SERDP
Strategic Environmental Research and Development Program

Electrochemical Oxidation of Alkylnitro Compounds

Pollution Prevention
PP-1345

LANL Reference (High Explosives, TATB, Remediation)

Background:

Energetic materials such as BDNPA/F (bis-dinitropropyl acetal-formal), HNS (2,2',4,4',6,6'-hexanitrostillbene), DMDNB (2,2-dimethyl-2,2-dinitrobutane), TATB (1,3,5-triamino-2,4,6-trinitrobenzene), and TNAZ (1,3,3-trinitroazetidine) all share structural elements consisting of nitro-groups bound to carbon atoms. The production of these alkylnitro compounds is generally accomplished with numerous powerful chemical oxidizers that are environmentally costly to produce and the use of which generates pernicious waste streams. Many of these energetic materials are used in current Department of Defense (DoD) systems. Therefore, it would be beneficial if more environmentally benign production methods were developed.

Objective:

The objective of this project is to develop a general technology for the synthesis of alkylnitro compounds using the clean electrochemical oxidation process. This approach eliminates the use of strong chemical oxidizing agents and the resulting by-products and waste streams.

Summary of Process/Technology:

The industrial production of materials such as bromine, sodium hypochlorite, potassium ferricyanide, and sodium persulfate is carried out electrochemically, where electronic tweezers are used to join molecules. The oxidizing reagents currently used in the production of energetic materials act in a similar but less efficient manner as chemical shuttles for the electrons. This project will explore the application of electrochemical oxidation to the manufacture of energetic materials of interest to the DoD such as BDNPA/F, TNAZ, TATB, and HNS. Initially, the project will screen these energetic materials for the ability to be oxidized electrochemically. Positive identifications will lead to demonstrations of the electrochemical oxidation process for the manufacture of energetic materials.

Benefit:

Electrochemical reactions are among the cleanest of chemical conversion alternatives in that only electricity, catalytic electrode surfaces, and a solvent are required. Use of organic materials is minimized, and solvents may be recycled and reused. The industrial production of energetic materials using the electrochemical oxidation process could dramatically reduce the environmental impact of their manufacture by removing the need for chemical oxidizers and avoiding the costs incurred in the disposal of waste by-products.

Accomplishments:

This project began in FY 2003. Accomplishments will be noted upon completion of the project.

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