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SAFETY CONSIDERATIONS IN STORING LIQUID GUN PROPELLANT XM46

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INTRODUCTION

The U.S. Army is currently developing a regenerative liquid propellant gun for artillery application. The liquid propellant XM46 (LP) is composed of 60% Hydroxyl Ammonium Nitrate (HAN), 20% Triethanol Ammonium Nitrate (TEAN), and 20% water. Since this is the first time that a liquid gun propellant is being planned for field use, it is important to investigate the conditions and environment for safely storing the LP. This paper will discuss some of the considerations necessary for storing XM46.

STORAGE COMPATIBILITY GROUP ASSIGNMENT

One major consideration for storing the LP is determined by its storage compatibility group assignment (SCG) given by its hazard classification. Liquid propellants have historically had their own classification and SCG assignment, however these hazard groupings (4 total) are designated by description in DARCOM 385-100 and not by rigorous testing. The LP XM46 is a monopropellant which did not fit any of these liquid hazard groupings. Therefore the tests required for solid propellant classification described in the Army TB 700-2 were modified for liquid propellant testing and then conducted on XM46 (ref 1). These tests resulted in a 1.3 interim hazard classification for the LP, but since there was no designation of liquid propellants for any of the storage compatibility groups in TB 700-2, the XM46 was given a compatibility group C which is the same as that for solid propellants. However, since liquid propellants have never been stored with solid propellants, the safety community requested that compatibility tests be conducted on solid propellants contaminated with XM46. Since there are no formal compatibility tests for an SCG assignment (assignment by description), the tests were developed independantly and then reviewed by the local (ARDEC) Safety Office. The tests were the same as the interim hazard classification tests described in TB 700-2 but were conducted on solid propellants immersed in the LP for at least 3 weeks. These propellants passed all of the tests except for the Thermal Stability test, which indicates that a solid propellant cookoff is possible if contaminated with LP. As a result, the SCG for the LP was changed to group L, which simply states that any material in this group will be stored alone.

The next revision of Army TB 700-2 will be modified for interim hazard classification testing of liquid propellants, but the Storage Compatibility Group descriptions still do not include liquid propellants. It is recommended that a new SCG be developed which is designated specifically for liquid gun propellants, and that formal compatibility tests be developed for assigning new liquid propellants into the appropriate SCG.

MATERIAL COMPATIBILITY

The decomposition temperature of neat XM46 is approximately 125°C, but it can be lowered if it degrades or becomes contaminated. Transition metals, for example, are known to accelerate the decomposition of HAN and lower the decomposition temperature of the LGP. Since the possibility of a spill in the magazine or storage site always exits, it is necessary to determine the compatibility of the LP with anything it may contact. This would include magazine construction materials, pallet and container materials, clothing and cleanup materials. Some of the materials necessary for compatibility tests are given below:

Construction Materials	Packaging Materials	Cleanup Materials
Concrete	Polyethylene	Rags
Wood (Softwoods)	Low Carbon steel	Rubber gloves
Pine	Paints (MSD 171)	Clothing
Nails	Plastic	Absorbent Mat'ls
	Fiberboard	

The compatibility tests to be developed will require analyzing the integrity of the material after LP contamination and also to analyze the sensitivity of the LP. This is designed to identify any materials which should not contact the LP or to identify the hazards which may occur in case of a spill.

ENVIRONMENTAL PROTECTION

Another important consideration for storing the LP is to protect the environment in the case of a large scale spill. The storage facility may need to be bermed so that any size spill can be contained in the magazine and thereby preventing contamination to the outside environment.

LONG TERM STORAGE

Temperature

It is also necessary to determine the maximum and minimum ambient temperature conditions required for safe long term storage. The XM46 does not freeze above -50 C, which is considered to be the coldest storage condition for propellants, and since degradation is decreased at lower temperatures, it is therefore anticipated that cold temperature storage should be safe.

However, since the LP does decompose more rapidly at elevated temperatures, it is essential to determine the kinetic rates of decomposition as a function of temperature and contamination, and also to determine the ignition temperature of the LP as a function of degradation. Current accelerated aging studies of the LP will eventually answer these questions (ref 2) and their results will be incorporated into the surveillance procedure for monitoring the stability of the LP during long term storage.

Packaging

Another major factor in the long term storage of the LP is its container. It is very important to design a container which is compatible with the LP at the entire storage temperature range of -50°C to 65°C. Since metal contamination can increase LP decomposition, the material in contact with the LP must be non-metallic. However, not all plastic materials are compatible with the LP and other plastics may not maintain its integrity at the required temperature extremes. They may become brittle and break at low temperatures or become soft and pliable at elevated temperature. At the present time, high density poylethylene is the preferred material, but additional compatibility and temperature testing with the LP is required before the final material is chosen.

In addition to the container compatibility, it is also important to incorporate pressure relief features into the container so that any gaseous degradation can be vented thereby avoiding a container explosion from pressure build-up.

REFERENCES

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