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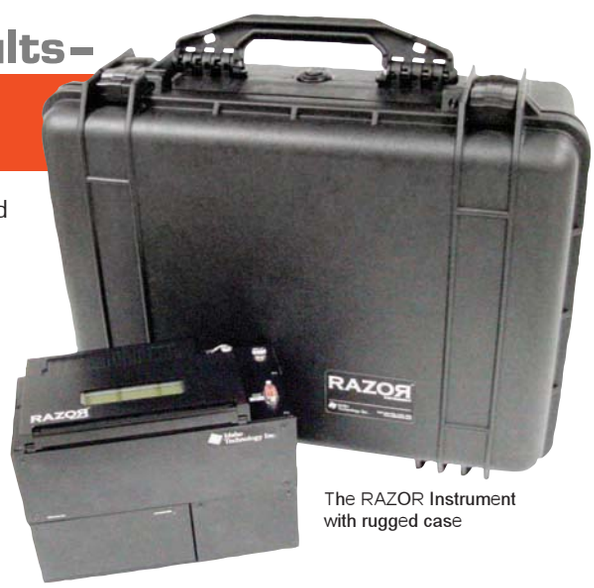

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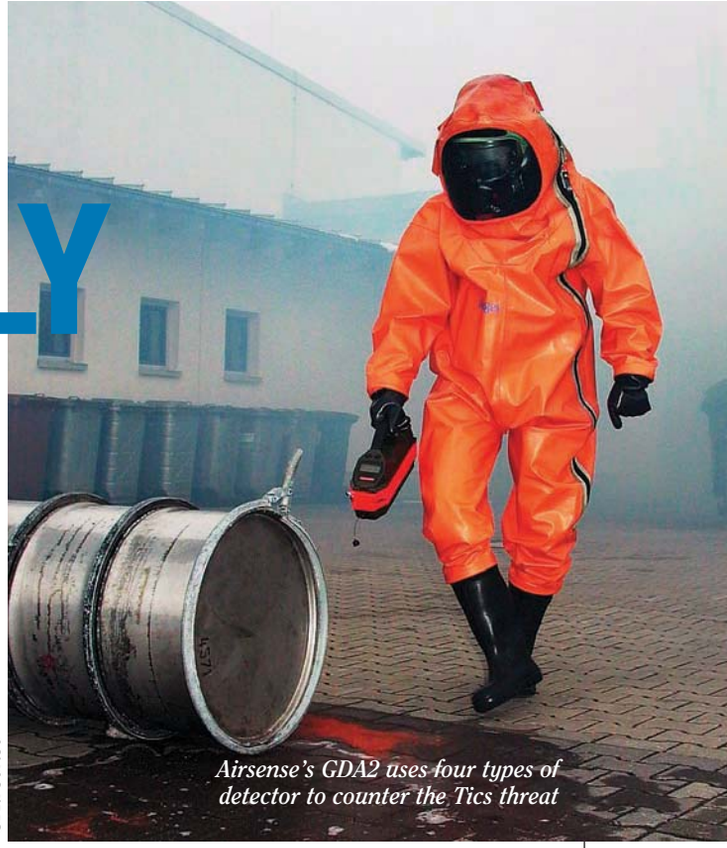
CHEMICALLY INDUCED THOUGHT

Brian O'Shea looks at some novel detectors designed to deal with the chemical threat



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Airsense's GDA2 uses four types of detector to counter the Tics threat

DEVELOPMENT usually works in one of two ways: iterative or revolutionary. These two tracks – which may be complementary – allow a reasonably steady path (revolution rarely comes) and a certain amount of planning. Outside of these is the novel approach – this could either be a new piece of technology that will provide extra capability, but not detract from the main path, or provide a utilisation of existing technology to provide a better capability. CBRNe is no different from any other industry, with people having bright ideas – the sort that start with, "You know it just might work" and end with "Why hasn't someone thought of that before?" While a great deal of innovation may be going on in the biological detection and identification field, the chemical detection world is not immune. CBRNe World's constant trawling of the internet and position in the word-of-mouth network threw out examples of each novel branch; new pieces of technology represented by Eyemarker Systems and their Oracular Scanning Instrument (OSI), while Airsense Analytics and their GDA2 representing the utilisation of existing technology.

