Tony Kingham reports on what's being done to find hidden explosives and how detection of TATP devices is being improved

THE FIGHT BACK

It has been a long-held desire for security services worldwide to find technology that allows the detection of explosives in a non-invasive way, from a safe distance or stand-off position for vehicles, goods and baggage, but most of all people.

The reasons are obvious; the Improvised Explosive Device (IED) is, and will remain the weapon of choice for terrorists. Recent events in Brussels and New York are just two of the latest in a catalogue of attacks using improvised devices. These were also examples of the use of Triacetone triperoxide (TATP) explosive. TATP has been a concern for the security services for some time now, but the increase in its use is creating something of a worrying trend. Terrorists use TATP because it can be produced using a selection of household products that can easily be bought over the counter and, therefore, do not attract the attention of any security services that might be watching.

TATP is produced using a mixture of hydrogen peroxide and acetone, chemicals that are typically found in regular household goods such as nail polish, hair bleach and antiseptic. It is relatively easy to manufacture, and doesn't require extensive chemistry training to prepare. However, it is unstable and can detonate at just the slightest shock. That might ordinarily pose a problem if the terrorist was hoping to survive an attack, but in the current climate where suicide bombers are becoming increasingly common, such early detonation on the way to an intended target is a risk worth taking as it is likely to cause casualties anyway.

The main appeal of TATP for the terrorist is that it has proved particularly difficult to detect because of its composition and the difficulty of obtaining positive readings due to its completely legal chemical makeup. And despite its humble origins, TATP is capable of devastating results in relatively small quantities.

Aircraft are especially vulnerable and remain a prime target for terrorists. Therefore, deployment of a technology that enables people to be properly screened for explosives, including TATP, while they are moving through security or in a scanning portal is regarded as the 'silver bullet' for airport security operations. But it doesn't stop there, border controls, public buildings, events, hotels, international train stations, cruise ships and public attractions are all places that are facing increased threat and so are keen to employ the technology to protect themselves as and when it becomes available.

This has led to a change in tactics by the terrorists that has resulted in a continual a race between the scientific community, industry and security services on one side and the terrorists on the other to respectively fill and exploit holes in our security.

The requirement for technology to perform stand-off screening has had a long history, going all the way back to 9/11 and there have been a number of promising technologies that have been pursued alongside a number of false starts.

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The so-called Explosive Trace Portals (ETPs) otherwise known as "puffers" showed early promise. They work by blowing (or puffing) air into a booth in which a person and/or suspect baggage is stood and then a sample from that air is collected for analysis. A mass spectrometer is then used to detect known compounds on a molecular level.

K AGAINST IEDS

Smiths Detection's TRACE-PRO is a hand-held explosive threat detector that can identify TATP

A few hundred ETP's entered service, mainly in US airports, acquired by the Transport Security Administration (TSA), but as the ETP pilot programme progressed, it became increasingly apparent that the problem of operating these delicate machines in the dirty and humid environment of a busy airport in summer was not going to be an efficient use of valuable personal and time, and so they were withdrawn from service. These systems are still on the market, but since the TSA experience there has not been any widespread take up. This technology still shows promise, but it's now a question of manufacturers making the machines reliable and durable enough to enter service.

Raman Spectroscopy is technology that probably offers the most promise for the development of an effective stand-off detection system, especially when it comes to the screening of objects rather than people. The Raman scattering is triggered by energising the substance with directed energy from laser beams. Raman scattering provides a unique molecular signature that then enables

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selective identification.

To identify an unknown substance, a laser beam is aimed at the object and the Raman scatter of the reflected light is detected and then analysed. The resulting signature is matched with a database enabling identification of the unknown substance. Use of such a laser beam means that an object or substance can be screened without touching the subject, but because the Raman signal is inherently weak it has to be used in very close proximity. Different techniques can be used to enhance a weak Raman signal for stand-off use.

However, for stand-off detection it is this use of a laser beam that is one of the chief problems. Increasing the power of the lasers to make an effective stand-off system in turn makes it unsafe for use in a public environment. So for the foreseeable future an effective stand-off explosive detection system remains only an aspiration.

In the meantime, the fight against international terrorism goes on and explosive detection systems in airports continue to play a pivotal role. So what are some of the technologies currently used and in what products?

Colorimetric detection is one of the oldest and most established methods for detection of explosives. It involves applying a chemical reagent to an unknown material or sample and observing the colour reaction. Colour changes to a chemical reagent are known and understood, and therefore indicate the identity of any unknown substance or trace.

One of the most successful systems on the market uses an automated colorimetric detection system, this is the SEEKERe range from DetectaChem in the US. The SEEKERe comes in three models, the XDU (Explosives only), the DDU (Drugs only), and the MDU (Explosives and Drugs). Developed for the military in America, it is very small and portable, highly ruggedised and easy to use, even by untrained personnel. It will detect Nitroaromatics, Nitramines, Nitrate Esters, Inorganic Nitrates, Chlorates, Peroxides (including TATP), Perchlorates and gun-shot residue.

One of its key benefits is its use of inexpensive disposable detection cards. These detection cards are what allows the system to be so versatile and completely automated. Each detection card comes individually packaged in an airtight, waterproof, lightproof, metallic-lined bag to ensure that it is ready whenever needed. Each bag has an easy-to-open perforated tear tab and is both colour coded and clearly marked for quick and easy selection and deployment.

Gerry Hall, MD of International Procurement Services, who represent DetectaChem in the UK highlights Seeker's strengths, pointing out: "The advantage of the Seeker over other systems we have seen, is that it is designed for durability, simplicity of use and economy of operation, which is why it is ideal for users patrolling airports and their environs".

Ion mobility spectrometry (IMS), meanwhile, is an analytical technique that is used to separate and identify ionised molecules in the gas phase based on their mobility in a carrier buffer gas. Sample collection typically occurs by using a swipe on the surfaces of any suspicious article. The swab is then rapidly heated to evaporate any adsorbed volatile species. Its greatest strength is the speed at which separations occur – typically on the order of tens of milliseconds. This is a mature technology that has been miniaturised and is widely used by airports worldwide for explosive and drug detection.

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DetectaChem's Seeker uses inexpensive disposable detection cards to highlight traces of dangerous substances

Smith's Detection IONSCAN 600 is a highly sensitive, lightweight, portable desktop system, which detects and identifies trace amounts of explosives and narcotics. It can detect common military and home-made explosives including TNT, RDX and TATP. Smith's newly launched TRACE-PRO uses IMS technology. It is a non-radioactive, hand-held explosive threat detector, and the company has recently announced it now has the additional capability to detect and identify TATP.

When it comes to monitoring and checking baggage, X-ray computed tomography (CT) is widely used. It works by irradiating baggage with intense X-ray beams and measuring how much of the beam passes through an object. CT scanners are able to probe the density of the baggage and its contents. An automated algorithm then compares the data with a database of known density values for a range of explosives including TATP. Any suspicious bags can then be pulled off the line and further inspected via IMS.

These are just some of the technologies that are currently in use and are being constantly improved and developed, and we are sure to see more significant technological break throughs in the coming years. One thing that is certain is that the cat and mouse game between the terrorists and civilised society will not be going away any time soon, and as they say "Necessity is the mother of invention".

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