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TECHNOLOGY TRANSFER: A COOPERATIVE AGREEMENT  
AND SUCCESS STORY

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ABSTRACT

This paper describes the cooperative agreement between the U.S. Department of Energy and Envirocare of Utah, Inc., wherein the former transferred macroencapsulative technology to the latter for purposes of demonstrating commercialization of treatment and disposal of 500,000 pounds of radioactive lead stored at departmental installations.

I. INTRODUCTION

The U. S. Department of Energy has accelerated involvement of private industry in resolution of environmental issues at federal installations and facilities. That involvement has taken numerous forms. Private industry has been encouraged to develop and demonstrate improved or new technologies. The Department of Energy has contracted specific environmental tasks to private companies. Technologies developed by the Department of Energy for use in environmental actions have been or are being commercialized. This paper discusses a cooperative agreement between the Idaho Operations Office of the Department of Energy and Envirocare of Utah, Inc., wherein a technology developed by the Office of Science and Technology of the Department of Energy has been transferred to a commercial enterprise for the purpose of demonstrating production processing of contaminated lead presently stored at various departmental installations.

II. REGULATORY SYNOPSIS

In 1990, the U. S. Environmental Protection Agency promulgated regulations which prohibited certain hazardous wastes from land disposal (40 CFR 268.35).

Lead (D008) was one of those wastes. The Environmental Protection Agency specified macroencapsulation as the only treatment technology for radioactive lead solids (Table 3 of 40 CFR 268.42). By definition, macroencapsulation required all exposed surfaces of lead be coated with "...materials such as polymeric organics (e.g., resins and plastics) or with a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media." The definition precluded "...any material that would be classified as a tank or container according to 40 CFR 260.10..." (cf Table 1 of 40 CFR 268.42).

In 1992, the Federal Facilities Compliance Act (P. L. 102-386) amended the Solid Waste Disposal Act of 1965 (P. L. 89-272) and required the Department of Energy to develop plans for processing inventories of mixed radioactive-hazardous wastes for which treatment technologies existed [42 U.S.C 6939c, Sec. 3021 (b)(B)(I)]. Even though the Department of Energy complied with requirements, no federal or commercial facility was licensed to treat and dispose of contaminated lead. Therefore, inventories of contaminated lead continued enlarging and remaining in storage.

III. STRATEGY

In 1994, the Department of Energy was investigating possibilities of using another technology as a macroencapsulative device in management of selected radioactive or mixed radioactive-hazardous wastes. The Department of Energy considered using a high-density polyethylene device for disposal of radioactive lead. However, the device did not satisfy the definition of macroencapsulation, although it could serve as the package for disposal of contaminated lead, provided the lead was

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surrounded on all surfaces by a jacket of inorganic material or polymeric plastic.

The Department of Energy learned that Envirocare of Utah, Inc. was licensed to receive, treat, and dispose of certain mixed radioactive-hazardous wastes, and it was told Envirocare of Utah, Inc. once treated and disposed of contaminated lead on behalf of Region 8 of the Environmental Protection Agency under a variance to the Land Band Restrictions. As a result, the Department of Energy and Envirocare of Utah, Inc. discussed possibilities of filling a plastic container with contaminated lead stored at the Idaho National Engineering Laboratory and using the extrusion technology and equipment developed by Brookhaven National Laboratory of the Department of Energy. Macroencapsulation of contaminated lead stored at federal installations was viewed as a reasonable commercial venture by the Department of Energy and Envirocare of Utah, Inc. That possibility was seen as an excellent opportunity to transfer technology developed by the federal government to private enterprise.

#### IV. COOPERATIVE AGREEMENT

In 1995, the Department of Energy and Envirocare of Utah, Inc. finalized a cooperative agreement in which each signatory to the cooperative agreement contributed equally to the costs of commercializing the macroencapsulative process and, in demonstration, treated and disposed of 500,000 pounds of contaminated lead from installations of the Department of Energy. The Department of Energy made available consulting expertise on and pledged literature about assembling and operating the extrusion equipment developed at Brookhaven National Laboratory.

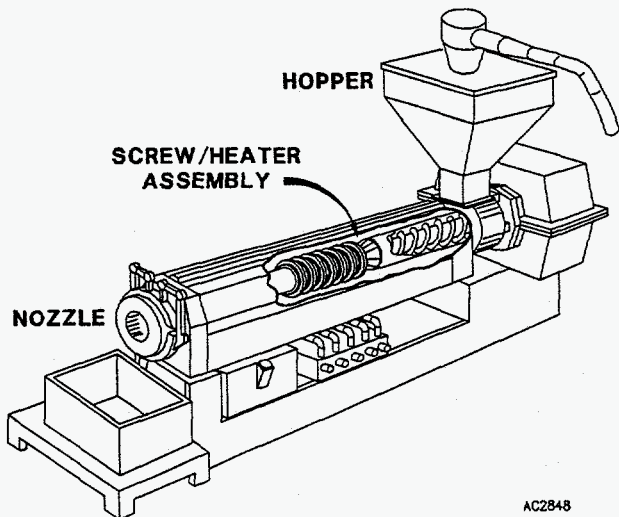
Envirocare of Utah, Inc. agreed to apply for and secure a modification to its operating license from the regulatory authority of the State of Utah. It agreed to construct processing facilities, construct a disposal cell, and treat and dispose of 500,000 pounds of contaminated lead or equivalent mixed radioactive-hazardous debris at its South Clive facility east of Wendover (Utah). Envirocare of Utah, Inc. subcontracted consulting expertise from Brookhaven National Laboratory to assist in the purchase, installation, testing, and demonstration of the polyethylene-extrusion technology for macroencapsulation of contaminated lead. Both the Department of Energy and Envirocare of Utah, Inc. agreed to complete transport, treatment, and disposal of contaminated lead by December 1996.

