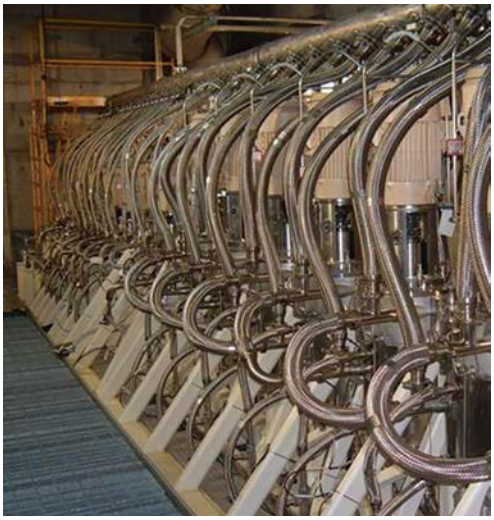

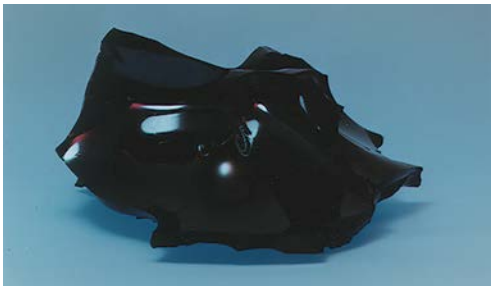

ABOUT THE IMAGES

Double-shell tanks being built in 1978 at Savannah River, South Carolina, to store radioactive nuclear waste.

(U.S. DOE)

Solvent extraction equipment used at the Savannah River Site to separate radioactive cesium from legacy nuclear waste.

(U.S. DOE SAVANNAH RIVER SITE)

Once separated from the wastes, cesium is safely captured in an inert glass for permanent disposal.

(U.S. DOE SAVANNAH RIVER SITE)

CLEANING UP NUCLEAR WASTES

Environmental management is a key DOE mission, in large part because decades of nuclear weapons production and nuclear energy research have left behind huge quantities of radioactive waste. Most of the radioactivity in the waste, however, comes from the element cesium, which is just a tiny fraction of the total waste. An alert research chemist at Oak Ridge National Laboratory, Bruce Moyer, recognized that if cesium could be removed, dealing with the wastes would be much easier and safer. Moyer also was aware of a potential solution—fundamental research into organic molecules that can recognize and capture metal atoms like cesium, some of it supported by the Basic Energy Sciences (BES) office of DOE. With BES support, he put together a team that, over a decade, showed the potential of this approach. Subsequent support by DOE's Environmental Management Office allowed the team to work out the practical details.

THE BREAKTHROUGH

Developing specialized organic molecules that can "recognize" and capture the element cesium, and subsequently developing a practical clean-up process.

- New methods of synthesizing these specialized molecules, analyses of their structure, and "fine-tuning" that structure to recognize metals like cesium.
- New understanding of the chemistry of potential extraction processes from complex solutions like nuclear wastes.
- Development of an automated industrial process to remove highly radioactive cesium from the wastes.

THE IMPACT

An elegant and efficient new cleanup technology for radioactive waste left over from the manufacture of nuclear weapons.

- The technology, already in use, will speed up the process and save over $1 billion.
- The underlying approach may also be applicable to extracting rare elements that are deemed critical materials for national defense-related technologies, or for creating molecular sensors that detect trace emissions of radioactive materials and thus provide early warning of rogue nuclear weapon development.

THE TAKEAWAY

BES-supported fundamental research on the chemistry of molecular recognition, and subsequent applied research by DOE's Environmental Management office, have created a systematic way to clean up a legacy environmental hazard.

Adapted from chapter 10 of A Remarkable Return on Investment in Fundamental Research, U.S. DOE, June 2018.
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