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Energetics Manufacturing Technology Center

CONTINUOUS PROCESSING OF COMPOSITE PROPELLANTS

Objective

This project is part of an international cooperative research and development agreement to develop the processing technology necessary to continuously manufacture composite propellants. They are the largest class of solid propellants employed by NATO, and are characterized by the incorporation of energetic chemicals into a plastic matrix. This project combines the process improvement activities in France and the US. The two countries are working jointly to improve ingredient feed systems, develop on-line quality control technologies, and advance the understanding of the process, quality, safety, and relationships in the twin screw mixer/extruder.

Benefits

Project results will enable the energetics manufacturing industry to reduce the cost of products containing composite propellants and other energetics. Lower costs will result from compact systems requiring less real estate and fewer buildings; flexible processes replacing multiple batch mixers and extrusion presses; combination and automation of functions to reduce

manpower; and product quality improvements that reduce wastes and costs. Additional benefits include improvements in operational safety and environmental impact.

Applicable Weapon System

Continuous processing will benefit a broad spectrum of energetic materials and weapon systems. The technology will be demonstrated in a composite 2.75 inch rocket motor currently in development.

Technical Approach

The technical tasks have been divided between the US and France. Interchange and participation in the tests and experiments continues. The principal French agent is the **Society National des Poudres et Explosifs** which has the lead for improving feed system technology and optimizing mixing and casting processes. The US lead is the Indian Head Division of the Naval Surface Warfare Center, which is developing on-line analytical methods for the mixing and extrusion processes. Demonstrations will be static testing of rocket motors.

Deliverables/Implementation

Results of this project will be published and made available to US industry. Additionally, the technology will be made available through an industry wide symposia hosted by the joint Army, Navy, NASA, **Air Force,** Interagency Propulsion Committee. Industry will also be invited to participate in the project tests and experiments. Overall results will be presented to SYSCOM managers and resource sponsors.

Status

The design for the 2.75 inch extrusion die is complete. Before a computational fluid dynamic model of the internal geometry for the extrusion die could be developed, accurate measurements of the rheological properties of the propellant were taken. A hydraulic ram type extrusion **press suitable for** operation with live energetics was modified to function as a capillary rheometer and successfully provided the needed data. Expected delivery of the die is October 1996. Preliminary testing has shown that near infrared spectroscopy is capable of measuring the loading level of ammonium perchlorate in a composite propellant. Since this material is the predominate ingredient and the loading level is critical to performance of the propellant, this data is very encouraging. Future work will determine the level of sensitivity and the predictive capability of this technique. In addition, we will install the equipment on the continuous processor to provide a real time measurement of product quality. The French have nearly concluded the feeder technology development and demonstrated it during an extended run in which we participated in June.

- **Start Date: October 1993**
- **End Date: March 1998**

Funding:

- MANTECH Expenditures to Date: $356,000
- Estimate to Complete: $2,518,000

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