



# Nitrate to Ammonia and Ceramic (NAC)



**Developer:** Rust Federal Services, Inc.  
**Contract Number:** DE-AR21-95MC32113  
**Crosscutting Area:** N/A

Mixed Waste  
 FOCUS AREA

**Problem:**

The Department of Energy (DOE) has large quantities of sodium-nitrate-based liquid wastes. These high-level waste tank supernatants are present at Hanford, Savannah River Site, Rocky Flats Plant, Idaho National Engineering Laboratory, and Oak Ridge National Laboratory. These tank wastes are typically 4 to 5 molar in nitrate and contain radionuclides, various salts, and heavy metals. These wastes are currently regulated and managed by the DOE. Under the Federal Facility Compliance Act (FFCA) DOE is subject to RCRA, which would apply to these tank supernatants. Stabilization of this waste is difficult because nitrates are very mobile. Additionally, vitrification of these wastes produces large quantities of hard-to-manage NOx emissions.

**Solution:**

Develop a controlled reaction process, the nitrate to ammonia and ceramic (NAC) process, to convert the large quantities of contaminated sodium nitrate waste to ammonia and a alumina-silica-base ceramic solid. The ceramic may meet leach stabilizaton requirements or can be further processed by calcining and

sintering. Volume reduction as high as 70% are expected.

**Benefits:**

- ▶ Safe, economic, and environmentally acceptable methodology for reduction of nitrate-containing mixed wastes
- ▶ Reduce major and extremely dangerous environmental hazards
- ▶ Provide environmentally acceptable waste form for disposal of nitrate mixed waste
- ▶ Provide additional time to find long term disposal solution for mixed waste problem

**Technology:**

The NAC process has been developed to remove a majority of the nitrate content from sodium-nitrate based liquid wastes. In the NAC process, solid aluminum at low temperatures (50 to 80°C) reduce nitrate to ammonia, and a solid aluminum oxide material is formed. Utilizing the NAC process, a problematic waste stream constituent (sodium nitrate) is decomposed to ammonia gas. In initial studies, the NAC solid

product was calcined and sintered to form a ceramic-type waste form. Stabilization of radionuclides and metals was achieved.

The NAC process has the potential to treat the large amount of nitrate tank waste at the DOE facilities. The NAC process can also utilize the large existing inventory of scrap aluminum at these facilities. Some of this aluminum has been radiologically contaminated and the NAC process offers an economical disposal option for this waste.

Other processes are available to treat or manage high-nitrate-based wastes including electromechanical destruction, biological denitrification, chemical reduction, calcination, and hydrothermal processes. The advantages of the NAC process are that it occurs at low temperature and atmospheric pressure, destruction is essentially complete, heavy metals and strontium form insoluble precipitates, volume typically decreases by 70%, and no pretreatment will be required for the alkaline waste solutions that are stored at Hanford, Oak Ridge, and Savannah River.

**Project Conclusion:**



Based on the stabilization studies conducted by Rust Federal Services, Inc., the NAC process, although not a solution to the problem, is capable of producing a large nitrate reduction in mixed wastes.

The process is not a complete solution to the present and severe waste problems of DOE, but does present itself as a possible interim solution by offering a capability for producing large reductions in the nitrate containing mixed wastes currently being stored by DOE, as well as eliminating significant portions of contaminated scrap aluminum being stored by DOE. This in turn will not only allow DOE to address the extremely large and immediate environmental and human impact that is a result of the leakage from and deterioration of DOE's existing storage tanks, but also provide a much needed increase in time which will allow for the development of other methods and/or the introduction of additional processes that will allow for the long term remediation and disposal of the nitrate containing mixed wastes.

**Contacts:**

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DOE's Federal Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

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