Case Study

Raman Spectroscopy:
Seeing drugs in a whole new light

In Kentucky, law enforcement officers and the Kentucky State Police Forensic Laboratories have gained a new ally in their battle against the proliferation of illicit and dangerous drugs in their state. It's called the Thermo Scientific™ TruNarc™ Narcotics Analyzer, and more than a dozen drug task force agencies across Kentucky are currently using it, with nearly 40 units in use throughout the state. It's a portable, hand-held electronic device, and it has become popular with its users because it can analyze and identify a multitude of drugs and other substances in the field in a matter of seconds and do so with high accuracy and precision. Best of all, it doesn't require actual contact with the substances themselves, because it is able to identify most of them even through their packaging. Also, it does not consume or destroy any of the substance being tested in the process. In addition, and perhaps even more critically, it also helps keep officers safe. According to Todd Young, the deputy director of the Bowling Green-Warren County Drug Task Force, "A lot of times when you had to do a field test, you had to take the substance out of its package. Now we don't have to do that, so that limits our officers' exposure to potentially harmful substances."

Kentucky's problems with illicit drugs aren't terribly different from those of other states. Currently, the primary drugs encountered include Fentanyl, Heroin, Cocaine, Methamphetamines,

TuNarc Handheld Narcotics Analyzer

and Marijuana. These make up 95% of the total volume of illicit drugs interdicted, according to Jeremy Triplett, Drug Section Supervisor with the Kentucky State Police Forensic Laboratories. But by far the biggest and fastest-growing problem he says is 'Crystal Meth' (methamphetamine).

Methamphetamine is a powerful, highly addictive stimulant. 'Crystal Meth' is a form of the drug that resembles glass fragments or shiny, bluish-white rocks. It is chemically similar to amphetamine, a drug used to treat attention-deficit hyperactivity disorder (ADHD) and narcolepsy. Other common names for methamphetamine include blue, crystal, ice, meth, and speed. The drug can be easily made in small clandestine laboratories, with relatively inexpensive over-the-counter ingredients such as pseudoephedrine, a common ingredient in cold medications. Methamphetamine production also involves a number of other very dangerous chemicals.

"TruNarc Narcotics Analyzer, is used by more than a dozen drug task force agencies across Kentucky. "

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The interception of Crystal Meth and other illegal drugs has become a severe policing problem worldwide. It is difficult for law enforcement personnel in the field to at least initially identify any particular substance as likely being a prohibited one. This can lead to false arrests or releasing suspects who are indeed carrying illegal drugs. While a properly equipped lab can make a definitive analysis, typical lab equipment does not lend itself to use by law enforcement personnel in the field because it is either too heavy, cumbersome, difficult to operate, or too expensive to distribute widely to large numbers of law enforcement personnel.

Colorimetric Analysis Methods

Prior to the availability of the TruNarc, law enforcement in Kentucky utilized common wet-chemistry test kits to identify narcotics in the field. Relatively easy to use, these kits call for a series of dilutions, where officers must interpret color changes in order to correctly identify a substance. This is known as Colorimetric Analysis. Colorimetric analysis is a method of determining the concentration of a chemical element or chemical compound in a solution with the aid of a color reagent. It is applicable to both organic compounds and inorganic compounds and may be used with or without an enzymatic stage. The method is widely used in medical laboratories and for industrial purposes, e.g. the analysis of water samples in connection with industrial water treatment. But colorimetric testing is not very specific; it is not always reliable, and only effective for a very narrow range of certain known drugs and not for other chemicals or substances such as newer synthetic drug compounds. More importantly, test results from the colorimetric do not always support probable cause in charging a drug suspect. Instead, all suspect samples collected from alleged offenders often must be transported considerable distances to a properly-equipped laboratory facility. Colorimetric test kits can often identify 'classes' of compounds rather than specific substances, so it is an imperfect field analysis method; but that was before the TruNarc narcotics analyzer and Raman spectroscopy.

Raman Spectroscopy: A Better Way

The TruNarc narcotics analyzer uses Raman spectroscopy – essentially a laser light beam – to analyze substances, and it does not need to be in direct contact with them; it can 'see' through the packaging material generally if it is translucent. Raman spectroscopy is a technique used to determine vibrational modes of molecules, and thus accurately and precisely identify specific substances that these molecules comprise. Raman Spectroscopy is based upon the interaction of light with the chemical bonds within a material.

Raman spectroscopy relies on inelastic scattering of monochromatic light (e.g., laser) which changes the excitation states of the molecules, which will then emit light. Each material emits its own specific Raman spectrum. As each specimen 'fluoresces' in the Raman range, it emits a unique 'Raman signature' that permits the specimen to be identified and characterized. This spectrum of light is analyzed with a spectrometer and then this wavelength signature is compared with a library of known Raman signatures in order to identify the precise identity of the specimen. This is why a TruNarc narcotics analyzer can accurately identify hundreds of individual substances.

Using Raman technology, the TruNarc narcotics analyzer quickly identifies a wide range of illegal drugs including narcotics, synthetic drugs including methamphetamine, cutting agents, and precursor materials. Analysis is performed in a single test, portable, hand-held, on the spot, in 30 seconds or less per sample, and it is capable of identifying up to 324 prohibited substances and can scan for up to 500 total substances in a single, definitive test.

Most drug samples can be quickly identified by simply pressing the sample—contained in a plastic bag, for example—against the nose cone and then pressing the 'scan' button. Typically, samples are identified in less than 30 seconds.

Conclusion

"The TruNarc technique is highly sensitive, but it is likewise robust, a much stronger and safer technique than the old Colorimetric system," Triplett says, "And because it is so much faster, it's also a powerful forensic backlog management tool. Its high throughput capability makes it very effective in the reduction of such backlogs in the labs."

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