INTRODUCTION TO HIGH EXPLOSIVES

HIGH EXPLOSIVES

High explosives are substances that detonate. This is to say that the substance, when suitably initiated, breaks down in a very violent manner, liberating vast quantities of heat and energy in a very short time. In fact it occurs in such a short time that the inertia of anything in its path has no time to be overcome thus the object is destroyed. Not moved. This breakdown occurs in a wave that passes through the substance in a linear fashion from the point of initiation. The wave is not a burning. It is a molecular breakdown of the substance into its constituent parts. It is not occurring on the surface. It occurs within the material. In the explosion of nitrate and nitro oxidisable explosives, nitrogen is set free in the elementary form and the oxygen combines with the oxidisable elements, forming great volumes of gases (CO, CO_2, H_20 [in vapour form]) and a large amount of heat. All explosion reactions are highly exothermic. Those hot gases occupy a volume 10,000 to 15,000 times as large as the volume of the original explosive. For a short time those hot gasses occupy the original volume of the explosive. They want to expand and they do. The temperature of the explosion may be 3000C and over. When metals are present in explosives, the heat of formation of the metal oxides contributes to further expansion of the hot gasses.

Some explosives groups, eg the Azide group, contain no oxygen. Therefore in the explosion of Lead Azide the only gas produced is nitrogen. Heat of explosion, maximum temperature of explosion, volume of explosion products and pressure developed in a closed chamber are the chief factors related to the total energy of an explosive. However, the effectiveness of an explosive is related directly to the rate at which its energy is released. The rate of detonation of a high explosive is a measure of its "brisance" and is therefore of great significance.

ALUMINIUM IN EXPLOSIVES

As far back as 1897 the suggestion was made to include Aluminium in explosives to increase the blast effect. This is brought about because the oxidation of the Aluminium during the explosion is a highly exothermic and therefore adds considerably to blast. A problem arises in that Aluminium tends to settle out during manufacture and to overcome this the substance carbon black is added to the mixture, the wetting agent lecithin also has the effect of controlling settling out. Aluminium explosives also tend to produce hydrogen gas because the residual moisture in the explosive reacts with the Aluminium forming Aluminium oxides and liberating hydrogen.

Ammunition so filled needs to be fitted with vent plugs. EG Torpedoes, aircraft bombs etc.

High explosives are divided into three groups...

INITIATORS	INTERMEDIARIES	MAIN FILLINGS

INTERMEDIARIES

One of the design problems that manufacturers of projectiles meet is the need to propel from a weapon, a large mass of High Explosive inside a shell. To achieve this, the shell and the explosive filling are subjected to some very violent shocks and accelerations. Subjecting a large mass of very violent explosive to these forces is asking for the explosive to detonate at the moment of firing unless the main filling is selected for its lack of sensitivity. Here is the catch, if the filling is insensitive enough to be projected from a Gun then how do you get it to detonate when the time is right? The answer of course is to fill the shell with a quite insensitive explosive and to provide an intermediate step between the main filling and the initiation system. (This arrangement is called an **Explosive train** qv.) These explosives are termed "Intermediaries" They are contained in metal capsules somewhat larger than those used for initiators because they are less sensitive.

SOME INTERMEDIARY EXPLOSIVES

PICRIC POWDER

This is a mixture of

Ammonium Picrate	43 parts
Potassium Nitrate	57

The F of I is 85 to 87

COMPOSITION EXPLODING (CE)

This explosive is named Trinitrophenyl-methyl-nitramine. The F of I is 70. It has been used very extensively as a magazine filling in British and Australian artillery ammunition. Its more common name comes from the original war time code name given to it to preserve secrecy.

TNT Crystals

This is TNT in a very high grade of purity and because of the crystalline state it has a lower F of I than when in the cast state. The F of I is ?

PICRIC ACID

This intermediary was used in some large calibre shells such as 15inch A.P.C. and it has been widely used as an intermediary in German shells and bombs. This particular explosive has been extensively used as a main filling during the First World War. It is not now used in military HE fillings.

MAIN FILLINGS

Bearing in mind the above, it follows that main fillings are selected with several conflicting requirements in mind.

- It needs to be powerful and violent.
- It needs to be insensitive to normal shocks.
- It needs to be stable in storage.
- It should not be affected by extremes of temperature.
- It should not react with metals.
- It should be easily loaded to high densities.
- It should give smoke on bursting.

It follows that no explosive will meet all these requirements so as with all things, compromise is the name of the game.

SOME BASIC MAIN FILLINGS

P.E.T.N.
Is an extremely violent and powerful explosive that is too sensitive to be used alone and is usually mixed with a less sensitive explosive, or wax. It is known as Penthrite and its proper name is Penta-erythritol-tetranitrate. Its power figure is 166. Its F of I is 50, its V of D is 8300 metres per second. It is used extensively as the core filling in detonating cords and the filling for magazines and Gaines.

PENTOLITE
Is a mixture of P.E.T.N. and TNT, the usual proportion being 50/50

RDX
Another very powerful and violent explosive that is too sensitive to be used alone. It is usually mixed with wax or TNT. It is also one of the most popular explosives in use in military circles.

HMX

This explosive was discovered by accident when the filters being used in the production of RDX were examined. What was found were crystals of an unusual shape that had adhered to the filter. Examination of these crystals showed them to be a denser version of RDX with a greater molecular weight. It comes in four different crystalline forms with the first “Alpha” being the most stable. It was given the name of High Molecular weight X hence HMX. It has the great drawback of being four times more expensive to make than RDX.