The eyes have it

While the eyes may or may not be the window to the soul, they are definitely the French windows to the body. It has been recognised for a centuries that the eyes can tell you whether someone is ill or not, yet only recently did it become apparent quite how much they could tell you about that illness. Eyemarker systems began looking at quite how much information the eyes held, and how that was kept in key markers in the eye – that would be able to provide pre-symptomatic exposure information.

It is easiest to explain this in a scenario. Terrorists release an organophosphate over central Milan. The exact geographic extent of the agent could not be determined, and since the quality of the agent was not high, fire crews have difficulty immediately ascertaining exactly what triage ticket people should have. They are able to place the OSI briefly over the eyes of the civilians and less than three minutes later will know whether they have been exposed or not – allowing them faster processing through decon. Wes McGee, CEO of Eyemarker, explained more. "One sentence will help describe us – it is about the exposure," he said. "Whether that is a nerve agent, botulinum toxin, carbon monoxide or cyanide, once the device gone off the question is who is hurt enough that they need to go to the hospital? When the company began to look at the human eye and determine whether there were ways to determine the exposures that people encounter when chemical devices go off, they found that the eye was interconnected with other physiological systems – everything from cardio-vascular and nervous to lymphatic; every system in the body.

"Finding that allowed us to move to the next step: to identify the ocular symptoms that would be identifiers of exposure in the eye, to employ the side effects in reverse – the symptoms that are biomarkers for a certain type of exposure. We would then employ imaging technology to get the ocular data and automate that with software algorithms to get a very small handheld unit. From the research we found that we could identify biomarkers for organo phosphate compounds, cyanide compounds, bot toxin and carbon monoxide and tell whether people had been exposed to those sorts of compounds."

The system can be made more selective so, while it takes three minutes to scan for all four agents, if you know what you are looking for – ie an OP – then it can run at a faster speed. All this is done 12-24 hours before the first symptoms manifest themselves, which is especially useful for bot toxin. Neither does the patient have to be conscious – though this might be a casualty that you wouldn't need to scan – nor do they have to move their eyes or respond in any way – which frees you from any language barriers and the system is unaffected by eye ailments (with the exception of bad cataracts). What it won't do, which would be useful for triage, is a quantitative analysis – how badly the individual has been slimed. "At the current stage of the device it will just tell you who has been exposed and who has not been," said Eyemarker's Chris Kolanko. "As we move forward we might build in a dose range area that would say, 'dose high' or 'dose low'. One of the issues, in the US at least, is whether we have to go for FDA approval. If we have to go for FDA approval we may have to end up doing clinical studies for some time and we would like to get this device into the hands of the military and civil community so they can begin using it. If we do a triage approach at the beginning and consider going for further capability at a later date then we will get the simplest approval from the FDA without clinical studies."

Since this works off symptoms, however, there is a shortage of agents that can be determined. Viruses, for example, cause a problem as the system could say that the

Eyemarker's OSI

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person is sick with particular symptoms, but which virus would be unknown. Equally, the device still needs to be put on the face, so a stand-off version that could work from two feet away is still beyond current technology. "We are limited by some of the biomarkers we are viewing," said Chris Kolanko. "We have to have some fairly good images, but currently you have to put your face close to the device. We haven't explored looking at these areas of the eye from a distance; you have to be close enough so that the system can identify the markers, but we haven't explored it and don't know the potential," he concluded.

"At a military readiness level, we are about a seven," said Wes McGee. "We are at true prototype, which are being tested at a number of locations to look at bot toxin and nerve agent. Subsequent to that, in the course of 2007 we will do the same for fire departments for cyanide and carbon monoxide. The experience from that might mean improvements are required in the software and in the imaging capture. By the end of the calendar year, if not earlier, we will be ready to put a product in the market. We will get the product out with these four items and then continue the research to add further items to the software; the device has the ability to upload new algorithms in the software as we work towards new agents or new compounds of exposure, like toxic industrial chemicals (TICs). These algorithms will be dropped into the device so it can have greater range and capacity than it would have in the first release. One of the roll-out items will be to determine whether someone has been substantially impacted by an IED and should not be allowed back into the theatre – and that would also be pre-symptomatic."

Ahead by a nose

While Eyemarker are bringing something different to the chemical detection business, Airsense are working on combining existing technology to produce a single, orthogonal detector. Airsense have a strong presence in the chemical industry, with products such asI-PED (their electronic nose) and Keg Control, and three years ago they combined it with a product for the first responder community – GDA2 (Gas Detector Array 2). GDA works on two modes with four detectors – ion mobility spectrometry (IMS) for chemical warfare agents (CWA) and photo ionisation detector (PID), electrochemical cells and two metal oxide detectors for TICs. It can also have an infra red heater for thermal desorption and surface analysis as an optional area. The device weighs 4.2kg, is battery powered and is designed for the average first responder, rather than a scientist.

