Application Brief AB-074

IDENTIFYING AND MANAGING CHEMICAL HAZARDS IN A CLANDESTINE "METH" LAB RAID

Introduction

Methamphetamine (a.k.a. "meth", "speed", or "crank") is a highly addictive stimulant that is quite simple to synthesize from readily available chemicals. Although most clandestine labs produce relatively small amounts of methamphetamine, the proliferation of "mom-and-pop" sites has imposed unpleasant burdens on law enforcement departments and agencies. These labs contain a variety of highly flammable, corrosive, and toxic precursors (or waste) which are often stored in unmarked containers. The dangers posed by these labs include fires, explosions, poisons, and environmental contaminations. In fact, for every 1 pound of "meth" synthesized there are approximately 5 pounds of waste produced. With safety, time, and cost in mind, first responders need the proper equipment to accurately identify these chemical hazards found on the scene to assist the remediation process and to prosecute the suspected offenders.

Although no single instrument identifies a variety of unknown solids, liquids, gases, and vapors, Smiths Detection offers a suite of portable and easy-to-use instrumentation to fulfill the critical needs of first responders. Specifically, the Sabre 4000™ utilizes ion mobility spectrometry (IMS) for detecting trace levels of toxic industrial chemicals (TICs) and illicit drugs. The HazMatID™, RespondeR RCI™, and GasID™ all use vibrational spectroscopy to identify larger quantities of solids, liquids, and gases. This application note discusses how a suite of instrumentation, all based upon well-established technologies, can be effectively employed to identify the various chemical hazards that law enforcement units are exposed to during a clandestine "meth" lab raid.

Chemical Drug Precursor and Waste Identification

Infrared (IR) and Raman spectroscopy are recognized technologies for the accurate identification of chemical unknowns. Both methods rely on measuring the unique interaction of light with chemical matter which results in a distinct pattern of bands called a spectrum. The spectra that arise from these different techniques are one-of-a-kind, and can best be described as molecular "fingerprints". With the help of spectral library matching, thousands of chemicals can be rapidly identified on the basis of their distinct patterns. Additionally, IR and Raman spectroscopies are established "evidentry" techniques for the prosecution process of criminals in the U.S. legal system.

Exposure to a variety of hazardous chemicals is likely during a typical "meth" lab raid. Consider, for example, the forced-entry of a suspected apartment by a team of police officers who discover that the dwelling appears to be a "mom-and-pop" lab. Quick inspection of the scene identifies used glass beakers, latex gloves, kitty litter bags, and chemical containers amongst other paraphernalia, while the noxious odors make it clear that volatile solvents are also present. The hazards at hand require first responders to manage and remedy the situation safely and quickly. The numerous organic solvents used in the street synthesis of "meth", such as acetone and petroleum ether, are extremely flammable, and create dangerous, reactive vapors that can lead to explosions. PID and LEL meters are traditionally used to detect the possibilities of a toxic or explosive atmosphere; however, in a few cases, these gas-monitoring devices have been shown to underestimate the fire and explosion hazards at play due to miscalibration.[3] Therefore, to reinforce or verify the initial gas-monitoring measurements conducted at the scene, Smiths Detection offers the GasID to rapidly identify gases and vapors using infrared spectroscopy. Using the specialized sampling device, users can collect solvent vapors that permeate into carpets or furniture for example, and analyze the samples in the IR analyzer. Infrared spectra of acetone and ether vapors are shown in Figure 1, and highlight how chemical "fingerprinting" can be used on-site to identify chemical hazards native to a clandestine "meth" lab within minutes. This spectral information can then be utilized to generate appropriate correction factors for the PID meter, leading to more accurate air monitoring for the duration of the raid.

In addition to dangerous solvent vapors, a variety of solids and liquids are also present in a "mom-and-pop" methamphetamine lab such as Sudafed™ tablets, and strong acids and bases. To further complicate matters, often the precursors and waste are found in unmarked or mislabeled containers. Smiths Detection

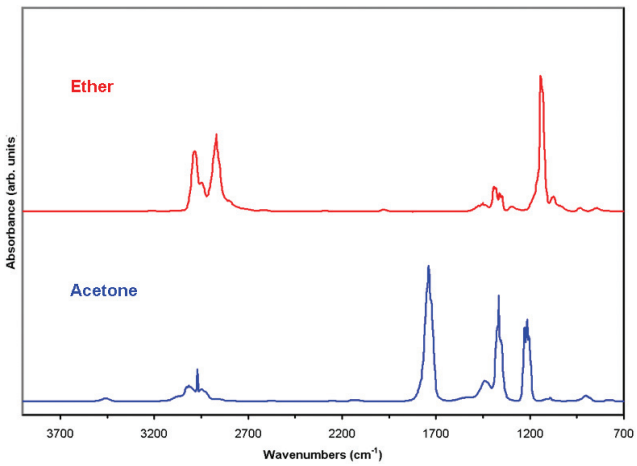

Figure 1. Infrared spectra of ether (red, offset for clarity) and acetone (blue) vapors, common flammable solvents used in a "meth" synthesis, can be accurately identified in seconds with the GasID™.

offers the HazMatID and RespondeR RCI to identify solids and liquids for these kinds of applications and are based on infrared and Raman spectroscopies respectively. The technologies underlying these easy-to-use instruments are different yet well-established, and therefore can provide complimentary data of the collected unknown samples. The HazMatID requires a small amount of sample (solid or liquid) to be placed on the diamond sensor and within seconds the accurate identification of the unknown species is complete. The RespondeR RCI, on the other hand, utilizes a near-infrared laser source which allows the light to pass directly through glass bottles and plastic bags. Therefore, the Raman chemical identifier can be utilized in a point-and-shoot mode where the liquid or solid samples do not have to be handled directly. To illustrate how these two instruments can be employed in a lab raid the infrared and Raman spectra of Coleman Fuel™ and S-L-X™ denatured alcohol, two toxic precursors commonly used in a typical "meth" synthesis, are presented in Figures 2 and 3. Like the GasID results, the differences in the data are quite apparent and emphasize how "fingerprinting" can be used accurately to identify toxic chemical precursors common in lab raids. Furthermore, a valuable feature unique to the HazMatID and RespondeR RCI instruments is the ability to communicate wirelessly with each other to compare and verify the results using advanced combined-search algorithms.

