Lecture W12

Can Obsolete Conventional Ammunition be Transformed Into Useful Products?

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Arms limitation and reduced armed forces have led worldwide to vast stocks of obsolete ammunition. Ammunition is associated with energetic material which suggests that a lot of valuable material and energy can be recovered. Unfortunately this is an illusion and the disposal of conventional ammunition is a costly process because special equipment and installations have to be used. However, the demilitarization cost can be dramatically reduced, when it is possible to turn the ammunition components into useful, saleable products. In the case of medium calibre ammunition Oerlikon Contraves Pyrotec has developed methods to recycle more than 90% of the components.

INTRODUCTION

Arms limitation and reduced armed forces have led worldwide to vast stocks of obsolete ammunition. After the fall of the Berlin wall, Germany, as an example, had to deal with approximately 300’000 tons of ammunition from the forces of former East Germany. By the end of 1996 this task was almost completed. The United States plan to reduce their arms stockpile yearly by 100’000 tons for the next ten years. It is estimated that the former Soviet countries have a stockpile of nearly 10,000,000 tons to be destroyed. While in some countries the demilitarization work is well under way, others are delaying the subject. The principal reason is that the destruction of ammunition needs financial resources. Only in countries with very low wages can the demil work be profitable and, only then, if the reclaimed material can be resold at world market prices. The overall demilitarization cost can, however, be reduced dramatically when it is possible to turn the ammunition components into useful, saleable products.

DEMILITARIZATION METHODS

There is quite a range of demilitarization methods available (1). Sea dumping and burying were favourite methods of the past, but they do not conform with present international conventions. Live firing is another means, but ecological considerations, safety aspects and operational cost limit this method to training purposes. For ammunition who’s life time has expired, this is certainly not the method of choice. Blowing up the ammunition in bulk is, till now, the most widely applied method. While this method seems to be accepted in some cases, for instance when the IFOR troupes in Bosnia destroy confiscated weapons, public opinion does not favour open burning and detonation. In addition to the noise, soil, water and air pollution are feared. This can certainly be the case if a clear distinction between harmless and hazardous material is not made. Finally the ammunition can be disassembled and separated into the individual components. The degree of separation is dependant on the money available and the revenue which can be generated from the reclaimed or recycled products.

MATERIAL ENCOUNTERED IN CONVENTIONAL AMMUNITION

To explore the potential for recycling ammunition components we have to consider the material involved. In all types of conventional ammunition the construction has some similarities. For gun ammunition and rockets there is a propelling section with its proper initiation system. The warhead section contains an arming and initiation section with a chemical material such as a high explosive or a pyrotechnical composition, depending on the desired effect. Typical metals used in ammunition are iron, copper, brass, aluminium, tungsten, lead and in some types depleted uranium. A broad range of chemical-technical products such as polymers, varnishes, paints, adhesives and sealants are encountered. Typical packaging material is made up of wood, steel and cardboard. The explosive substances, which can be divided in propellants, explosives and pyrotechnics usually come out of a limited set of basic substances blended into different formulations.

R^3 OF PROPELLANTS

Propellants in gun and mortar ammunition are loose grains or strands filled directly into a cartridge case or in separate propellant bags. The reclamation is usually straightforward. If smaller particle sizes are necessary for further processing, the propellant can be ground with suitable equipment under water. In rocket motors the propellant is, in most cases, in the form of a single solid block, sometimes bonded to the rocket motor case. The reclamation needs special techniques and adds more to the project cost than the static firing of the motor. The methods involve sawing with water-cooled blades, as well as water jet cutting and washing-out.

The chemical compositions of propellants range from nitrocellulose propellants, over nitramine propellants to propellants with an inorganic fuel such as ammonium nitrate as the active ingredient. As long as the shelf life of the propellants is not reached, the propellants can be re-used, for instance in training ammunition, or they can be reprocessed and blended to new propellants. One such application is the manufacture of ball powder for hunting ammunition.

