Explosives and Terrorists

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EXPLOSIVES AND TERRORISTS

AristaTek recently received an E-mail asking why the explosive Semtex was not in the PEAC data base, although the explosive C-4 was in the PEAC data base. Semtex is the plastic explosive probably most widely used by international terrorists. (With the release of PEAC-WMD versin 5.0 in December 2004, both Semtex A and Semtex H are included in the PEAC database.)

Semtex is a plastic bonded explosive manufactured by Explosia, a company in the Czech Republic. It was invented in 1966 by Stanislav Brebera for the Czechlovakian government, which then sold the explosive to North Vietnam as a counterpart to the U.S.-made C-4 plastic bonded explosive. After the collapse of the Soviet Union, Semtex could be purchased on the open market. Semtex has many industrial uses, but unfortunately is also a favorite of terrorists. Only recently has the Czech government imposed controls.

Both Semtex and C-4 contain two powerful explosives RDX and PETN [also known as cyclonite and pentaerythritol tetranitrate] but differ in the plastic binder material. The explosives RDX and PETN are manufactured worldwide. Plastic bonded explosives containing RDX and PETN and binders are manufactured in several other countries, and theft is possible resulting in the explosive following into the hands of terrorists. Iran is believed to manufacture plastic bonded explosives. By agreement, several countries that manufacture plastic bonded explosives (U.S., Canada, Austria) incorporate tracer materials to enable the explosive to be traced to the country of origin.

In this month's article, we will review explosives that might be used by terrorists. This is a continuation of a PEAC Newsletter article which appeared in December 2003 [available at /Newsletter/03%2012%20December/Technically%20Speaking.htm].

Classification of Explosives

Explosives can be classified into two broad categories, called "high order explosives" or "low order explosives". High explosives produce a defining supersonic over-pressurization shock wave. Detonation rates are usually between 1000 to 10000 yards/second. Examples are TNT [trinitrotoluene], PETN [pentaerythritol tetranitrate], RDX [cyclonite], plastic-bonded explosives such as C-4 or Semtex, dynamite, nitroglycerine, and ammonium nitrate/fuel oil (ANFO) mixtures. It is custom to rank the explosive destructive capability in terns of TNT equivalents, for example, plastic bonded explosives such as Semtex may contain 1.5 times the explosive destructive power as TNT on an unit weight basis.

Low order explosives create a subsonic explosion. Burn rates may be on the order of inches to yards per second. The characteristic overpressurization shock wave is not produced. Examples are gunpowder, pipe bombs, ignition of gasoline vapors, Molotov cocktails, and aircraft used as guided missiles. A vapor cloud explosion that occurs if the chemical concentration in the air is between the lower and upper explosion limits and is ignited fall into this classification.

Injury patterns are different for high order as opposed to low order explosives.

Terrorists will use whatever is available, high order explosives or low order explosives or a combination thereof. They may be military issued or purchased from a supplier or improvised.

Propellants

Propellants are explosives used in the propulsion of projectiles in firearms and rockets. The propellant may be a low explosive such as gelatinized nitrocellulose, but it may also be a mixture of a low explosive and a high explosive such as nitroglycerine. The propellant must deliver enough force to deliver the projectile from a gun but not generate a sudden shock that might break the gun. Some propellants used are as follows:

Smokeless powder: An explosive used as a propellant which may be gelatinized nitrocellulose or nitrocellulose mixed with nitroglycerine. The name is a misnomer because it is neither free from smoke when exploded nor is it a true powder. Double-based smokeless powder or explosive refers to the combination nitrocellulose mixed with nitroglycerine.

Cordite: A double based, explosive contains 30 to 40% nitroglycerine, nitrocellulose, and a small quantity of petroleum jelly as a stabilizer.

High Explosives and Detonators

Many of the high explosives including TNT, RDX, PETN, and plastic bonded explosives such as C-4 and Semtex have a high resistance to shock or friction and can be safely stored and handled. Other high explosives such as nitroglycerin are so sensitive to detonation that they are almost always mixed with an inert desensitizer. Sometimes the high explosives are mixed to form various compositions. Examples of compositions are:

Composition B: A mixture of TNT and wax; used in bombs.

Torpex: A mixture of TNT, wax, and aluminum. Especially effective for underwater charges.

