

Forensic Examination of Explosives

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Abstract: The primary explosives are mercury fulminate, lead/silver azide, lead styphnate etc. Commonly used explosives and ammunition are nitrate mixture, black powder, gun powder, smokeless powder, blasting explosives etc. Bombs are improvised grenades, time bombs, letter bombs, transistor bombs, suitcase bombs, human bombs, position canal, tunnels, explosives for security forces, firework display during festivals and others bombs cocktail bombs, throw down bomb etc. Lawful explosives/bombs are used for mineral and building stones, construction for railway lines, dams, occasions, police/armed force use tear gas, shells etc. Illegal explosives are used by terrorist activities, murder etc.

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Introduction

Explosives are divided into two categories; high explosives and low explosive. High explosives are those which have a very high rate of decomposition and have a shattering effect upon their surroundings. They are ordinarily, initiated by shock or blow. Their fast rate of reaction is called detonation. The speed of detonation varies from three thousand to eight thousand meters per second. The explosion is often uncontrollable. The products of explosion travel in the same direction is the detonation wave, T.N.T. is a high explosive.¹

Low explosives have comparatively low speed of reaction about fifty centimeters per second-about 1/10,000 of the rate of detonation. The scattering effect on the surrounding is not so intense, and has rather a displacement effect. It is controllable. The low explosives are, therefore, used as propellants. Smokeless powder is an example of low explosive.²

Primary explosives are highly sensitive to various stimuli: impact, heat and friction, and are easily initiated with an electric spark or direct flame. The primary explosives do not deflagrate, they detonate. They are used only in small amounts as initiators in firearm ammunition, blasting caps and detonators or to initiate, sensitize and explode the secondary explosives. The latter form the main charge of powerful explosive devices. The primary explosives are initiated by impact, by an electric spark or by stabbing the primary charge. The

¹ Anil Sachdeva (eds.), *Medical Jurisprudence and Toxicology* 5444 (Delight Law Publishers, 2007).

² *Ibid.*

important common primary explosives are: Mercury fulminate, Lead/Silver azide, Lead styphnate, Tetracene (tetrazene), Dinol (Diazo-dinitro-phenol) etc.³

Most of the secondary high explosives are mixtures containing one or more high explosives chemicals. Pentaerythritol Tetranitrate (PETN) and Royal Demolition eXplosive (RDX) have been used in equal proportion to give rise to a high explosive called SEMTEX. Similarly, a pliable plastic explosive is made using 80% RDX in a mixture of oils, waxes and plasticizers, known as C-1 to C-4 composition.⁴ The common secondary explosives are (Tri Nitro Toluene) TNT, RDX, (High Melting Explosive) HMX, PETN, etc.⁵ These are sold under several trade names, different products being marketed for a particular use and for a particular location. These generally contain nitro-glycerine mixed with either nitro-cellulose or ammonium nitrate and other inert substances. These are put in a cylindrical shaped water proofed paper and stamped with the maker's name. Gelatin dynamite, ammonia dynamite are example.⁶

In terrorist activities normally chemicals explosives are used. In clandestine mixture is usually the resultant of the available explosives at a point of time. Like combination of the following types are encounter in recent explosion in India causing severe damage and killing of large number of people.

- (i) Acid bomb- Potassium chlorate + Arsenic Sulphide along with sugar and sulphuric acid as initiator.
- (ii) Mixture of RDX + TNT.
- (iii) Mixture of RDX+ No-Ng.
- (iv) Mixture of RDX+TNT+Nc-Ng.
- (v) Mixture of Ammunition Nitrate + Fuel oil.
- (vi) Mixture of Ammonium +Fuel oil + Sugar.
- (vii) Mixture of Ammunition Nitrate + Aluminum pellets + fuel oil.
- (viii) Mixture of RDX + Ammonium nitrate + fuel.⁷

For any explosion to be effective the explosives need to be confined with a tight container. The clandestine preparation uses any container like Tiffin Boxes, Tin Boxes, and cast iron container external missiles. The container is placed in bags normally carried by school children or officer goers so that no suspicion occurs when such bags are placed in public buses, train etc.⁸

³ B.R. Sharma, *Forensic Science in Criminal Investigation and Trials* 1076(Universal Law Publishing Co. Pvt., Ltd., New Delhi, 2014).

⁴ B.S. Nabar, *Forensic Science in Crime Investigation* 327 (Asia Law House, Hyderabad, 2014).

⁵ *Supra* note 3 at 1077.

