

BTEX and Other VOCs in Ambient Air by Membrane Interface Mass Spectrometry (MIMS)

AMETEK's ProMaxion™ Process Mass Spectrometer offers fast on-line monitoring of VOCs in ambient air in a reliable, easy-to-use package.

Process Overview

Industries producing hazardous substances, or using such substances in their manufacturing process, are required to monitor the environment in and around the plant to ensure that the concentrations of known pollutants remain below the exposure limits.

Of particular concern is a class of compounds known as volatile organic compounds (VOCs). These include the hazardous VOCs: Benzene, Toluene, Ethylbenzene, and Xylenes, which are collectively referred to as BTEX (or BTX), and the highly reactive VOCs: ethylene, propylene, 1-3 butadiene and butanes.

Membrane Interface Mass Spectrometry

Mass spectrometry has been used on-line for more than 30 years to control and monitor industrial process gas streams. Membrane Interface Mass Spectrometry (also called Membrane Inlet Mass Spectrometry or MIMS) is a specific technique ideally suited for the analysis of VOCs in ambient air. At the heart of the MIMS technique are the various membrane materials which mostly block polar compounds (e.g., water) while allowing nonpolar species to migrate through the membrane. Usually the membrane is a thin sheet or tube of dimethylsilicone, which works well with BTEX chemicals.

This selective extraction of the analyte from the bulk matrix concentrates the components-of-interest and delivers a highly enriched sample directly to the ion source. Since the mass spectrometer is already very sensitive, this technique provides very low limits of detection.

ProMaxion™ for MIMS

Equipped for MIMS operation, the ProMaxion process mass spectrometer uses a dimethylsilicone membrane inlet coupled directly to its ion source. A subatmospheric sampling system draws sample into the analyzer and a multiport valve arrangement is provided for multiple sample stream selection and the introduction of calibration standards.

The speed of the ProMaxion facilitates the analysis of multiple streams with just one instrument. Multiple inlet ports are available, providing the option of a centrally located, high stream count, multiple sample point configuration. An alternative approach is to have fewer sample points to minimize the length of the sample lines and to provide the earliest advance notice of contamination. The system design depends on the plant layout and user preferences.

The software provides easy set-up, operation, and calibration together with advanced alarm and automation capabilities. Self-diagnostics and modular design ensure ease of maintenance by your own personnel on-site. Modem support is available for additional factory diagnosis and troubleshooting.

Data can be exported using all common industrial protocols as well as dedicated analog lines to bring the data to a common point for collection. Alarms are available for every stream, along with an "on-the-fly" mathematical package allowing data to be presented in any number of ways (mole, %, mg/M³, lbs/hr, etc.).

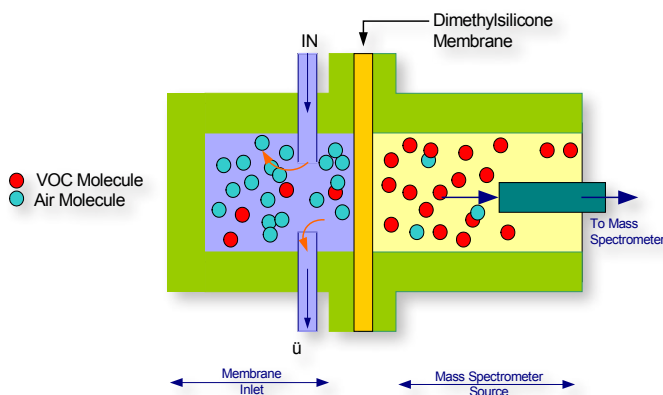


Figure 1. Membrane Inlet System

The ambient air sample stream is delivered to the membrane at a controlled temperature. BTEX and other nonpolar molecules will pass through the membrane to the ion source of the mass spectrometer, effectively increasing the concentration of the analyte.

Mass Spectrometry and BTEX

Traditionally, monitoring the ambient air in and around a plant involved either air sampling followed by laboratory analysis, the use of dedicated component monitors, or process gas chromatography (GC). MIMS provides significant advantages over these traditional analytical methods.

Speed of Analysis

Mass spectrometry is generally a very rapid analytical method. Quadrupole-based instruments, like the ProMaxion, produce the fastest results. Process gas chromatographs and laboratory analysis are too slow to provide effective warning of potential problems. Even when taking into consideration delays for stream switching, a MIMS-equipped ProMaxion provides data at 10 to 15 seconds per sample stream. This is generally 10 to 50 times faster than GC methods which require separation prior to analysis.

Specific Component Information

Mass spectrometry offers direct quantification of the species of interest, as well as a total reading. A single mass ion can be chosen specific to each compound and these masses can be continuously monitored. If a total concentration is required, the mass spectrometer can survey all VOCs or BTEX, total them within the software, and

output real-time concentration. The selectivity of the technique also avoids sounding false alarms. Dedicated monitors are not always selective for specific components but can react to whole classes of compounds.

Ability to Scan for Unknowns

In addition to monitoring specific ions, the analyzer can periodically scan for mass intensities across the operating range. This will detect the presence of components other than those specifically monitored and can provide advance warning of leaks or other problems.

Multiple Component Analysis

A major advantage of process mass spectrometry is the ability to measure multiple components on the same sample stream almost simultaneously. Different calibration and analysis methods can be assigned to each inlet port.

Summary

The advantages of on-line mass spectrometry bring a level of confidence and ease-of-use that can be offered by no other technique.

- || High sensitivity and specificity
- || Monitor multiple locations with one analyzer
- || Multicomponent analysis (up to 32)
- || Detection of abnormal conditions
- || Ease of maintenance and calibration
- || Data necessary for compliance with emissions regulations
- || Real-time response provides early warning of potential problems
- || Can monitor different compounds at each location
- || Scan for unknowns

Figure 2. AMETEK's ProMaxion process mass spectrometer in NEMA 4X enclosure is available with ATEX or NEC hazardous area protection.



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