Sussex Police Exhibit 4 - GE Security Statement

GE Security Technology Statement

The Itemiser is programmed to detect and identify microscopic amounts of many different types of narcotics. Cocaine is one of the most reactive and easy to detect substances in the Itemiser's library. Responses are reported to the user by a simple and clear computer interface. An "alarm Strength" number gives intensity of the response. This strength is an indication of the amount of narcotic contamination that was collected on the sampling media used, in the case of Itemiser Mk 2, a cotton – paper disk and with the Itemiser 3 a Teflon coated fibreglass strip. These traps are cleaned and packed by GEIT in Boston, USA to ensure they are not contaminated before use. They should also be checked before use on site in a customs or police application.

Samples are taken from areas likely to contain fingerprints from the target subject but not necessarily directly from the person themselves. The machine will correctly identify contamination down to nanogram (billionth of a gram) levels.

Alarms of between 1 and 2 times the alarm threshold can be classed as a "low" response. It could be attributed to cross contamination of the surface tested, background contamination, or greatly degraded historic contamination. It is not indicative of recent direct contact.

Alarms of between 2 and 3 times the alarm threshold can be classed as a "medium" response. It could be attributed to cross contamination of the surface tested or recent historic contamination that may have been left a number of days prior to the sample being taken.

Alarms of between 3 and 4 times the alarm threshold can be classed as a "high" response. This level of response would not be attributed to cross contamination and is indicative of recent and direct contact with measurable quantities of the narcotic identified by the machine.

Readings of 4.00 and above are estimated to relate to microgram amounts of contamination being transferred to the sample media. This level of contamination is not generally experienced in any other environment than somewhere that has been in direct contact with a bulk amount of the source narcotic, i.e. this level is not generally experienced as background contamination or through incidental cross contamination by being in close contact with other contaminated areas or persons.

It should be noted that the presence of any response to drugs using the Itemiser could be used as grounds for furthering an investigation depending on the SOP of the enforcement agency using the device.

A full technical introduction to the Itemiser detection principals follows.

Technology Notes - Trace Detection Technologies

The three most prevalent technologies available for trace detection of narcotics and explosives include Ion Mobility Spectrometry (IMS), Combination Gas Chromatography-Chemiluminescence (GC-CLD), and enhanced IMS, or Ion Trap Mobility Spectrometry (***ITMS***). A fourth combination gas chromatography and mass spectrometry (GC-MS) is also available, but it is used mostly in lab-related equipment.

IMS separates ionized molecular compounds on the basis of their transit times (sometimes called "time of flight" or "drift time") when subjected to an electric field in a tube. This time is then compared to stored transit times of known compounds making it possible to distinguish the target material (explosives or narcotics) from other molecules. This technique is fast and makes a compact device possible.

Gaseous samples enter an ionization chamber where an ionization source emits low-energy beta particles resulting in ion formation in the gaseous phase. A gating mechanism allows the ions of the correct polarity to pass through the shutter grid and enter the ion drift region where an applied electric field mobilizes the ions. Less than 1% of the ions created in the ionization chamber actually reach the drift tube as more than 99% of the ions are discharged on the shutter grid. The rate at which these ions traverse the ion drift region is inversely proportional to the size of the ion. This correlation allows for the identification of the analyte of interest[3]

GC-Chemiluminescence uses quantitative measurements of the optical emission from excited molecules to determine analyte concentration. Although GC-CLD technology has good sensitivity and selectivity, its range of detection is fairly limited. The GC-CLD technology employed in explosive detectors can only detect nitro compounds. Today, with the ever-increasing threat of non-nitro substances such as HMTD and TATP that are outside the detection range of this technology, the practical application of GC-CLD as an option for security outside the structured controls of a laboratory is limited. In addition, there are practical concerns about the expense of maintenance, instrument complexity, high consumable gas costs, and containment of potentially harmful materials, such as ozone, from the operator.

ITMS, like IMS, separates ionized vapours and then measures the mobility of the ions in an electric field. In the typical implementation of ITMS, the gaseous sample passes through a semi-permeable membrane prior to ionization. Also like IMS, the gaseous samples then enter an ionization chamber where an ionization source emits low-energy beta particles resulting in ion formation in the gaseous phase.

Unlike IMS, however, the ionization in ITMS is allowed to reach equilibrium in a field free region and then pulsed into the drift tube where an electric field accelerates the ions to the collector. Note that in the ITMS detector, the shutter grid does not exist, resulting in a much greater portion of the ions entering the drift tube.

Performance Requirements of Trace Detection

When comparing these technologies, there are important performance requirements that we can use to evaluate their application for checkpoint, facility, or event security. The requirements include sensitivity, selectivity, and range of compounds detected, logistics, and reliability/maintenance.

Sensitivity (detection effectiveness) is the degree of response of an instrument to an introduced concentration. In other words, how much of an explosive or narcotic material is required to detect it. In real world application of these devices, we must realize that there is a time limit to complete the analysis in order to process sample targets through the unit, typically in the 3- to10-second range.

Assuming this is a realistic range; GC-CLD technology will have a loss in selectivity, as the GC column will not provide enough separation of the nitro compounds over this analysis time.

Traditional IMS loses sensitivity with the loss of ions to the shutter grid with its non-equilibrium ionization. ITMS enhances the sensitivity through many methods.

Selectivity is the ability to distinguish between compounds. Typically when sampling for explosives or narcotics, other materials are present and the threat signals need to be selected by the technology. All three technologies are able to accurately select the threat compound if it is present above the sensitivity level of that detector, although there are significant operational differences.

Range of compounds detected is quite simply the spectrum of material that the device can detect simultaneously. GC-CLD concentrates on distinguishing between nitro compounds, but detects *only* nitro substances. IMS detects *either* negative or positive ions, but not both at the same time. ITMS simultaneously detects negative and positive ions, including both nitro and non-nitro target substances.

