D9 Evaluation of Clandestine Methamphetamine Diffusion Through Building Materials by Ion Mobility Spectrometry and SPME-GC/MS

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After attending this presentation, attendees will have a better understanding of clandestine methamphetamine laboratories and the contaminates that transport through structures where these exist.

This presentation will impact the forensic science community by demonstrating how current standards for clandestine methamphetamine laboratory remediation are not sufficient.

Portable Ion Mobility Spectrometry (IMS) is frequently used to gauge the success of remediation in Clandestine Methamphetamine Laboratory (CML) sites. In most cases, remediation involves surface cleaning, followed by IMS interrogation to detect any residual contaminants. Even after seizure of the facility and with most contents removed from the structure, the remnants are still heavily contaminated with hazardous chemicals as well as methamphetamine. Besides direct chemical spill contaminations, airborne contaminants are absorbed or deposited onto surfaces throughout the facility such as the flooring, walls, ceilings, and structural supports.

The transport of methamphetamine in air and through surfaces is dependent upon the protonation state of the ionizable amine center on the molecule. While transport can occur as particulate, it can also occur in the vapor phase. The vapor pressure of methamphetamine as the free base (un-protonated) is 0.163mmHg, suggesting that methamphetamine will vaporize to a significant and detectable extent under typical indoor temperatures and pressures. Because it is an amine, detection limits for airborne methamphetamine are relatively low using IMS and as such, IMS is an ideal analytical tool to study the fate and transport of methamphetamine residuals left in remediated environments.

A Plexiglas chamber of size 1.5'x1.5' x 2' was made as airtight as possible (known to be watertight). The box offers the ability to place a hot plate within for heating, and a window along one wall in order to gain access to the plate. Along another wall there are three columns of four vertical ports. The first column contains an opening for IMS "sniffing," while the second allows for Solid-Phase Microextraction (SPME) to be accomplished through septa. The third column was added to track any temperature gradient that develops. A 4-channel datalogging thermometer was used for this purpose. The third wall of the chamber contains an opening 12"x12" allowing for a building material to be exposed on one side to vapors created within the chamber. This chamber establishes mock CML conditions into which building materials could be placed

For the analysis, methamphetamine salt was converted to its basic form and extracted into hexane. After drying, the methamphetamine was then gently heated in the presence of the building material being studied. The concentration of the airborne methamphetamine in the chamber was monitored at half-hour time intervals over 24 hours by IMS and every hour by SPME. Using both methods allowed for direct calibration of the IMS response for gas-phase methamphetamine. Chamber experiments were utilized to calculate diffusion coefficients for many different building materials. The ability to measure the concentration of gaseous methamphetamine in real time using IMS significantly simplifies the analytical process required to calculate diffusion coefficients and associated quantities such as flux. Experimental results were compared to those obtained with a simple modeling program and will be discussed.

Methamphetamine, Clandestine Lab, IMS

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