⁶ *Supra* note 4 at 328.

⁷ Rukmani Krishnamurthy, *Forensic Science in Criminal Investigation* 264 (Selective & Scientific Books, New Delhi, 2011).

⁸ *Ibid.*

Lawful Explosive

Explosive are used legally in the wide field of industry for legitimate purpose. Rapid industrialization and widespread construction activities have not only increased manifold, but also made explosives easily available, virtually all over the country. The pilferage and theft from the legitimate stocks of explosives⁹ the legitimate uses of explosives include the following: (i) Mining and quarrying work to get ores, mineral and building stones, (ii) rock blasting for the construction of railway lines, roads, dams, canals and tunnels, (iii) firework display during festivals and some others occasions, (iv) ammunition for security forces, (v) for making military bombs, tear gas, shells, smoke candles, etc. (v) to collapse illegal buildings and other structures etc.¹⁰

Ill-Legitimate Explosives

- Explosives used in terrorist activities. Murder, dacoities, burglaries, etc.
- Sabotage, political and communal troubles.
- Accidental explosives occur while manufacturing, starting and landing.¹¹

Nitroglycerine

It is pale yellow liquid. It is an extremely dangerous explosive in pure form. It is not used as such. Its common notified forms are: dynamite, gelignite, gelatin, plaster gelatin. Nitroglycerine is prepared from glycerin (an externally innocent and useful material) by nitration with nitric acid and sulfuric acid. Its commercial products are prepared by mixing it with clay and inert organic and inorganic substances. It is sometimes mixed with explosive, gun cotton to give cordite.¹²

Trinitrotoluene (T.N.T.)

(Tri Nitro Toluene) TNT is a powerful explosive. It is obtained by the nitration of toluene tar product. It forms the major part of the bursting charge in many military explosives, either singly or in combinations. Some products are:

- (i) Amonal: It is a mixture of TNT ammonium nitrate aluminum and carbon powder.
- (ii) Amatal: It is mixture of TNT and ammonium nitrate. Picric Acid and Picrates-Picric acid is obtained by the nitration of phenol. It is yellow in colour. It is also used in solution as tincture. Picrates are derivatives of picric acid. The acid is ordinarily handled in water.¹³

⁹ B.P. Maithi, *Physical Evidence in Criminal Investigation & Trials* 307 (Selective & Scientific Books, New Delhi, 2012).

¹⁰ *Id.* at 308.

¹¹ *Supra* note 7 at 266.

¹² *Supra* note 1 at 585.

¹³ *Ibid.*

Fulminate

Fulminates of mercury and silver are used in explosives. They are highly sensitive to pressure and impact. Consequently they are highly dangerous to handle. They are used as initiators in explosives, percussion cap and other primes.¹⁴

Types of Bombs

Some common homemade bombs (IEDs) which are very often encountered by the crime investigation team are described below:

Improvised Grenades

The empty tins, cast iron or aluminum alloy shells, GI pipes, and other metal container in the shape similar to army grenades are filled with high explosives such as dynamite and closed tightly leaving a hole in the center of the lid or at the one end which is screwed light for the fuse. The fuse initiates the detonator embedded in the explosive mixture by conventional ways or with an electric spark by the battery.¹⁵

Time Bombs

These are also termed as clock or watch bombs. These are usually made up of an explosive mixture contained in a package fitted with an initiating device, which accurate in a certain time. In a time bomb, the initiating device may be mechanical, such as a sensitive explosive material is packaged at the site where alarm hammers strikes. In some cases initiation device could be electrical. At the given set time, the clock completes electric circuit and heating element puts the explosive on fire at the relevant site. Another initiation device may be a chemical reaction, where a capsule filled with cone; sulphuric acid is placed in a mixture of sugar and charcoal. The acid corrodes capsule wall, trickles-down and thus initiates explosion.¹⁶

Magnetic Bomb

Magnetic bombs are usual time bombs having a moderately powerful magnet attached to the device. The magnet helps to fix the bomb to the car of the victims. The bomb would explode at the prefixed time, blowing the car to pieces and killing the persons in the car and bystanders.¹⁷

Letter Bombs

A letter bomb may look like an ordinary letter or a postal parcel. It is designed to injure an individual when it is opened or mishandled. In a letter a bomb, a friction sensitive explosive material such as potassium chlorate mixture is place at the opening or cutting points. In some cases, detonator and spring operated hammer or a tiny battery may be used as initiating device in the parcel bombs or book bombs.¹⁸

¹⁴ *Ibid*

¹⁵ *Supra* note 9 at 315.

