

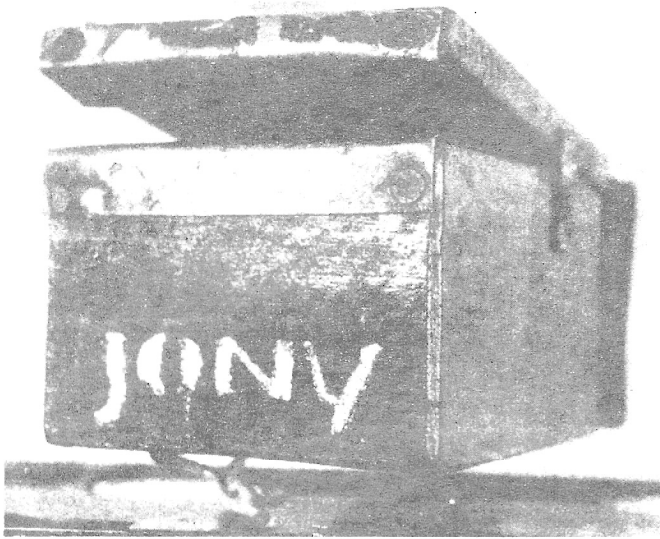
# HISTORY CHEMISTRY AND TECHNOLOGY OF EXPLOSIVES

**W.D.G.S. GUNATILLEKE**  
*Senior Assistant Government Analyst  
Government Analyst's Department,  
Colombo 7*

An explosion occurs, when the energy previously confined is suddenly released to affect the surroundings. It is always associated with the sudden and rapid escape of gases from a confined volume accompanied by high temperature, loud noise and violent shock. Explosions can be classified into three fundamental types: Mechanical, Chemical and atomic. Small harmless explosions such as bursting of a toy balloon are simple mechanical explosions. In this type no chemical reactions are involved. The famous Krakatao Volcanic explosion, the greatest steam explosion in the history occurred on 27th August 1883 as a result of the violent vaporization of an estimated cubic mile of ocean water when the Krakatao Volcano ruptured and spilled a great mass of hot molten lava into the sea. The ultimate result was the loss of about 36,000 human lives which dramatically illustrates the potential of a mechanical explosion. As the name implies the chemical explosions are always associated with chemical reactions. This article will mainly concentrate on this type. Well known widely used explosives such as Gun Powder, Dynamite, Tri Nitro Toluene, Plastic Explosives etc. are chemical explosives. An atomic explosion may be induced either by splitting of the nucleus of an atom or joining together under great force of the nuclei of atoms of certain elements. The atomic bombs dropped on Japan in World War II were rated as equivalent to 20,000 tons of Tri Nitro Toluene in explosive power, yet the amount of fissionable material required to produce the same amount of energy weighed about 2.2 pounds. Also, this type of explosions result long term radiation hazards.

Chemical explosives contain oxidizing and combustible ingredients united in a single molecule or present in different chemicals as a mixture. For example Nitro Glycerine and Tri Nitro Toluene are single chemicals and Gun Powder is a mixture of Chemicals.

All the explosives are not alike, they have different properties. An explosive used as a propellant in ammunition is not effective in breaking boulders in a quarry and conversely, an explosive such as Dynamite used in quarries would shatter gun barrels. According to the properties and the methods of initiation, they can be classified into three main classes; initiating, Low and High Explosives. Initiating explosives are easy to explode and generally sensitive to flame, spark, impact, shock and friction. But they do not necessarily produce large volumes of gases and hence this type of explosives themselves are not suitable in blasting operations. Explosives such as Mercury Fulminate, Lead Azide and Lead Styphnate are considered as initiating explosives. Low explosives are generally sensitive to flame and spark and safer to handle. The chemical reaction involved in this type of explosions is the simple combustion of combustible materials with oxygen.



Jony Mine

The most widely used Low explosive is Gun Powder. Blasting granules also contain the same explosive mixture, but the granules are graphited in order to minimise the absorption of moisture and facilitate filling bore holes. Gun Powder or Black Powder as it is now called was the first explosive used and it was first discovered in the 13th century. Gunpowder consists of a mixture of Potassium Nitrate, Carbon and Sulphur in the approximate proportion of 75:15:10 and it is readily ignited with a spark or flame even in complete absence of air. But if it is not confined, generally it does not explode. When it is burned in a confined space, as in a bore hole or a military shell, then as the pressure increases the rate of burning also increases to a high value resulting a violent explosion. Here, Potassium Nitrate acts as the Oxygen supplier. The rate of flame propagation in Gun Powder is of

the order of hundred metres a second. When Gun Powder explodes it undergoes a combustion reaction with a rapid release of gases and energy. The ultimate explosion products of Gun Powder may be Potassium Carbonate, Potassium Sulphate, Potassium Sulphide, Carbon Dioxide, Carbon monoxide and Nitrogen. This is the slowest acting of all explosives and has a shearing and heaving action tending to blast objects into large fragments. This has very wide commercial applications and also it is very interesting to mention that this is the approved explosive mixture in crackers. Gun Powder is used as the core of safety fuse in explosive industry and also as a propellant in aerial rockets in fireworks industry.

However, it is sad to mention that most of the crackers available in the market now contain a mixture with silvery shiny appearance due to the presence of aluminium powder. The use of aluminium powder mixed with other ingredients in crackers is prohibited under the Explosive Regulations because it enhances the friction and impact sensitivity of Gun Powder making it unsafe, although it produces a louder noise. This may lead to accidental explosions and uncontrollable fires.

