SRNL is a DOE National Laboratory
operated by Savannah River Nuclear Solutions.

We put science to work.™

Innovations

from Savannah River National Laboratory

U.S. DEPARTMENT OF ENERGY • SAVANNAH RIVER SITE • AIKEN • SC

srnl.doe.gov

Partners in Success

National Laboratories
Savannah River National Laboratory
Oak Ridge National Laboratory
Argonne National Laboratory
Pacific Northwest National Laboratory
Idaho National Laboratory

Department of Energy
Office of Environmental Management
Office of Basic Energy Sciences
Savannah River Operations Office

Universities
University of South Carolina

Contractors
Savannah River Nuclear Solutions
Savannah River Remediation
Parsons
CH2M Hill

Commercial
Marshallton Research Laboratories
CINC Industries
General Atomics
IBC Advanced Technologies

Other Government Agencies
U.S. Environmental Protection Agency
S.C. Department of Health and Environmental Control

Office of Science Contributions

- Fundamental chemistry of calixarenes for cesium extraction
- Optimized chemistry and design of solvent system for cesium extraction in tank waste chemistry
- Chemical and radiation stability of solvent system

Contact Information
SRNL Office of Communications
803.725.4396

Next Generation Solvent doubles processing rate, saves over $1 billion

This innovation used state-of-the-are molecular modeling to challenge the limits of chemical processing and approach. This led to the development, testing, and deployment of a new chemical process. The Next Generation Solvent, an improved cesium extraction system, doubles production rates in salt waste processing at SRS. This scientific advancement will allow for more rapid removal of waste from tanks slated for closure, and enable the Department of Energy to overcome a potential conflict in the cleanup schedule caused by delays in the construction of a new salt waste processing facility.

The Problem

The Salt Waste Processing Facility (SWPF) at the Savannah River Site is designed to use a cesium extractant process that serves as the baseline technology for liquid waste treatment. The baseline technology was successfully used to treat four million gallons of salt waste at the pilot-scale interim salt waste processing facility. However, changes to the expected start-up date for SWPF created a significant delay to the schedule for the remainder of salt waste processing and overall SRS tank waste cleanup program completion. The consequence of this schedule delay is an extension of the tank waste treatment program at SRS for an estimated two to three years, with a cost of more than $500 million per year.

Limits of Current Practice

In developing one-of-a-kind waste treatment facilities, the treatment technologies are typically frozen at the time of facility design. Since hardened nuclear facility construction can take many years to complete, the technology may no longer match the cost, schedule, or regulatory needs of the current program. By using a baseline that is frozen in place at the time of facility design, evolving demands cannot be met.

New Approach

By challenging the limits of chemistry, researchers went to work in a collaborative effort to make the solvent more efficient and make up for time lost as a result of delays in facility construction and startup. The Environmental Management and Science programs continued to actively improve the technology, even after the SWPF design was finalized and construction had begun.

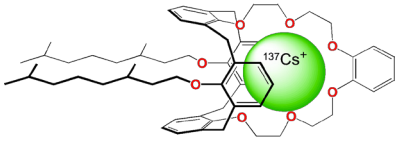
>>>

Innovations from Savannah River National Laboratory

New Approach *(continued)*

In an effort led by Oak Ridge National Laboratory, the Savannah River National Laboratory worked to ensure that ideas developed in this multi-lab effort met process requirements of facility design. This allowed the program to focus on approaches that achieve a step-change in process effectiveness, and meet the development timeline for regulatory requirements and the facility startup schedule.

- Built a team of national laboratories, suppliers, and contractors to concurrently perform research and testing to speed the development schedule. This allowed the new technology to be ready for immediate use upon facility startup.
- Used molecular design principles to investigate chemical compounds that could offer step-changes in solvent performance.
- Established process parameters and conditions so that researchers could ensure that the new technology could be deployed at facility startup.
- Created the solvent to allow for the treatment of a more concentrated stream of waste, and developed an acid that not only removed more cesium, but was also more compatible with downstream processes.



MaxCalix solvent with captured cesium ion

Centrifugal contactor that mixes the waste stream with the solvent

Next Generation Solvent Timeline

Return on Investment ~$1.3 Billion

1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014

EM Science Funding: $2.2M

Concept Development

- Fundamental chemistry
- Application/performance in a nuclear environment

EM Funding: $45M

MCU Deployment

Baseline Solvent System

- Impacts on downstream processes
- Performance in operating environment
- Development of operational parameters (flowsheet development)
- Engineering for deployment· Construction (MCU)

EM Funding: $11.5M

MCU Deployment

Next Generation Solvent System

- Impacts on downstream processes
- Performance in operating environment
- Development of operational parameters (flowsheet development)
- Scaled testing

(Leverages earlier SC- and EM-funded work)

NOVEMBER 2015 13CC00015KPIS020