Pentolite: A mixture of TNT and PETN

Cyclotol: A mixture of RDX and TNT. Cyclonite is another name for RDX.

Detonators are compounds which are used to detonate the relatively insensitive high explosives. The detonators will explode under conditions of relative mild shock or heat, and this explosion is enough to set off the main charge. Examples of detonators are:

- Mercury fulminate
- Mercury fulminate and potassium chlorate
- Lead azide
- Lead styphnate
- Diazodinitrophenol
- Mannitol hexanitrate

A blasting cap or exploder is a small charge of a detonator designed to be embedded with the main explosive (e.g. dynamite) and ignited by a burning fuse or a spark.

Blast Injuries

The following information was obtained from the Center for Disease Control website at http://www.cdc.gov/masstrauma/preparedness/primer.htm :

Explosions produce unique patterns of personnel injury. The injuries associated with the blast may be subdivided into four categories as in **Table 1**, below.

Table 1: Mechanisms of Blast Injury			
Category	**Characteristics**	**Body Part Affected**	**Types of Injuries**
Primary	Unique to high explosives, results from the impact of the over-pressurization wave with body surfaces.	Gas filled structures are most susceptible - lungs, GI tract, and middle ear.	Blast lung (pulmonary barotrauma) Tympanic membrane (TM) rupture and middle ear damage Abdominal hemorrhage and perforation - Globe (eye) rupture- Concussion (Traumatic brain injury without physical signs of head injury)
Secondary	Results from flying debris and bomb fragments.	Any body part may be affected.	Penetrating ballistic (fragmentation) or blunt injuries Eye penetration (can be occult)
Tertiary	Results from individuals being thrown by the blast wind.	Any body part may be affected.	Fracture and traumatic amputation Closed and open brain injury
Quaternary	All explosion-related injuries, illnesses, or diseases not due to primary, secondary, or tertiary mechanisms. Includes exacerbation or complications of existing conditions.	Any body part may be affected.	Burns (flash, partial, and full thickness) Crush injuries Closed and open brain injury Asthma, Chronic obstructive pulmonary disease, or other breathing problems from dust, smoke, or toxic fumes Angina Hyperglycemia, hypertension

Selected Blast Injuries may include:

- **Lung Injury**: "Blast lung" is a direct consequence of the high explosive (HE) over-pressurization wave. It is the most common fatal primary blast injury among initial survivors. Signs of blast lung are usually present at the time of initial evaluation, but they have been reported as late as 48 hours after the explosion. Blast lung is characterized by the clinical triad of apnea, bradycardia, and hypotension. Pulmonary injuries vary from scattered petechae to confluent hemorrhages. Blast lung should be suspected for anyone with dyspnea, cough, hemoptysis, or chest pain following blast exposure. Blast lung produces a characteristic "butterfly" pattern on chest X-ray. A chest X-ray is recommended for all exposed persons and a prophylactic chest tube (thoracostomy) is recommended before general anesthesia or air transport is indicated if blast lung is suspected.
- **Ear Injury:** Primary blast injuries of the auditory system cause significant morbidity, but are easily overlooked. Injury is dependent on the orientation of the

ear to the blast. TM perforation is the most common injury to the middle ear. Signs of ear injury are usually present at time of initial evaluation and should be suspected for anyone presenting with hearing loss, tinnitus, otalgia, vertigo, bleeding from the external canal, TM rupture, or mucopurulent otorhea. All patients exposed to blast should have an otologic assessment and audiometry.

- **Abdominal Injury:** Gas-containing sections of the GI tract are most vulnerable to primary blast effect. This can cause immediate bowel perforation, hemorrhage (ranging from small petechiae to large hematomas), mesenteric shear injuries, solid organ lacerations, and testicular rupture. Blast abdominal injury should be suspected in anyone exposed to an explosion with abdominal pain, nausea, vomiting, hematemesis, rectal pain, tenesmus, testicular pain, unexplained hypovolemia, or any findings suggestive of an acute abdomen. Clinical findings may be absent until the onset of complications.
- **Brain Injury:** Primary blast waves can cause concussions or mild traumatic brain injury (MTBI) without a direct blow to the head. Consider the proximity of the victim to the blast particularly when given complaints of headache, fatigue, poor concentration, lethargy, depression, anxiety, insomnia, or other constitutional symptoms.

