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National Defense Center for Energy and Environment

Munitions Metals and Residue Treatment for Active Range Restoration

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Background

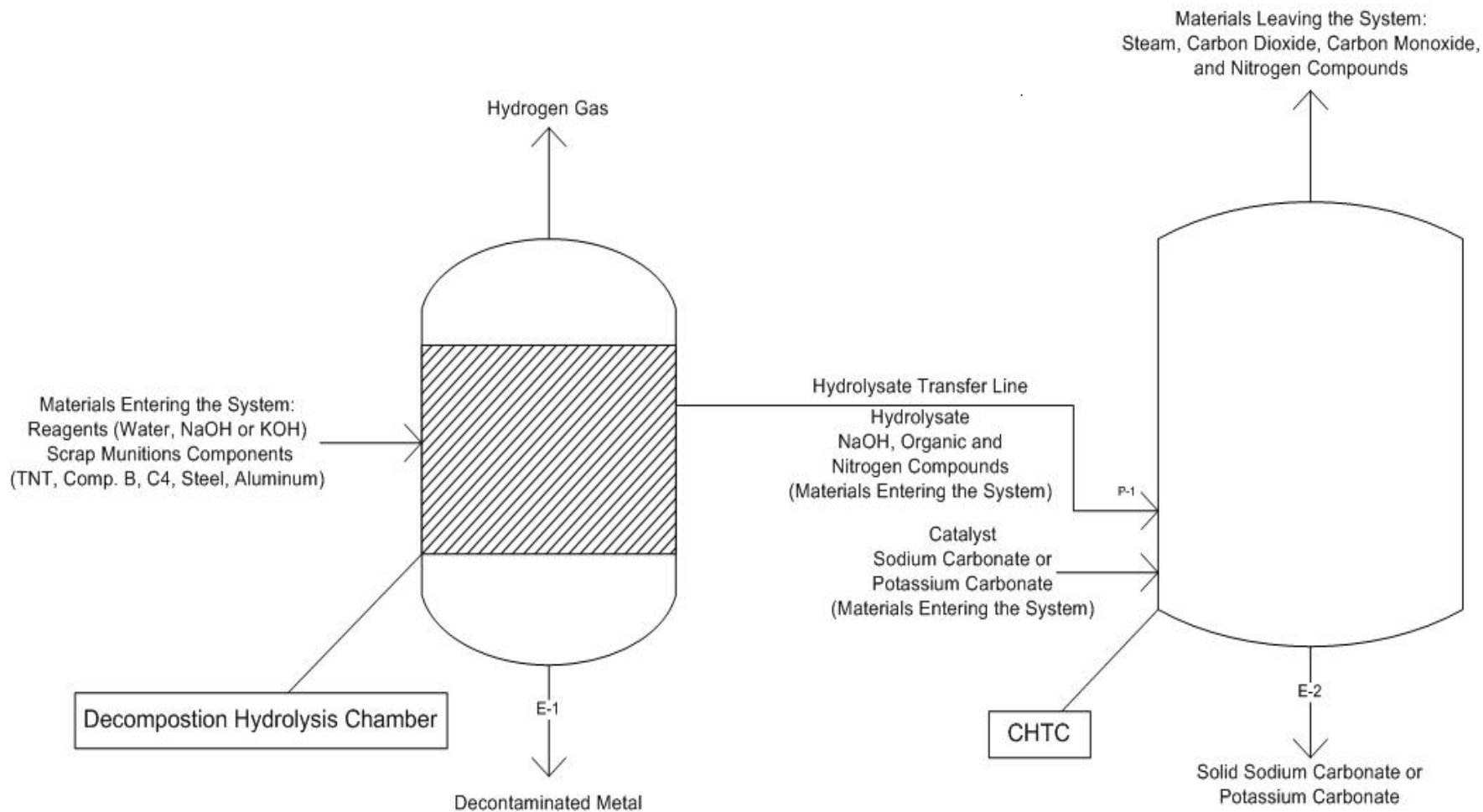
- Energetic materials on ranges pose a potential for off-site transport.
 - Conventional methods such as open burning/open detonation have been found to distribute energetic materials on ranges.
 - Converting chunk material to non-hazardous products provides good land stewardship.
- The technology being developed and demonstrated will be capable of converting explosive residue to non-hazardous products through base hydrolysis and catalytic hydrothermal conversion (CHTC).



