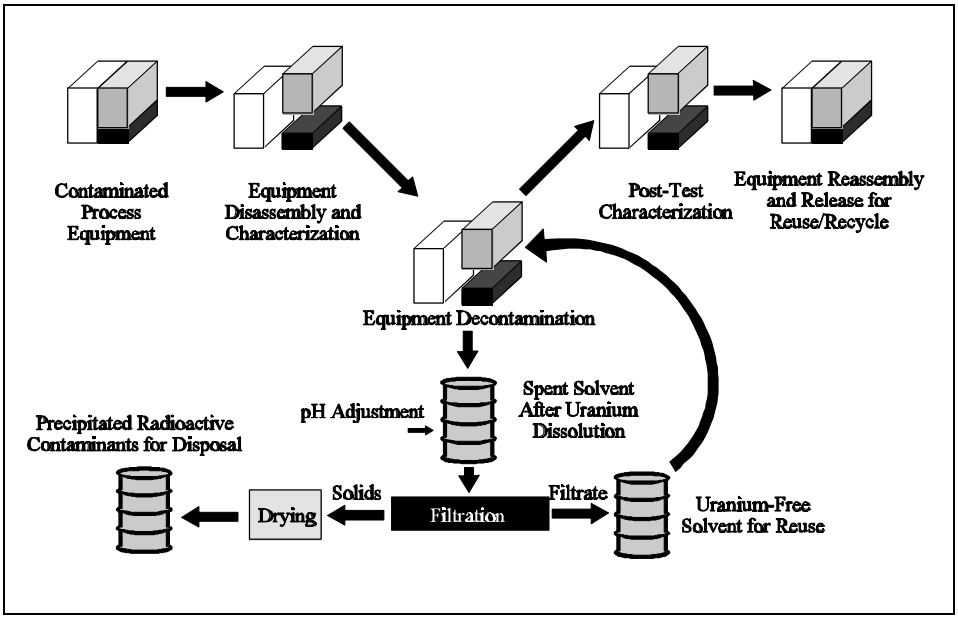
Decontamination of Process Equipment Using Recyclable Chelating Solvent

Developer: McDermott Technology, Inc. (MTI)
Contract Number: DE-AC21-93MC30168
Crosscutting Area: N/A

Deactivation & Decommissioning FOCUS AREA

Problem:

The Department of Energy (DOE) deactivation and decommissioning (D&D) programs require cleanup of a tremendous volume of equipment and material. Existing technologies are not adequate for meeting the cleanup goals with current and projected resources in a timely manner. Technologies are needed to decontaminate equipment to levels which would allow for reuse and/or recycle and to reduce the high costs associated with cleanup and disposition of contaminated equipment and material.



Solution:

Develop and demonstrate an effective and efficient chemical process, utilizing chelate-based solvent systems, for removal of uranium and other actinides from contaminated process equipment. After decontamination the chemical solvent is treated to remove the active materials and to regenerate the chelate so that it can be reused in the decontamination of additional process equipment.

Benefits:

- Potential significant reduction in equipment cleanup costs
- Cleaning of surface contamination on process equipment to a level allowing for reuse of the process equipment components or materials
- Limits the amount of metal removal during decontamination so the process equipment components or materials can be more readily reused or recycled
- Reduces the overall volume of contaminated material and hence, reduces disposition costs
- Regeneration and reuse of solvent to minimize secondary waste generation

Technology:

This technology is similar to that used in the chemical cleaning of steam generating equipment. Chelating agents form extremely stable complexes with certain metallic species; stabilization of the metal in solution allows the chelate to continually enhance the dissolution of the species of interest into the solvent.

A number of readily available chelates, such as EDTA, DTPA, and HEDTA, are known to form very strong and stable complexes with uranium. The purpose of this project was to optimize the chemical

conditions needed to selectively dissolve the actinide-based contaminants from the process equipment. To encompass the entire technology, commercially available proprietary chelate systems and specially synthesized actinide selective chelates were included in screening test. An example of a synthesized actinide chelate is the tetrahydroxamate ligand synthesized by New Mexico State University under separate DOE sponsorship.

After application of the chelating solvent to the process equipment for an appropriate time period, the spent solvent is removed to a waste processing facility, and the dissolved radioactive contaminants are precipitated out of solution. The precipitated contaminants are then filtered and dried for subsequent disposal. The regenerated chelating solvent is then available for reuse in the cleaning system, thereby minimizing the amount of secondary waste generated by the process. In related steam generator chemical cleaning technology, iron has been reduced from over 7000 ppm in a chelate solution to less than 1 ppm, thus demonstrating the feasibility of this approach.

Another program investigation area was the potential use of foam in the process application. In this concept, foam is used as the transport media to deliver the solvent to the process equipment surfaces. The benefits of foam cleaning include minimization of waste volumes and the potential improvement of solvent contact with the equipment surfaces.

Project Conclusion:

This project was completed in January 1996 at the end of the initial project phase. Phase I program goals included reducing the level of radioactive contamination within the metal surfaces, reducing the volume of contaminated material, and minimization of secondary waste generation.

Babcock & Wilcox, Inc. (B&W) was successful with a mixture consisting of EDTA, Carbonate, and Hydrogen Peroxide which effectively removed 99.9% of uranium dioxide from contaminated stainless steel samples, although carbon steel efficiencies ranged from as low as 23% up to 92% removal. In addition, it was not evident that the EDTA solvent would be recyclable. Given the apparent inability of this technology to meet all of the DOE's goals, this project was concluded at the end of Phase I.

Contacts:

B&W is engaged in innovative product and process development to address environmental remediation needs. For information on this project, the contractor contact is:

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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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