Even more rapid reaction can be produced when oxygen and fuel are united in a single chemical molecule. This type of explosives are generally named High Explosives. The chemical reaction involved in this type of explosions is not combustion; it is called "Detonation". Although it is simply defined as "instantaneous combustion", this process of detonation can best be defined as the passage through the explosive substance of a sudden supersonic wave of very high pressure and temperature which causes the molecules to break down into fragments. These fragments later recombine to give the ultimate products. The rate of this reaction is of the order of 8000 metres a second. Since this is independent of the

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pressure of surrounding gases, confinement is not necessary for an explosion. When such an explosive charge is detonated, very hot expanding gases are formed in a period of approximately 1/10,000th of a second. These gases generally exert pressures of about 700 tons per square inch on the atmosphere surrounding the point of detonation and rush away at velocities of up to about 9000 metres per second compressing the surrounding air. This mass of expanding gases rolls outward in a spherical pattern from the point of detonation like a giant wave weighing tons, smashing and shattering any object in its path. This is generally called the blast pressure wave and the further it travels from the seat of explosion, the less power it possesses until, at a great distance it dwindles to nothing. Now it is obvious that the initiation of this type of explosive is not an easy task since a supersonic wave of a suitable strength is necessary. A small device called "Detonator" which can be initiated either by flame or electricity, is used to fulfil this requirement. It has the ability to explode less sensitive high explosives.

Nitro Glycerine is the main active ingredient in most of the dynamites; the commercial high explosive most widely used in blasting operations throughout the World. Pure Nitro Glycerine is a colourless to pale yellow liquid which has a characteristic smell of almond. In 18th century an Italian Chemist named "Ascanio Sobrero" discovered Nitro Glycerine. But this oil was highly explosive extremely dangerous to handle and could be set off by being struck. In 1863 "Alfred Noble" a Swedish Chemist invented a way to control Nitro

Glycerine by treating it with Kieselguhr, an extremely porous earth and hardening into sticks called "Dynamite" creating a new word from the Greek "Dynamis" meaning power. But, unfortunately during period, an accidental explosion in Alfred's Workshop killed his younger brother and critically injured his father. I believe that Alfred Nobel had no idea throughout his life of using his invention for the purpose of killing people. Now this type is widely used by the extremist groups to manufacture land mines, booby trap bombs, time bombs, etc. against human lives. The most common symptom of Nitro Glycerine poisoning is severe headache which is noted upon commencing work but gradually passes off. It can be absorbed even through uninjured skin and may produce eruptions on the palms. However, in normal careful handling of Dynamites the physiological effects of Nitro Glycerine cause only temporary discomfort and are not seriously injurious to health. It is important to note that the possibility of accidental self detonation in handling deteriorated Dynamite is a great risk.

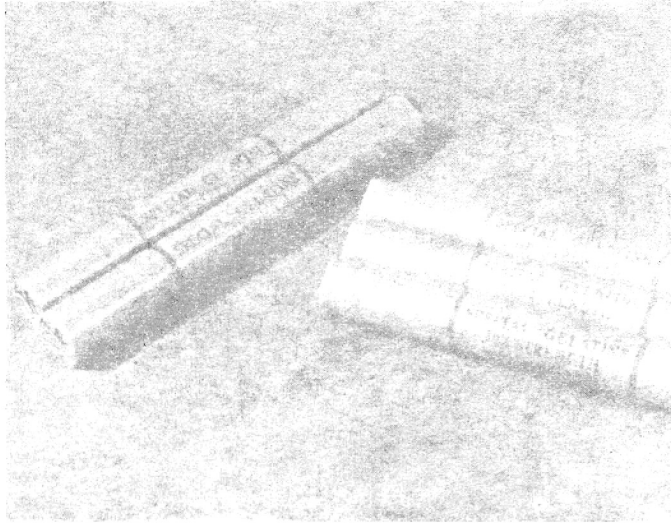
Tri Nitro Toluene (T.N.T.) is a widely used military explosive and it is a colourless to pale yellow solid. This comes as monoclinic crystals, and widely used as the main charge in hand grenades, air delivered bombs, and also in the manufacture of another useful high explosive called :Composition - B" which is mainly used in mortars, R.P.G. rockets, anti-tank mines, torpedoes and grenades. Tri Nitro Toluene is also used locally in the manufacture of "JONY" mines in the



**Anti Personal Mine**



**"ARGES" Grenade**



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High Density Gelatinous Explosive

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northern part of the island which has become a major threat to the security forces.

This is a comparatively stable and safe explosive but the acute or chronic poisoning of Tri Nitro toluene from inhalation of dust, skin absorption or ingestion may cause Jaundice, nausea, loss of appetite, dermatitis, cynosis etc.

Cyclo tri-methylene tri-nitramine (R.D.X.) a white crystalline powder is one of the most powerful high explosives in use today; and has more shattering power than Tri nitro toluene. This is the main active ingredient in plastic explosives and plastic sheet explosives.

However, it is extremely important to note that the readers should never experiment with explosives or pyrotechnics as there will be no excuse for mistakes. It may also lead to serious explosions and severe uncontrollable fires.



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Consequences of a Bomb Blast

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