Gun Propellant

Shri R K Jadhav, presently Scientist C at HEMRL joined DRDO in 2009. He is working in the area of Gun Propellant for Artillery Gun Ammunition like Bi-Modular Charge System (BMCS), Uni-Modular Charge System (UMCS), 40 mm Air Bursting grenade, etc.

The ancient man for the unending quest for food and continuous need to defend himself used rude club or spear and subsequently bow a real weapon. Bow remained man's most effective hand weapon for about fifty thousand years. It was made virtually obsolete by another revolutionary development - gunpowder also known as black powder. Its earliest use as a propellant to fire a projectile from a gun has been recorded as early as 1313.

The history of modern propellants dates from 1846, when Christian Schonbein, a German chemistry professor at Basel, announced his discovery of nitrocellulose or guncotton. When burned, it decomposed completely into gaseous products with release of an enormous amount of heat almost three times as much energy as black powder. However, the use of nitrocellulose as a propellant faces with many difficulties due to its rapid burning and enormous pressure generation resulted many disastrous explosions.

Another event made the year 1846 historically important in the development of modern propellant was the discovery of nitroglycerine by the Italian chemist, Ascanio Sobrero. In 1888, Alfred Nobel, the Swidish chemist, famous for his invention of dynamite used nitroglycerine as a material to effect gelatinization of nitrocellulose. The gelatinous mass was rolled and cut and named as ballistite, the first modern gun propellant. The English developed a method for mixing nitrocellulose with nitroglycerine and then bringing gelatinization about by means of acetone and resulting mass was extruded through holes in a plate to form long cords and finally cut to desired length. This propellant was known as cordite.

Gun propellants are low explosive contain carbon, hydrogen, nitrogen and oxygen. The products of the burning process are gases and heat. The gas pressure and energy so released on burning are utilised to impart motion to a suitably shaped projectile inside a gun barrel. Propellant grains encased in cartridge case are used in Tank and Artillery gun ammunition. The projectile is integrated with cartridge case in case of Tank gun ammunition whereas it is loaded separately in case of Artillery gun ammunition.

Gun propellants classified on the basis of ingredient present as follows

(a) Single Base Propellants: Composed almost entirely of nitrocellulose. This is used in small arms and cannon ammunition.

(b) Double Base Propellants: Consists of Nitrocellulose and Nitroglycerine as major ingredients having more energy. This is used in small as well as high caliber guns

(c) Triple Base propellants: It includes picrite (nitroguanidine) other than Nitrocellulose and Nitroglycerine. Picrite functions as coolant and flash reducer. Most propelling charges of artillery guns contain triple base propellant, which causes less erosion and is ballistically stable for longer than double base propellant

(d) High energy Propellant contains nitrocellulose, nitroglycerine, nitroguanidine and RDX capable of giving high energy. These are used in tank guns for propelling kinetic energy penetrator, the principal requirement being to achieve very high muzzle velocity

Processing of gun propellant involves mixing of ingredients along with additives in Sigma blade mixers to get dough, extrusion of dough through suitable die using hydraulic press to obtain required shapes, cutting the extruded chords to required length and then drying in Air drying ovens. The propellant grains so obtained are evaluated initially in static and then in dynamic firing.

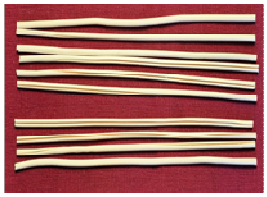
Propellants developed at HEMRL

1. Single base propellants

Notable development among are NH096 for 105 mm HESH, MEX-NC for 30 mm Navel gun, NC/T 057 for 0.5" RMG gun, non-toxic propellant for 7.62 mm PKT ammn and BMCS propellant for lower zone modules of 155mm Artillery gun ammunition.

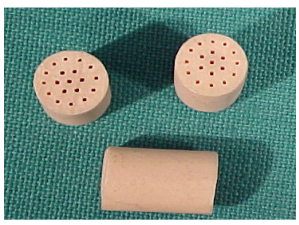
2. Double base propellants

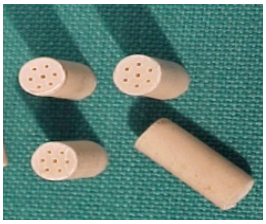
Notable development in HEMRL among are AP/S 400-120 for 120 mm HESH, PCB & TB ammn., AP/S 376/117 for 130 mm HE RVC, T-28 for 106 mm RCL, HEAT ammn. and AP 043 for 100 mm Russian gun



3. Triple base propellants

Notable development in HEMRL among are NQ/M 110 for 120 mm FSAPDS, NQ/M 119 for 125 mm FSAPDS, N-07, NQ/M 054 & N/S 123-043 for 105 mm IFG, NQ/M 036 for 75/24 PACK How, NQ/S 156-056 for 105 mm HESH, IPC for 120 mm FSAPDS, NQ/M 028 for 120 mm Blank ammunition, NQ/M 354 for 130 mm FVC, NQ/S 251-084 for 130 mm FVC, BMCS propellant for higher zone modules of 155mm Artillery gun ammunition and UMCS propellant for 155mm Artillery gun ammunition.





4. Low vulnerable ammunition (LOVA) propellant

Nitramines like RDX, HMX, etc are added in conventional gun propellant formulation along with other additives to achieve high force constant with low vulnerability characteristics. These propellants are characterized by high force constant, high flame temperature and low sensitivity. These are aimed at using in large calibre tank gun ammunition.

HEMRL developed single, double and triple base propellants are being used in small arms and tank gun ammunition. TOT has taken place to various ordnance factories. Technology for gun propellant based on Nitramine is being developed considering futuristic need of propellant for Low vulnerable high performance, low temperature co-efficient (LTC) and improved shelf life of ammunition. HERML has latest pilot scale manufacturing facility incorporating latest safety measures like automatic deluge system, fire detection system, etc. HEMRL is fully geared to meet any challenge in design and development of propellant in future.