An obvious application seems to use the energetic material as a source for energy production. Unfortunately the energy content is not as high as might be expected. The heat of reaction of a typical gun propellant is in the order of 3 MJ/kg, the heat of combustion in the order of 13 MJ/kg. Compared to coal with 35 MJ/kg or fuel oil with 42 MJ/kg propellant cannot compete, especially as the safety aspects and the formation of nitrous oxides pose additional problems. Nevertheless, the reclamation of the energy by mixing 5% propellant with 30% water and 65% kerosene to form a fuel for heating purposes has been successfully applied (2).

There are other possibilities to transform propellants into useful products. The use of the nitrocellulose for lacquers is restricted because the nitrogen contents is higher in the propellant and because the demand of this type of lacquer is decreasing. Composting the propellant (3) is possible, although the reaction rate is slow and hazardous by-products can be formed. Another more successful application is the reprocessing of propellants into water gel explosives for the mining industry and for oil well stimulation (4, 5). Still another very valuable approach today is to use the propellant as a source for a fertilizer (6).

Oerlikon Contraves Pyrotec uses the medium calibre propellant of obsolete ammunition for re-use in training ammunition or sells it to the blasting industry which uses it for road work.

R^3 OF EXPLOSIVES

TNT is the most frequently encountered high explosive in conventional ammunition. TNT can be melted out of shells, be regenerated and resold. As the demand for military applications is decreasing it is used in civil explosives as well. In the case of other explosive formulations, often with metal powder additions such as aluminium, the re-utilization is more difficult and expensive.

Hexogen and Octogen are rather expensive explosives. Therefore, the reclamation makes sense. The explosives can be extracted by solvents and recristallized. The final application is again for military or civil application, such as mining, demolition or metal bonding.

TNT and other explosives formulations can be transformed to the basic material for the synthesis of new energetic material (7). As for the propellants the transformation into fertilizer is possible.

Oerlikon Contraves Pyrotec has developed a method to get Hexal type explosives out of projectiles, which combines drilling and high pressure water jet wash-out.

R^3 OF PYROTECHNICS

Pyrotechnical compositions such as tracers, signalling, illuminating and smoke mixtures are made up of a variety of metals and oxidizers, usually bonded in an organic matrix. The recycling or reuse is thus very difficult and can only be judged on a case by case basis. The limited amounts prohibit excessive development word. Burning or the finding of a new application for the pyrotechnic items remain. One such application is the use of pyrotechnic munitions for special effects or fireworks. In the case of medium calibre ammunition no useful application of tracers, igniters and detonators could be found.

R^3 OF INERT COMPONENTS

The recycling of the metals is straight forward. Depending on regulation and further processing the metal scrap must be free of explosives, which necessitates a heat treatment of the scrap, although the introduction of minor amounts of explosives or even complete primers into the melt does not represent a hazard. The flow of the material has to be monitored to prevent an illegal re-use of the components.

The recycling of wood and plastic material is only possible for specific cases. Wood can be shredded and used for heating purposes. Sometimes it is contaminated with fungicides and insecticides, necessitating an installation with exhaust gas treatment.

CONCLUSION

Many creative possibilities exist, to transform obsolete ammunition into useful products. The cost for the development of the methods, the large variety of ammunition types and, in the end, the limited amount, make the task difficult. However the higher destruction cost can be compensated to a certain extent, if the reprocessed items can be sold. Moreover the ecological aspect clearly speaks for recycling, when compared to burning or detonating.

LITERATURE

1 R. Flückiger in G. Rippen, Handbuch Umweltchemikalien – 29. Erg. Lfg., Ecomed, Landsberg, Germany, 1995

2 L. Baxter et al., Proc. 4th Global Demil Symposium, Sparks NV, USA, 1996, page 663

3 D.L. Kaplan, Biotechnology and Biodegradation, Gulf Publishing Company, Houston, USA, 1989, page 155

4 O. Machacek et al., Proc. 4th Global Demil Symposium, Sparks NV, USA, 1996, page 309

5 D.S. Wulf and F.T. Nixon, Proc. 4th Global Demil Symposium, Sparks NV, USA, 1996, page 884

6 F.O. Kroh et al., 4th Global Demil Symposium, Sparks NV, USA, 1996, page 831

7 A.R. Mitchell and R.D. Sanner, Proc. 24th int. Annual Conference of ICT, Karlsruhe, Germany, 1993, page 38