NEWS THIS MONTH

YOUR SOURCE FOR ALL THINGS ROCK-BREAKING

DOES NXBURST™ DETONATE

One of the most salient features distinguishing Nxburst™ from high explosives is that explosives detonate whilst the propellant used in a Nxburst™ cartridge deflagrates.

Deflagrations are thermally initiated reactions propagating at subsonic speeds that proceed radially outwards in all directions through the energetic material, away from the ignition source. The maximum pressure developed by deflagration is dependent on the energetic materials involved; their geometry; and the strength (failure pressure) of the vessel or structure confining the materials. Deflagration speeds of propellants are in the order of 200 to 1000 metres per second producing pressures reaching 1000 Mpa, which are developed in thousandths of a second.

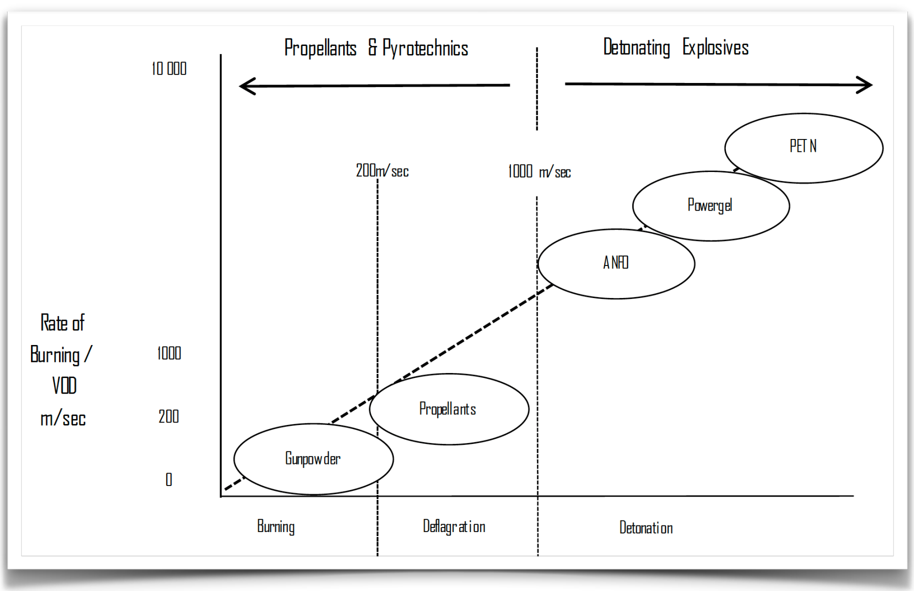

Figure 1 – Burning, deflagration and detonation of commonly known energetic materials

High explosives are defined as materials intended to function by detonation. The reaction speeds of detonation are higher than the speed of sound in the explosive material. The speed of sound through a material is dependent on the density of the material; the higher the density, the higher the speed of sound will be through it. A reaction speed of 1000 metres per second is set as the minimum speed that distinguishes detonations from deflagrations. Detonation speeds are in the order of 1,000 to 10,000 metres per second producing pressures from 1,500 to 15,000 Mpa which are developed in millionths of a second.

The effects of detonations are very different from those of deflagrations. The supersonic reaction speed of detonation develops a shock wave in the explosive, which triggers the propagating reaction. The propagation of the shock wave is accompanied by a chemical reaction that furnishes energy to sustain the shock wave advance in a stable manner, followed by the formation of the final gaseous products and their associated pressures at some time later. Conversely, deflagration produces no shock wave and only those pressures produced by the formation of gaseous products are present.

The rock to which an explosive detonation is applied will experience a supersonic blow from the detonation front's pressure pulse followed quickly by a prompt release of pressure and then followed immediately by a build-up of pressure imparted by the gaseous products of the explosion, which will be applied in a more or less sustained manner. Deflagration produces only the last effect as it does not produce a shock wave.

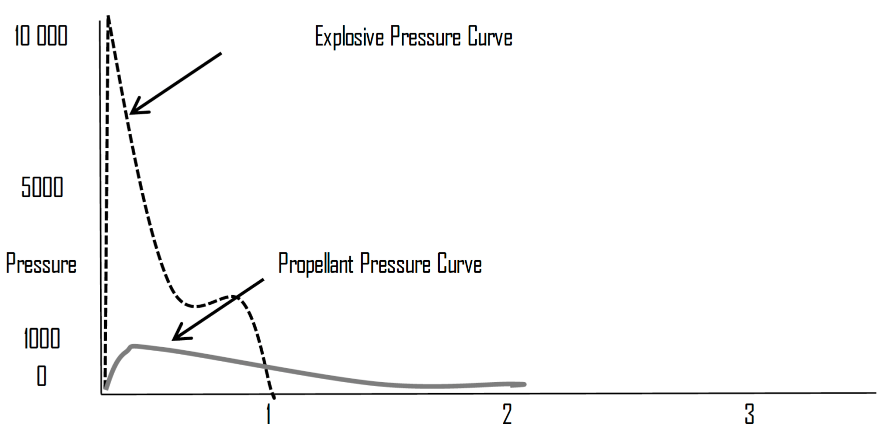

Figure 2 – Increase of pressure over time curves for explosives and propellants confined in a drill hole in rock

In Figure 1 a range of energetic materials used for rock breaking is shown in ascending order of burning or detonation speeds. Pyrotechnics such as black powder are represented in the lower end of the scale with a burning speed of less than 200 metres per second, whilst propellants occupy a range of burning speeds from 200 to 1000 metres per second. The higher order propellants are double based or composite propellants. Blasting agents such as ANFO and AN slurries are represented in the 3,200 to 3,500 metres per second range whilst Powergel has a VOD of approximately 4,000 metres per second. High explosives such as TNT and PETN have VODs in the range 6,500 to 7,000 metres per second.

In general, the higher the VOD of the explosive, the greater the shock wave produced, which is responsible for the shattering action of the blast. In high VOD explosives much of the energy is disseminated in the detonation shock wave whereas in propellants and pyrotechnics, as well as explosives with lower VODs, most of the energy is used in the heaving action produced by the gaseous products pressurizing the drill hole.

Figure 2 illustrates the vast difference in drill hole pressures developed by detonating explosives compared to deflagrating propellants – a difference in the order of 10 to 20 times. As a result of the relatively low-pressure regime developed by a propellant in a drill hole, the shock wave inherent in rock breaking using high explosives is avoided, which allows propellant-based rock breaking methods to be used in situations where high explosives are prohibited.