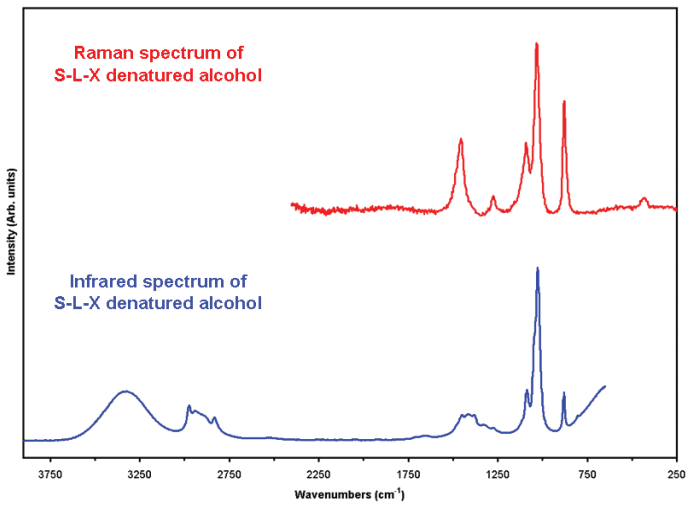

Figure 2. S-L-X denatured alcohol™, which is a hazardous chemical often found in clandestine labs, gives very different Raman (red) and Infrared (blue) "fingerprints" highlighting the complimentary nature of the two easy-to-use techniques.

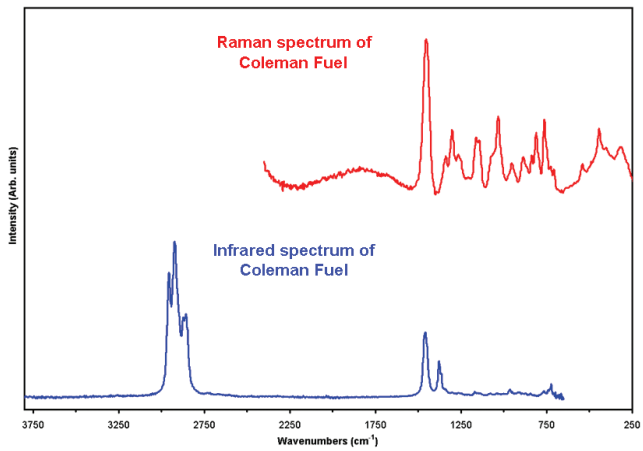

Figure 3. Coleman Fuel™ can be independently identified during the raid using the RespondeR RCI™ (red) and the HazMatID™ (blue) to further analyze dissimilar low-wavenumber data.

Trace Detection of Methamphetamine

The trace detection of methamphetamine present at a clandestine laboratory is ideally suited for the Sabre 4000. Utilizing ion mobility spectrometry, the Sabre 4000 is a portable, rugged device that can accurately detect and identify trace amounts of narcotics (amongst explosives, TICs, and CW agents) within seconds. The information directly obtained from the Sabre 4000, like the instruments mentioned above, can be vital to the successful prosecution of the suspicious persons responsible for the illegal operations.

In many cases visually detecting and identifying "meth" can be a tricky task, yet is imperative to successfully prosecute the offenders. Consider again the apartment scenario described within the previous section. Like many clandestine methamphetamine laboratories, these random dwellings often serve as temporary spaces for the users to synthesis their drugs and, once finished, move on, leaving their toxic waste behind. While locating large quantities of "meth" at the scene is improbable, the presence of trace drug residues is nearly impossible to avoid. For example, residues might be found on refrigerator or faucet handles within the apartment. In this situation, particle collection with the Sabre 4000 by means of a simple swab can be deployed to locate and confirm trace quantities of methamphetamine within seconds. This hand-held device relies on ionizing technology, and works by measuring the drift times of differently sized and shaped ions traveling within the electric field. Indeed, the IMS signal of a chemical species, such as methamphetamine, is characteristic and can be used for accurate on-site identification.

Summary

A suite of Smiths Detection instrumentation based on vibrational spectroscopy and ion mobility spectrometry can be utilized to safely manage a variety of hazards present at a clandestine "meth" lab raid. Due to the unique technologies now available, typical solid, liquid, and gas chemical precursors and toxic waste native to these incidents can be detected and identified accurately. Indeed, the detailed on-site information can be very valuable to the law enforcement first response protocol. The various instruments now available to emergency responders can be effectively utilized to remedy a greater range of hazards more than any one device can do independently.

References

1. The Police Chief, 42 – 47, Feb. 1998.
2. Title 21, Code of Federal Regulations, Sec. 1310.02.
3. Continuing Challenges Conference, Sacramento, 2005.

21 Commerce Drive Danbury, CT 06810-8153 Phone: (203) 207-9700 Fax: (203) 207-9780 www.smithsdetection.com

smiths