

## WHAT IS AN EXPLOSION?

Firstly it must be clearly stated:

**Explosives are man made! There are no naturally occurring Explosives.**

But what is an explosion?

Well, if you burn a mixture of gaseous hydrogen and air you get a flame and some heat. If you mix hydrogen and air in the right proportions in a sealed container and pass an electric spark through the mixture you will get the same reaction, a flame and some heat. BUT, the speed of the reaction will be markedly different. The liberation of heat from the initial reaction will raise the temperature of the gas and cause it to expand very rapidly which will shatter the container.

Some examples of this type of explosion are the explosion of a mixture of air and methane in coalmines (Firedamp) and the explosion of a mixture of air and petrol in an internal combustion engine. This brings us to a first definition of an explosion.

"A rapid chemical reaction liberating a large amount of heat energy with the simultaneous creation of a large volume of gaseous products"

These gaseous based explosions, while apparently quite violent are, in relative terms, mild and are thus suitable for use in moving pistons, projectiles etc. They are not violent enough to use as working explosives. This is mainly due to the fact that the expansion is a product of the heat effect only. To put this in a text book fashion "An explosion is a combustion whose velocity varies from about 300mm a second up to about 300m a second. This velocity is constant for any given substance"

When gunpowder explodes however, at normal pressure it produces 500 times the original volume as gases but when the heat from the liberated gases is added to the process the volume of gases rises to values in the order of 4000 times the original volume. Nitroglycerine when it explodes produces 1200 times the original volume expanding to 10000 times the original under the influence of the liberated heat. Thus 1cc of NG gives 10 litres of gas when it detonates. Those 10 litres of gas are still locked in the space of the original 1cc. They want to expand and they do!

**THIS IS AN EXPLOSION**

The above indicates that an explosive needs to generate some portion of its products as gas to be effective through the expansion of that gas. The heat energy trapped in the solid and liquid residue products cannot be used. It is wasted energy.

This brings us to the question of “What is an explosive”?

“An explosive is a substance designed to exert on its immediate surroundings a violent and intense pressure after being suitably initiated.”

(“**Suitably initiated**” This is a fancy phrase meaning “Detonated” or “Exploded”)

This pressure arises because the initiation of the explosive causes it to decompose very rapidly into some gasses and some solids. WITH THE SIMULTANEOUS LIBERATION OF HEAT.

So, what the chemical engineers are looking to design is a substance that has the following parameters:

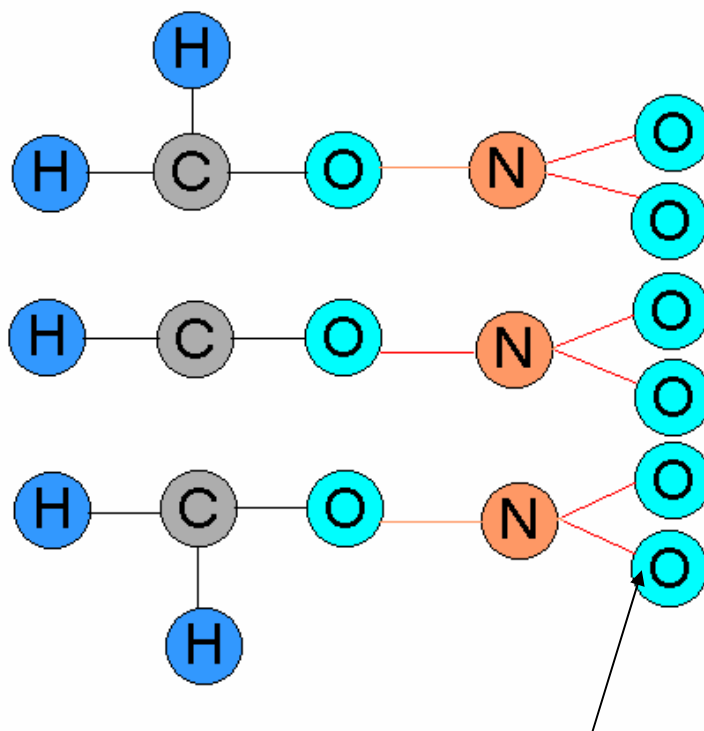
1. It should possess high potential energy, which is independent of external sources.
2. It must form gaseous products with the simultaneous liberation of energy.
3. It must be capable of rapid decomposition when suitably initiated.

Explosives may be a solid a liquid or a gas. They may be individual compounds or mechanical mixtures. When they are a mixture it is not necessary for the individual parts to be in themselves explosive (e.g. Gunpowder)

In Gunpowder the necessary oxygen is provided by Potassium Nitrate ( $\text{KNO}_3$ ) and the fuel is provided by the carbon. Having the oxygen separate from the fuel is inefficient. To provide both the oxygen and fuel atoms in the same molecule is to produce a more efficient and powerful explosive. It should be mentioned here that normal air is a poor source of oxygen because the nitrogen content of the air acts as a damper. (Some 78% by volume of dry air)

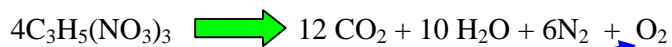
Shown below is a molecule of Nitroglycerine ( $\text{C}_3\text{H}_5\text{O}_9\text{N}_3$ ) which clearly shows the relationship between the oxygen, carbon and nitrogen atoms. If you look at the arrangement of the Nitrogen and oxygen atoms you will notice that there is an excess of oxygen which is quite rare in the explosives field it is also the reason for NG being so violent. All of it is consumed in the explosion.

## GLYCERILE TRI NITRATE (NITROGLYCERINE)



NG Molecule showing the excess oxygen atoms (the secret of its power) and those reluctant Nitrogen atoms.

This is shown quite clearly when the chemical reaction is examined closely.



There is the excess oxygen. Very few explosives have this characteristic. (The little green arrow indicates that something chemical took place)