Envirocare of Utah, Inc., in cooperation with consultants from Brookhaven National Laboratory, tested equipment and refined the encapsulative process using non-radioactive lead purchased locally. Demonstrations of the refined process were held in November (1995) and January (1996) using radioactive lead from the Idaho National Engineering Laboratory. After the demonstrations, the State of Utah approved the modification of the operating license of Envirocare of Utah, Inc. (*i.e.*, permit modification 95-3420 "Macroencapsulation" UTD982598898).

The Department of Energy began transporting contaminated lead to the South Clive facility of Envirocare of Utah, Inc. in September 1995. The initial shipment of 10,000 pounds was taken from the stored inventory of characterized contaminated lead at the Idaho National Engineering Laboratory. A second shipment of 80,000 pounds was transferred from the same inventory in February 1996. The shipment made in March (1996) moved an additional 20,000 pounds from the installation in the State of Idaho to the South Clive facility. At the time of this writing, the Department of Energy has transferred total of 110,000 pounds of contaminated lead from the Idaho National Engineering Laboratory. Envirocare of Utah, Inc. has treated and disposed of 80,000 pounds of lead. The Department of Energy intends to complete the transfer of the agreed upon amount by November 1996. Envirocare of Utah, Inc. will complete treatment and disposal of that amount by December of 1996.

#### V. PROCESS OF MACROENCAPSULATION

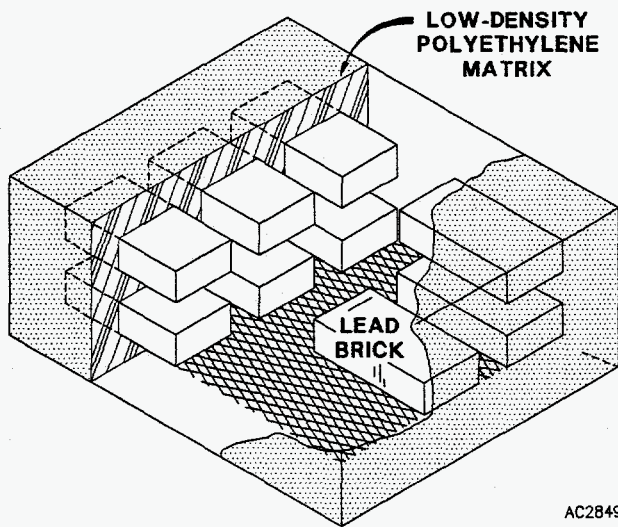
The process of macroencapsulation is simple. Envirocare of Utah, Inc. places contaminated bricks and/or pieces of lead on a steel grate suspended two inches above and away from the bottom and sides of a rectangular mold measuring approximately 24 by 20 by 10 inches. A mixture of low-density polyethylene beads and chemical binders is poured into a hopper above and behind the extrusion machine. Activation of the machine turns the single screw extruder, which simultaneously transports, homogenizes, and heats the mixture to 300°F. The melted plastic exits the 4.5-inch nozzle as a continuous rope, flowing over, around, and adhering to each exposed surface of the lead. The State of Utah requires that two inches of plastic isolate the waste from the disposal environment. The block of polyethylene separates from the mold as it cools and hardens. If the block passes inspection (*i.e.*, no cracks, cold joints, or voids and 2 inches of insulative plastic in all dimensions), it is ready for disposal. The process of macroencapsulation of contaminated lead is diagrammed in Figures 1 and 2.



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Figure 1. Schematic of extrusion equipment used by Envirocare of Utah, Inc. in macroencapsulation of radioactive lead from federal installations.

complicated regulatory environment of today, a positive working relationship with a regulatory authority can resolve sticky, waste management issues, reduce real or perceived risks to people and natural environments, and affect an avenue whereby an agency of the federal government can comply with congressionally mandated requirements (*i.e.*, comply with P. L. 102-386). Throughout the permitting process, the Utah Department of Environmental Quality repeatedly demonstrated that success is predicated upon a team-effort. The cooperation effected between private enterprise, state government, and a federal agency defines a way whereby other forms of mixed radioactive-hazardous wastes in storage can be eliminated. The cooperative agreement discussed in this contribution will serve as a model for other agreements between the federal government and private enterprise, and it will encourage and foster better cooperation between federal, state, and local governments, private enterprise, interested third parties, and public in resolution of pressing waste management issues elsewhere around the nation.



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Figure 2. Diagram of radioactive bricks encapsulated in a matrix of low-density polyethylene.

## VI. BENEFITS AND IMPLICATION

Potential benefits of the cooperative agreement are enormous. For example, the Department of Energy has demonstrated transference of a waste-treatment technology developed at national laboratory with public moneys to a company licensed to treat and dispose of solid, mixed radioactive-hazardous wastes for commercial application. Envirocare of Utah, Inc. has demonstrated that, in the