What about Semtex and Terrorists?

As mentioned before, Semtex is a trade name for plastic bonded explosive manufactured by Explosia near Prague in the Czech Republic. An article which appeared in the magazine, Chemical Week, Jan 30, 2002, stated that the Czech government will acquire Explosia from its owner Unipetrol during 2002. An article in the Sunday Mirror (an English newspaper) stated that about 7000 metric tons of Semtex was exported to Libya, Iraq, and North Korea during the 1970's and 1980's, at least some of which was delivered to terrorists [see http://www.intellnet.org/news/2002/11/16/13551-1.html]. Even after the Czech government took control of Explosia there were reports of Semtex seizures [see http://www.buzzle.com/editorials/text7-9-2002-22092.asp ; http://www.alertnet.org/thenews/newsdesk/L06672497.htm]. There are reports of stolen Semtex [http://www.rense.com/general20/sem.htm]. Semtex is a favorite choice of terrorists [see http://www.kreten.8m.com/new/semtex.htm].

It is believed that world stockpiles of Semtex may be 40,000 tons. Only 12 ounces of Semtex molded inside a Toshiba cassette recorder brought down Pan Am flight 103 near Locherbie, Scotland, in 1988, killing 270 people. [see Christian Science monitor article, http://www.csmonitor.com/2002/0226/p07s02-woeu.html for additional details].

Semtex was invented in 1966 by Stanislav Brebera as an explosive for industrial use and also to safely clear land mines. It was named after the town of Semtin in Czechoslovakia where Brebera invented it. Shortly after its invention, Czechoslovakia began supplying the explosive to North Vietnam.

Detection of Semtex

Approximately 40 varieties of Semtex has been produced by Explosia. It comes in a variety of colors, including red, yellow, black, white, or grey-brown. It is a putty-like material can be molded into almost any shape. For example, Semtex 1A, used for blasting operations, is in the form of red bricks. Semtex 10SE, used primarily for hardening metals, is in the form of white sheets. Semtex has a lifetime of 20+ years. It is essentially odorless and can pass through undetected through airport detectors.

More recently, a "smelly" version of Semtex has been invented which can be detected by sniffer dogs. Metal traces have also been added to the explosive which enable the material to be detected by airport scanners. This formulation will also deteriorate after 3 years making it harder for terrorists to stockpile the material.

The U.S. military explosive C-4 is also invisible to airport x-rays and is essentially odorless, but it is Semtex that has fallen into the wrong hands. Both C-4 and Semtex contain the explosives RDX and PETN; however, Sentex is reported to be an improvement over C-4, using a styrene-butadiene rubber binder to give much-improved consistency and shelf life.

Detection of explosives depend upon the fact that explosives leak minute amounts of vapor to the air. There are several devices available as well as use of trained sniffer dogs for detection of these vapors. Sniffer dogs are probably the most effective option available today. The problem is that these methods are usually not sensitive enough, especially in the case of Semtex where the explosives are well wrapped.

A fairly technical article on explosive detection published by the Dept. of Energy can be obtained from the Internet at http://www.osti.gov/bridge/product.biblio.jsp?osti_id=666025.

The magazine, Nature, 23 October 2002, [see http://www.nature.com/nsu/021021/021021-3.html], carried an article on a British team who developed a methodology for on-spot detection of minute traces of RDX vapor with the sensitivity of a few trillionths of a gram. The sensor device uses a sodium amalgam in mercury, which converts the RDX to a compound which is detected by surface-enhanced Raman scattering.

More information on commercially available explosive detection equipment can be obtained by visiting the following websites:

Scintrex Trace Corp. http://www.tracedetection.com/sitemap.html

http://www.tracedetection.com/explosives_detector.html

Control Screening LLC http://www.controlscreening.com/trace.html

Mistral Group http://www.mistralgroup.com/SEC_explosives.asp

Implant Science Corp. http://www.implantsciences.com/products/exp/

Advanced Canine Technologies (sniffer dogs) http://www.controlscreening.com/trace.html

Medimpex United Inc (aerosol field kit) http://www.meditests.com/exaerfieltes.html

IONSCAN http://www.global-security-solutions.com/IonScanSentinel.htm

For a guide and listing of explosive detection systems visit the website: http://www.securitymanagement.com/library/nij1789139-2.pdf