¹⁶ *Id.* at 316.

¹⁷ B.R. Sharma, *Firearms in Criminal Investigation & Trials* 438 (Universal Law Publishing Co. Pvt. Ltd., New Delhi, 2012).

¹⁸ *Supra* note 9 at 316.

Transistor Bombs

Terrorist have used transistor bombs in recent times. The terrorists would leave such bombs in public places where someone would pick them up and fiddle with them. The bomb would explode killing the fiddlers and nearby persons. In transistor bombs the cover of the transistor is utilized to house the explosive and missiles. The electrical system, including off-on switch, serves to initiate the bomb electrically.¹⁹

Suitcase Bombs

IED's intended for explosion, concealed in suitcases along with the timing device and the initiators are known as 'suitcase bombs'. Intended targets for use of such bombs with variation in its intensity, are mostly public and crowd places, such as buildings, market places, trains, buses, cars or festival locations etc. explosion of the infernal device is caused at the time set for the purpose.²⁰

Human Bombs

The human bomb is an improvised device containing adequate quantities of high explosive and an initiating device. It is attached, in a concealed position, to the body of a person who has been frightened or hypnotized to sacrifice his life. The explosives may be stitched in a specially made vest, to be worn under the normal clothing. Usually a large sum is also paid to him or his kith and kin to motivate him to act as a human bomb.²¹

Position Bombs

Sometime, explosive are filled in common containers such as tin, can, box, etc. the current is provided from a battery filled in the container, and the circuit is completed by mercury joining the two contact points. The charge gets ignited, if the container is lifted from its position tilted or moved.²²

Cocktail Bombs

These are of incendiary type bomb also called petrol bombs. In such type of bombs, a liquor bottle is filled with petrol and small amount of cone, sulphuric acid at the bottom. The bottle is tightly corked and a thick paste of potassium chlorate, sugar and gum is coated from outside. When the paste is dried up, the bottle is thrown at the target.²³

¹⁹ *Supra* note 17 at 438.

²⁰ Anoop Modak (eds.), *Firearms Investigation* 220 (Universal Law Publishing, an imprint of LexisNexis, Gurgaon, 2016).

²¹ *Supra* note 17 at 240.

²² *Supra* note 9 at 316.

²³ *Ibid.*

Throw Down Bomb

Chemical mixtures in addition to that of fulminates or suitable chlorate, can be used as initiator for explosion of throw down bomb, the function of which entails throwing down the bomb with sensitive material kept inside, and results in explosion by the impact of throwing.

The Scene of Explosion

The scene of explosion is the most important source of evidence. It has the crater, the shattering wave route and the destruction. They indicate the power and possible nature of the explosive used, and of the explosive device itself.

In addition it has evidentiary clues:

- Traces of the explosives used, flash impacted on the object around.
- The shattered pieces of the container.
- Remnants of the timing mechanism, clock mechanism and the like.
- Fragments of electrical and electronic systems used, including circuit board etc.²⁴

In addition, there may be traditional clues like fingerprints, footprints, discarded containers, bags, tools, tool marks, blood due to accidental injury, fibers, hair cigarette stubs, match stick, and the like, which may have survived the explosion. They may help to provide linkage of the explosion with the perpetrator.²⁵

Dispatch of Explosives Materials

All the times, bomb charge, initiator, container, wrapper, string, wire, paper, fiber, cloth, tape, switches, caps and extraneous materials such as hair, dust, dirt, paint, tools are collected from the scene should be sent for the examination to the concerned lab. The following points should always be considered while dispatching exhibits: (i) Initiating and detonating devices should always be packaged separately, (ii) Try to send minimum amount or number of explosive devices for examination. For example one or two detonators are sufficient for required examination; (iii) Dangerous explosives such as mercury fulminate, lead azide, etc. should not be sent, even with the special messenger. These should be examined at the site only, and (iv) Country made bombs should be kept submerged in water for at least seventy two hours, only then should be transported in water filled container.²⁶

The inspectors of explosives, located at different places, were the authorized person to handle the evidence till some decades ago. Now the explosives experts of Forensic Science Laboratories carry out the examination of explosives, explosive devices, and their explosion products. The experts normally visit the scene of explosions and assist the investigator to locate, collect and pack the correct rule. Dangerous explosives

²⁴ *Supra* note 17 at 447.