Airsense's Wolf Münchmeyer explained the system's origin. "GDA was started for the fire services in Germany; that development started in 2001 and this is now the third year of GDA in the market," he said. "The fire service had IMS and PID and they found their IMS was always contaminated and their PID was not selective enough, etc. So they had difficulties and that was the starting point."

Since then GDA has been sold to a variety of first responders, with the Italians and Austrians joining the Germans as a GDA user. This is not just a collection of detectors – the systems work together to cover each technology field's weakness, but added to this is a wide range of agents and data fusion to provide accurate alarms. It is this synergy that makes the product different, as Mr Münchmeyer is keen to point out. "The coverage is very broad. The first part of the system is not very specific – it is just an alarm to indicate something is there. Beyond that there is the identification, and that runs off a library – there are three libraries in the detector and each holds 256 compounds. We can offer varied libraries, including mixes of compounds – if it is a chemical company, for example, then we can tune the library to their needs.

"We have a variety of identificators in there that can give the total background response – they can work together to provide an orthogonal detection."

"We have a variety of identificators in there," he continued, "that can give the total background response – they can work together to provide an orthogonal detection. This is the benefit – we can track many more compounds that wouldn't be picked up by IMS; things like phosgene that are transported regularly and are very dangerous. The user finds things like IMS useless for chlorine, and we cover the broader range. The second issue is that the device has more information about the compounds by having very good diagnosis and information on the compound."

All the detectors are Airsense's own, and have been designed to operate at a higher standard than most other IMS devices. Yet Mr Münchmeyer reiterated that it had nothing to do with any particular detector. "It is all about the combination," he said. "An IMS alone can only detect compounds that ion mobility spectrometry will work on – it is limited. We offer the whole range. PID offers a greater range, but it is very selective in terms of the information that it holds, so it is not sophisticated. GDA provides recognition for the highest number of compounds – there is no detector that can provide this spread."

The detectors not only cue each other to provide analysis of the compound, but also to protect each other – PID will protect the IMS, for example, to stop it getting flooded and contaminated. This does come at a cost, however; the system costs more than four detectors bought separately. Mr Münchmeyer suggested that, so far, the military were not interested enough in TICs to warrant the cost, but that it was perfect for those organisations that had to deal with TICs on a constant basis. "You cannot compare the cost because single detectors do not have the integration. The ability to link all the information together is what GDA is about, rather than just four detectors. The cost is higher than the detectors alone, but our IMS is also very sophisticated, with quite a nice resolution, and our high-end features do make it a very efficient system. Our goal is TICs, and the amount of TICs the military are interested in is limited; they are mainly interested in CWA. Maybe if they get more involved we would do better, but the benefit from GDA is to deal with these compounds, rather than just CWA. Currently they seem happy with their IMS, but this might change if they need to do more TICs."

Innovation is what drives the market and also inspires doctrine and tactics. While neither Airsense nor Eyemarker will shift enough units to become the next Smiths Detection, there is no doubt they will find a niche. Items such as JBAIDS (Joint Biological Agent Identification and Diagnostic System) for biological diagnosis are expensive, and devices like OSI would allow them to be used with greater discrimination. It would also have a major impact on the role of paramedics – suddenly providing them with a force multiplier. Equally, GDA2 will allow first responders (and some niche members of the military) with a less training-intensive detector than GC/MS, providing them with some of the capability with less of the on-costs. Hopefully in the future I will be able to provide further innovations in chemical detection and identification.

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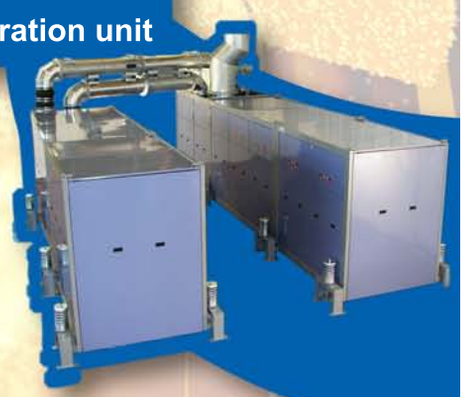

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