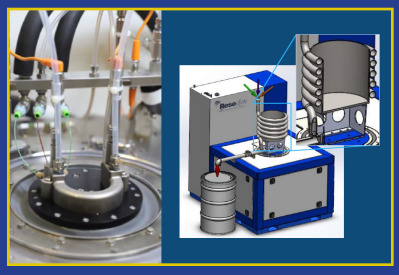
Continuous Acoustic Chemical Reactor for Nitration, Oxidation and Hydrolysis Reactions for Energetics Production



PERIOD OF PERFORMANCE:
September 2018 to March 2022

PLATFORM:
Energetics / Low Sensitivity mortar propelling charges used by U.S. Marine Corps

CENTER OF EXCELLENCE: EMTC

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TOTAL MANTECH INVESTMENT:
$1,426,000

S2778 — Resonant Acoustic Continuous Microreactor (RACMR)

Objective

The objective of this Energetics Manufacturing Technology Center (EMTC) initiative is to develop and build a prototype Resonant Acoustic Continuous Microreactor (RACMR) for the nitration, oxidation, and hydrolysis of energetic materials and their precursors. There are many advantages associated with the continuous production of chemical compounds. Continuous flow chemistry exhibits much better heat and mass transfer, smaller footprint and enhanced safety due to much smaller quantities of potentially hazardous chemicals at a given time. However, for reactions wherein solids are precipitated or deposited during the course of the reaction, clogging is an inherent problem. RACMR technology may provide a solution to this phenomenon and allow effective continuous production of slurries without clogging the reactor.

2,6-diaminopyrazine-1-oxide (DAPO) has been chosen as the material to be synthesized to demonstrate this capability. DAPO is the immediate precursor to the energetic compound 2,6 diamino-3,5-dinitropyrazine-1-oxide (LLM-105). DAPO is currently produced via a batch process with low yields. To improve the cost, availability, and quality consistency of DAPO, a continuous chemical reaction process that is capable of handling solids within the reaction pathway is desired. This chemical reaction process and the associated equipment will be advantageous to other chemical syntheses, such as nitrations, oxidations and hydrolysis reactions for energetic compounds.

Payoff

LLM-105 is being evaluated as a high-energy, low-sensitivity, secondary explosive material to replace varied percentages of Research Department eXplosives (RDX) and High Melting eXplosives (HMX) in propellant formulations, and has found application in the development of high-performance, low-sensitivity, mortar-propelling charges used by the United States Marine Corps. Development of a continuous chemical reaction process to manufacture DAPO will ensure a reliable and lower cost supply of LLM-105.

Implementation

The successful completion of this project will result in a fully operational continuous resonant acoustic chemical production facility at Naval Surface Warfare Center Indian Head Division that is capable of continuously manufacturing energetic materials and their precursors whose synthesis involves the problematic precipitation of solids during the reaction. While the RACMR will be developed to produce DAPO as part of this initiative, it will be adaptable to produce other energetic materials and their precursors as well.