²⁵ *Ibid.*

²⁶ *Supra* note 9 at 323.

or explosives devices are not sent to the laboratory without defusing them. The expert usually examines them at the scene.²⁷

Examination of Bombs/Explosives

Examination of debris from the scene of occurrence of explosion is the commencement of identification of explosives, which entails the sequence of:

- Preferable application of technique of Gas Chromatography for detection of presence and nature of the explosives, prior to collection, concentration and analysis of the debris.
- Stereo-microscopic examination of residues, especially of the small broken pieces of the non-explosive components of the device.²⁸

The examination of the scene of an explosion provides important evidence on the all of the above aspects. It is a daunting task because of its vast area extensive damage and destruction, huge amount of debris and extensive destruction of the explosive device and near-complete annihilation of the explosive used in most of the explosions. Proper examination helps to find out:²⁹

- The nature of the explosive and the explosive device.
- The quantity of the explosive used.
- The source of the explosive and the explosive device.
- The mode of initiation.
- Evidentiary clues to link the criminal with the crime.
- The target.
- The victim.
- The scene of the explosion.
- The culprit, his wearing apparel, shoes, etc.
- The culprit's vehicle.³⁰
- The culprit's workshop, residence where he assembles or make explosive devices.
- The culprit's officer: documentary evidence.
- The culprits' associates or helpers.³¹

Priming mixtures are strong explosives likely to explode not only from heat or shock but also upon being crushed or subjected to friction. It is also called percussion mixture. When crushed by the blow of the firing pin,

²⁷ *Supra* note 3 at 1120.

²⁸ *Supra* note 20 at 243.

²⁹ *Supra* note 17 at 446.

³⁰ *Ibid.*

³¹ *Id.* at 447.

it explodes and instantly gives off a hot flash driving it with great force and a great speed.³² Explosive examinations are: (i) A video film of the scene is prepared before collection of the clues, (ii) the location of the clues is documental through images, sketches and written record, (iii) the investigator marks the clue for identification before packing, (iv) the recovery memo is signed by the recovery witnesses, in accordance with law, in addition to bearing the signature of the investigator, and (v) the authenticity and integrity of the clues must remain beyond doubt and the chain of possession must remain unbroken.³³

Methods of Examination of Explosives/Bombs

Friction Test

Few bombs are sensitive to friction. They explode when rubbed against rough surface. A trace of the suspected material is placed on a stone slab. The material is scratched with a meter-long bamboo stick. The experiment is repeated with increasing amounts of the material. If the material catches fire, it is an explosive.³⁴ The bomb examination techniques are:

Impact Test

Some bombs are impact sensitive. They are tested with a hammer blow. A small quantity (starting from a trace and increasing the amount gradually to a pinch) is taken on a piece of paper, kept on a standard anvil and struck with the hammer.³⁵

Wet Tests

These tests generally performed for identification of inorganic cationic and anionic. Identification of chlorate, nitrate, phosphate perchlorate, sulphide and thiocynate anionic radicals is important. Similarly identification of cat ions like sodium, potassium, ammonium, calcium, barium, strontium and arsenic cationic radicals are normally performed.³⁶

Flame Test

A small amount of the material under test is taken on the tip of a strip of paper. If the material is liquid, the paper is dipped in the liquid to absorb a fraction of a drop of the liquid and dried. The paper tip is then exposed to a candle flame. If the burning takes place violently, it is possibly an explosive. The colour of the flame may indicate the nature of explosive.³⁷

³² *Ibid.*

³³ *Id.* at 454.

³⁴ *Id.* at 463.

³⁵ *Ibid.*

³⁶ *Supra* note 7 at 274.

³⁷ *Supra* note 17 at 463.

Conclusion

The explosives misuse is due to easy availability of explosives material ammonium nitrate, potassium chlorate explosive material, easy homemade/improvise explosives/bombs, illegal supplies explosive. Suicide bombing is the recently trend in misuse of explosive/bombs, terrorist activities etc. The misuse of bombs/explosive is a serious crime. The forensic examination of explosives/bombs are: image of explosives, sketches, video-filmed explosive and crime place, traces the explosive material, location identification, size, shape of explosive, sealed the explosive, dispose explosive, live explosive not dispatch directly to forensic labs, collection explosive material properly, packing and sealing properly, case diary maintain, disposal live bombs, nature of the incidence of explosives, methods of examination of explosives (friction test, impact, test, flame test etc), analysis improvise explosive materials, identification types of explosive, characteristics of explosives/bombs, blast scenes, diffused bombs etc.

