Separable High Explosive Systems

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October 27, 1971

MEMORANDUM

TO: L. M. McGrew
FROM: M. Finger and P. Archibald
SUBJECT: SEPARABLE HIGH EXPLOSIVE SYSTEMS

DECLASSIFICATION
STAMP ON REVERSE.

INTRODUCTION:

In reference to your memorandum (COMW 71-499) regarding the feasibility of separable high explosive systems for possible application in the Super Safe Program (Ambassador), we have considered a number of approaches. After a very brief and limited investigation we have categorized various systems and given examples.

The two basic approaches in the Ambassador program appear to be:

1. Movement of fissionable material.
2. Movement of explosive.

Since explosives are our business, we will comment only on the latter approach. Movement of the explosive could entail small amounts of HE, such as for a detonator, booster, or a portion of the main charge. These possibilities tend to beg the issue of true safety and dispersal. Movement of the entire main charge or of separate non HE components is certainly more desirable.

EXPLOSIVE SYSTEMS

At present, the paste explosive system is the single most outstanding candidate to fill the basic systems requirements; and is the only system sufficiently developed for use in immediate applications. Single component liquid explosives are also possible but suffer from possible unacceptable energy, stability, and sensitivity characteristics. Paste and single component liquid HE's have been described elsewhere. We list below some alternate explosive schemes. Each of the possible approaches discussed below would require an additional major development effort.

1. Separable Explosives.

In Table I, we have summarized several separable explosive systems. In the following discussion we enlarge upon these ideas.

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1.1 Two Component: Liquid-Liquid

Liquid mixtures should behave as a homogeneous explosive and give predictable explosive performance. The individual components may, in themselves, be non-explosives. Mixtures of non-explosives, however, may be extremely sensitive. A system that mixes and forms the explosive seconds before detonation could then conceivably use an extremely shock sensitive explosive. Liquids, in general, suffer from lower energy than PBX's and have possible toxicity problems. However, it may be possible to use a wide variety of chemical systems, including some possible cryogenic explosives.

1.2 Two Component: Solid-Liquid

The solid component could be either the oxidizer or fuel component. In this system, the solid could be pressed to the desired density or formed to a porous structure and the liquid fuel would be injected. Some of the mixtures are very shock sensitive, i.e. Lithium Perchlorate/hydrazine; and they might be used in detonators. These mixtures are heterogeneous and their detonation properties are unknown. A few systems may have energies at the LX-04 to 9404 level. Generally, however, practical systems appear to be in the Composition B to LX-04 energy class.

1.3 Three Component

Any combination of oxidizers and fuels is possible and may lead to slightly greater energy or other desirable properties. However, the main purpose of this system is to make use of the strength of a metal fuel or solid oxidizer to provide structural support. The metal or oxidizer could be in the form of a honeycomb structure.

2. Wooden Explosive

The term "wooden HE" has been used to describe high temperature stable explosives. In our context, we refer to a very insensitive explosive. An explosive, that by standard tests, will not detonate. The concept is to convert this wooden material into an explosive just before its intended use. Two examples of systems that might be made to work in this concept are:

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2.1 A composite Propellant

This material may not be detonable under any reasonable criteria. However, by an extremely strong shock of long duration, or by adding thermal energy, the material may be made to detonate. Perhaps multiple shocks are necessary to detonate.

2.2 Perchlorate/Graphite

The system KClO_4 /Graphite cannot be detonated by conventional means. Based on a suggestion by E. Lee, it may be possible to quickly heat the graphite electrically and cause a detonation. This system may also yield the combined thermal and chemical energy.

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MF:eg

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TABLE I. SEPARABLE EXPLOSIVE SYSTEMS

System	Example	Significant Advantages	Problems	Unknowns	Energy	Density g/cc	Sensitivity
<u>Two Component Liquid-Liquid</u>	TNM ⁽¹⁾ /NB	Non-HE Components	Toxicity, Mixing	Freezing Point	66% HMX or 73% LX-04		Mixture extremely sensitive
	OF ₂ /CH ₂	Energy	OF ₂ pressurized	Reactivity, Handling	= 9404		Unknown
<u>Solid-Liquid Solid Oxid + Liquid Fuel</u>	LiClO ₄ /N ₂ H ₄	Non-HE Components	Toxicity, Hygroscopicity	Detonation behavior, Reactivity	> 66% HMX	1.75	Mixture very sensitive
	NH ₄ ClO ₄ /CH ₂	Very Insensitive HE	Fabrication	Detonation behavior	~ 80% of HMX	1.78	Unknown
	NH ₄ ClO ₄ /NB	Very Insensitive HE		Detonation behavior	~ 84% of HMX	1.76	Unknown
<u>Solid-Fuel Liquid Oxid</u>	TNM/Anthracene	No HE	Toxicity	Detonation behavior	~ 70% HMX		Unknown
<u>Three Component Solid-Fuel</u>	TNM/NB/Al	Strong Structure	Toxicity	Detonation behavior	?	?	Unknown
	TNM/NB/NH ₄ ClO ₄	Strong Structure Separable but detonable liquid	Toxicity	Detonation behavior	?	?	?

(1) Other liquid Oxidizers include N₂O₄, HNO₃, etc.