Logistics incorporate practical application issues present with each technology. This could include regulatory issues for ozone, radioactive sources, bottled gases, etc. IMS and ITMS contain radioactive sources. GCCLD requires handling of sensitive gases such as hydrogen, ozone, or helium.

Reliability/Maintenance.

Looking at the real world application of this technology in areas outside the controlled laboratory environment, reliability of operation and the ability to maintain peak performance in dusty, high-traffic, or humid conditions become a concern. Downtimes due to maintenance or excessive maintenance costs become other factors of concern. Both GC-CLD and IMS are unprotected from dust, dirt, and water vapour entering the system. This is a serious problem for traditional IMS, as the dryer or desiccant requires frequent changing and leads to downtime. In addition, the contamination material can lead to a loss of sensitivity over time if it is not installed in a very clean environment. The latest ITMS systems have regenerating dryers that do not require changing and a semi-permeable membrane to protect them from dirt, dust, and humidity. GC-CLD systems require replacement of the chemical modules approximately every 3-6 months if usage is high, which can be almost as expensive as a new bench-top ITMS or IMS detector.
While all three require similar sampling consumables, the GC-CLD requires gas bottle replacement on top of the consumables. The ITMS and IMS devices require dopant depending on the application.

ITMS vs. IMS Technology
Enhancements to IMS analysis through ITMS technology allow for vast improvements to ionization efficiency, and therefore sensitivity of the detector. ITMS enables extremely low concentrations of electrophillic vapours, such as explosive vapours, to be detected— impossible with traditional IMS.
The ionization chamber in the ITMS detector is a field-free region where the ion population, both negative and positive ions, is allowed to build up by the action of the beta particles on the dopant gas. With IMS and ITMS, the high density of electrons produce a high probability of ionization of the dopant gas molecules, which in turn collide with the target molecules. Electric charge is then transferred to the target molecules because of their extremely high charge affinity, and the overall result is high ionization efficiency.
Since the ITMS detector does not incorporate a shutter grid as in traditional IMS, there is no loss of ions by discharge onto the shutter grid, which could account for a loss of up to 99% of the ions. With ITMS, ions are accumulated over a 20mS interval and then compressed into a pulse of 0.2mS, increasing the density and collected current by a factor of 100 [4,5,6] . Further enhancement is made with the addition of a semi-permeable membrane that excludes dust and dirt.
This enhancement makes the system more sensitive to the materials of concern and allows continued operation and sensitivity in environments outside the lab that are high-traffic, humid, or dusty. In addition to providing a charge medium, the chemical dopant that is added into the analysis in the detector region to reduce the chances of ionizing unwanted analyte. Ammonia is the primary dopant for positive ions used in the ITMS detector, while methylene chloride is used as the dopant for negative ions. The dopants accept charge from the low-energy beta particles thereby reducing the chance of analytes with charge affinities lower than that of the dopant to accept charge. The target contraband molecules will accept the charge more readily than the dopants due to their higher affinity for the charge. This process reduces the amount of possible interferences due to the other analytes because the detector recognizes only charged species [4,5,6].
Finally, recent advancements in ITMS technology incorporate engineered high speed

switching systems that allow for millisecond alternating from positive to negative ion mode, thereby allowing for simultaneous detection and analysis of target positive and negative ions. Most narcotics have a positive ion affinity, while most explosives have a negative ion affinity; however, there are some important exceptions. TATP, for example, is an explosive that is seen as a positive affinity molecule, which would not be detected in a traditional IMS in single-mode operation for explosives. Detection limits for real world samples in ITMS in vapour sampling mode is in the picogram range.

Summary

As we look to implement a total solution for security, trace detection technologies become an integral component of that solution. Complementing x-ray scanners and metal detection, trace detection closes security loopholes by detecting microscopic particles that remain on clothing, luggage, ID cards, and more after explosives or narcotics are handled. Because it can sniff out vapours that build up in confined spaces, trace detection is especially effective for finding contraband hidden in compartments, suitcases, and lockers. ITMS technology offers the advantage of detecting a wider range of targeted substances in a more flexible detector design. Therefore it is ideal for practical applications such as checkpoint security, and screening vehicles, personnel, shipside, sea craft, packages, luggage, and cargo.

References [1] J. Brokenshire, N. Pay, ”Ion mobility spectrometry“ in International Laboratory, Graseby Analytical Ltd, Warford, Herts, England, **1989**, p4 [2] P. Z. Jankowski, A. G. Mercado, S. F. Hallowell, ”FAA Explosive Vapor/Particle Detection Technology“ Proceedings ”Applications of Signal and Image Processing in Explosives Detection Systems“, Boston, Massachusetts, 16-17 Nov. **1992** Volume 1824, pp13-27 [3] Eiceman, G.A., Karpas, Z., Ion Mobility Spectrometry” CRC Press **1994**. [4] ITMS (*U.S. Patent No. 5,200,614*). [5] McGann, W.J., Jenkins, A., Ribiero, K., Napoli, J., *SPIE on Substance Detection* Vol. 2092, **1993**. [6] McGann, W.J., *SPIE on Chemistry and Biology-based Techologies For Contraband Detection.* Vol. 2937, **1996**. [7] Haigh, P.B., “Dual Mode Detection” technical presentation, GE Ion Track, Wilmington, MA, **2003**. T E C H N I C A L P A P E R *For more information on ITMS products call, email or consult our website. 1 . 9 7 8 . 6 5 8 . 3 7 6 7 / s a l e s @ i o n t r a c k . c o m / w w w. i o n t r a c k . c o m* GE Ion Track Limited