**Open Burning/Open Detonation Site
at Hawthorne Army Depot**

(<http://ndep.nv.gov/hwad/hwadg01c.htm>)

Process Flow Diagram (PFD) of the Conceptual CHTC System



CHTC Dem/Val Approach

- Determine and implement process requirements that will prepare technology for full scale validation testing.
- Develop a test and safety plan that will safely and effectively test the technology's ability to convert explosive residues to water and non-hazardous gases.
- Demonstrate the technology in a way that will produce the data necessary to determine the effectiveness of the technology as well as its applicability at DoD installations.



Accomplishments and Results

- Designed and modified concept components of the system to increase efficiency and meet reliability, ruggedness, and throughput requirements.
- Compiled system requirements and design questions for the overall CHTC system. Specific areas for which requirements were developed include:
 - CHTC Sub-System Upgrades
 - Decomposition/Hydrolysis System Requirements
 - Operational Concept
 - Improvements from the SERDP Project.
- Reviewed and prepared a summary of the “Base Hydrolysis Process for the Destruction of Energetic Materials” (2001) Final Report prepared for Assembled Chemical Weapons Assessment by the US Army Tank-Automotive Armament Command-Armament Research, Development, and Engineering Center (TACOM-ARDEC) for background information on the hydrolysis reaction of energetic materials with sodium hydroxide.
 - Concluded that base hydrolysis with sodium hydroxide (NaOH) is a proven process for the effective destruction of energetics recovered from the demilitarization of chemical weapons.

Accomplishments and Results (cont.)

- Modeled the kinetics and thermodynamics of the hydrolysis and polymerization reaction.
- Conducted bench-scale evaluation of energetic neutralization via caustic hydrolysis.
 - Reaction calorimeter (Mettler RC1 reactor)
 - Test parameters:
 - Selected NaOH and potassium hydroxide (KOH) as the caustic solutions for base hydrolysis reactions
 - Tested Trinitrotoluene (TNT), Composition B Explosive (Comp B), and C4
 - Added aluminum to determine the impact of hydrogen gas generation



Mettler RC1 reactor used for bench-scale evaluations

Accomplishments and Results (cont.)

- Results of bench-scale evaluation:
 - TNT and Comp B were readily consumed in the base hydrolysis reaction
 - C4 was not solubilized in the reaction
 - Due to its composition of 10% polyisobutylene
 - Hydrolysate residue from two test runs (TNT and KOH and Comp B and KOH) were subjected to drop weight tests (ASTM E680)
 - Verified that the hydrolysate was safe and no longer displayed explosive characteristics
 - Quantified drop weight test results of Comp B and NaOH and TNT and NaOH by analogy from previous work

Energetic	Chemical Composition
TNT	2,4,6-trinitrotoluene
Composition B Explosive (Comp B)	60% RDX, 39% TNT, 1% polyisobutylene
C4	90% RDX, 10% polyisobutylene

Path Forward

- Build the CHTC subsystem;
- Design and build the decomposition/hydrolysis subsystem;
- Bench-scale test the decomposition/hydrolysis and CHTC subsystems with TNT, Composition B, and C4;
- Incorporate any improvements from the bench-scale testing into the final CHTC system design;
- Develop operation and safety manual;
- Develop demonstration plans; and,
- Perform the demonstration on an active range using energetic materials found on the range.

Project Stakeholders

- U.S. Army Training Support Center (ATSC)
- U.S. Army Cold Regions Research and Engineering Laboratory (CRREL)
- Department of Defense Explosives Safety Board (DDESB)
- Deputy Chief of Staff for Operations, G3
- Office of the Deputy Assistant Secretary of the Army (Environment Safety and Occupational Health) (ODASA (ESOH))
- URS Corporation
- U.S. Army Corps of Engineers (USACE)
- U.S. Army Environmental Command (USAEC)
- U.S. Army Technical Center For Explosive Safety (USATCES)
- U.S. Navy

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