Rapid Response Fieldable Mass Spectrometry with Reverse Gas Stack Modeling and Earth-Based Separations

Guido F. Verbeck[1], Nathan R. Smith[1], Ethan M. McBride[1], Phillip M. Mach[1], Kenneth C. Wright[2], Jaime L. Winfield[2]

[1]*University of North Texas, Denton, TX*
[2] *Inficon, Syracuse, NY*

Presented here is both deployable automobile and backpack mass spectrometers, the front end of MIMS incorporates three dual inlet ports allowing for differing MIMS materials and selectivity for specific environments. Membranes here have proved selective for volatile organic compounds (VOCs) as well as aromatic hydrocarbons, common petroleum, chemical pollutants, and clandestine labs, while remaining selective against the aliphatic chains prevalent in oil and gas samples. The system is deployable and rugged which is especially significant considering the numerous accoutrements such as foreline pumps and inert gas tanks required of a mass spectrometer. This developed system has applications in both water and atmospheric monitoring. Further innovations include increasing sensitivity by development of a near-infrared (NIR) laser diode system for membrane desorption and enhanced permeability (100ppt sensitivity with 7 second response). All of these are incorporated with GIS, for position monitoring, mapping, and integrity of analysis. Software has been developed to incorporate the chemical mass mapping, reverse gas stack modeling, and SAMs data to produce accurate point of source determination, even with simple drive-bys or stationary remote monitoring.

The Reverse Gas Stack Model utilizes atmospheric dispersion parameters to determine an upwind source location. A chemical sensor downwind from a suspected emission point quantifies the emission concentration. This analytical model unifies atmospheric dispersion and other meteorological phenomenon of chemical interests with a developed mobile mass spectrometer system. As mobile mass spectrometer and other chemical sensors are developed, applying a reverse atmospheric model to datasets will provide an additional avenue to determine how sources of pollution and activities that produce effluent behave. This will lead to better Earth-Based Separation models, allowing real-time chemical separation without the time cost of chromatography front ends.