Lecture W13

Reuse of Demilitarized and/or Excess Energetic Materials as Ingredients in Commercial Explosives

Dr. Oldrich Machacek
Universal Tech Corporation

INTRODUCTION

The use of military type energetic materials in commercial explosive products is not a new concept. This work outlines the work which has been accomplished mainly by Universal Tech Corporation ("UTeC") in the area of recycling of energetic materials, that has been derived from either demilitarization efforts or manufacturing excess. The information is broken into two sections: Rocket Motor Propellants and Conventional Ammunition Propellants.

ROCKET MOTOR PROPELLANTS

Universal Tech Corporation ("UTeC") designed a facility for the processing of rocket propellants into commercial explosives, in cooperation with United Technologies, Chemical Systems Division ("CSD") in 1995. This facility has come to be known as the Propellant Reuse Facility ("PRUF" Plant). Since 1995 the PRUF plant has processed over 2.5 million lbs. of many Class 1.3 Composite Rocket Propellants and produced over 10 million lbs. of finished package commercial explosive product, which has been used by different mining customers in the United States. The PRUF plant is located near Columbus, Kansas. It houses a propellant shredder as well as the final product mixing and packaging equipment. The plant was partially re-engineered in 1997 following a fire at the facility.

The shredding of large propellant grains (up to 1 cu. ft. size) is conducted while submerged under the oxidizer solution, which is used in the production process of watergel slurries. Approx. 20 - 25% of the shredded propellant in sizes below 1 inch (25mm) is added to the watergel slurry and the final product is pumped and loaded into packages.

The following table contains some explosive characteristics (detonation velocity and underwater energy test data) for a hexamine based watergel slurry that contains different amounts of composite rocket propellant.

Unconfined VOD Test results for Class 1.3 composite propellant mixes at 22ºC (meters/second)

Mix Descriptions	Charge Diameter (inches/mm)		
	4/102	**3/76**	**2/51**
Standard Hexamine Slurry	4,600	3,900	Fail
90% STD + 10% propellant	4,060	3,860	3,210
80% STD + 20% propellant	3,950	3,540	3,080
60% STD + 40% propellant	3,790	3,500	2,830

Unconfined VOD Test results for Class 1.3 composite propellant mixes at 5ºC (meters/second)

Mix Descriptions	Charge Diameter (inches/mm)		
	4/102	**3/76**	**2/51**
Standard Hexamine Slurry	4,010	3,450	Fail
90% STD + 10% propellant	3,910	3,410	Fail
80% STD + 20% propellant	3,680	3,130	Fail
60% STD + 40% propellant	3,400	2,870	Fail

Underwater Energy Test Data for Class 1.3 composite propellant mixes (cal/gm)

Mix Descriptions	Shock Energy	Bubble Energy	Total Energy
Standard Hexamine Slurry	373	414	787
90% STD + 10% propellant	370	434	804
80% STD + 20% propellant	398	470	868
60% STD + 40% propellant	449	525	974

NOTE: The initial testing was conducted using the Minuteman III Stage III propellant, however, subsequent testing on similar propellants has yielded similar results.

CONVENTIONAL AMMUNITION PROPELLANTS (SMOKELESS POWDERS)

The practice of using surplus smokeless powder propellants as ingredients in commercial explosives in the United States goes back to 1920's. Large quantities of these materials were used in watergel slurries in late 1950's and 1960's with the end of World War II and the Korean War. The most prominent company, in this field, at that time was Hercules, Inc.

In the last six to ten years, a more strict interpretation and enforcement of the US's environmental laws, governing the disposition of hazardous waste streams and energetic materials, has revitalized the efforts of many U.S. commercial explosive manufacturers to incorporate surplus military explosives as ingredients in their commercial explosive products. Because of heavy restrictions being placed upon the often-used practices of opening burning and open detonation of these hazardous waste materials, in many instances, the military has been forced to use more costly alternative disposal solutions, such as contained incineration. For these reasons, the U.S.military has encouraged and, sometimes partially funded, the development of technologies based upon the recycling of waste and/or surplus energetic materials into commercial explosive products. The recycling of such energetic materials as useful ingredients in a commercial explosive does not require the material to be treated as a hazardous waste, according to the U.S. environmental regulations. Furthermore, significant advances in the U.S. military's tactical weapons arsenal has rendered many of its conventional weapon systems obsolete, thereby generating large quantities of similar energetic materials as surplus and in need of disposal. These stockpiles are usually large enough to serve as a reliable and consistent source of raw materials for the development of a commercial explosive product.

UTeC as well as several other U.S. explosive companies, including DYNO NOBEL and ORICA, have developed packaged commercial explosive products containing demilitarized

conventional smokeless powder propellants. The following products contain smokeless powder propellants and are marketed in the United States.

DYNOGEL HD

Smokeless powder sensitized watergel slurry explosive, developed, produced and marketed by DYNO NOBEL, Inc. DYNOGEL HD consists of an ammonium nitrate/sodium nitrate slurry matrix that contains 30-35% small grain smokeless powder as sensitizer.

This product is marketed as a booster sensitive explosive, in package diameters of 100mm and larger. It is promoted as a high density, high detonation velocity and dead press resistant product. It was introduced into the United States market in 1993. The current production rate is about 8 million lbs. per year (estimate).

GIANITE

Gianite is a glass bubble sensitized water-in-oil emulsion packaged explosive produced and marketed by ORICA. Gianite contains about 35% level of single base smokeless powder. Gianite uses whole grain powder, usually cylindrical shape 3-6mm diameter, 7-13mm long with one or 7 perforations. Gianite is a booster sensitive explosive, available in package diameters of 100mm and larger. The current production rate is about 7.5 million lbs. per year.

600 SLX-20A

600 SLX-20A is a watergel slurry explosive, sensitized by hexamine nitrate, containing 20-25% of smokeless powder. This product was developed and is manufactured by UTeC and marketed by Slurry Explosives Corporation. This product currently uses whole grain single based powder usually with 7 perforations. 600 SLX-20A is marketed as a booster sensitive explosive in package diameters of 100 mm and larger. This product was introduced into the United States market in 2000. The current production rate is about 16 million lbs. per year.

SLURRAN 430

Slurran 430 is a smokeless powder sensitized watergel slurry packaged product. It contains a significantly higher percentage of smokeless powder propellant (approximately 60% usually triple base), compared to other products containing smokeless powder.

It was found that relatively large grain smokeless powder propellants could be made to readily detonate in their original configuration, when surrounded by a high density liquid medium. Because of the high percentage of smokeless powder the Slurran 430 cannot be produced using the traditional mixing and pumping equipment for a typical watergel slurry explosive. Slurran 430 has an unconfined detonation velocity in the 6.0 to 6.5 km/sec range and a density of 1.50 g/cc.

The product is marketed as a packaged booster sensitive explosive in cartridge diameter of 3 inches (75mm) and larger. The current production rate is approx. 6 million lbs. per year.

SUMMARY

The use of composite rocket and conventional gun propellants as ingredients in commercial explosives is a viable method of their disposal. It allows not only for the beneficial use of the surplus energetic materials as an effective ingredient in commercial explosive products, but it may also solve many environmental and economic problems associated with their disposal as a hazardous waste.