (has the ability to individually isolate specific concentrations of VOC compounds present in the exhaust stream). Considerable computation is involved in FTIR measurement, one of the biggest challenges is the ability of the device software to properly identify and compensate for interference patterns that occur in the measurement of exhaust compounds. This technology has progressed significantly in the past couple of years and is becoming a much more widely accepted measurement technology. Unlike FID, not all jurisdictions accept FTIR as a measurement technique for VOC's coming from stationary engines. Be sure to check with your local air regulator before making a commitment to FTIR technology.

Gas Chromatograph (GC) measurements using EPA Method 18 can also be utilized to measure VOC concentrations. To our knowledge this technology is not often used because it cannot easily identify all of the VOC species in a single pass.

In summary, VOC emissions are present in the exhaust of all stationary engines. The EPA regulates VOC emission rates for most prime power engine applications by typically mandating the use of an oxidation catalyst. VOC emissions are of particular concern on large natural gas installations (> 20 MW) as these emissions rates are generally measured/reported to the EPA; as a result it's important to take great care when selecting an oxidation catalyst for larger engines. Make sure your supplier asks the right questions about your process conditions since this has a big impact on catalyst formulation. It's also important to be aware of the CEMS reporting requirements and the available measurement techniques. Safety Power Inc. in a manufacturer of emissions systems that integrate oxidation catalyst for VOC reductions. If you are working on a project and have any questions specific questions regarding VOC emission and reporting we are more than happy to assist. Please contact us at 1-800-657-1280 or email at info@safetytpower.ca . We have offices just outside of Toronto, Canada and San Jose, California.

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About the Author

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