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**Volume Reduction System
for Solid and Liquid TRU Waste from
the Nuclear Fuel Cycle
Quarterly Report**

October, November, December, 1976

Monsanto

MOUND LABORATORY

Miamisburg, Ohio,
operated by

MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company

for the
**UNITED STATES ENERGY RESEARCH
AND DEVELOPMENT ADMINISTRATION**

U.S. Government Contract No. EY-76-C-04-0053

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VOLUME REDUCTION SYSTEM FOR SOLID AND LIQUID TRU WASTE
FROM THE NUCLEAR FUEL CYCLE

QUARTERLY REPORT
OCTOBER, NOVEMBER, DECEMBER 1976

I. INTRODUCTION

The primary objective of this project is to provide design criteria for a volume reduction system to treat combustible solids and liquids generated in the nuclear fuel cycle. Progress has been made in each of the major areas of interest.

Primary emphasis has been in the design and purchasing of equipment for liquid feed mechanisms and in evaluating technology available for compaction of empty waste containers.

Literature review of current technologies and the technology investigations conducted under the ERDA/DWMPPR project, "TRU Waste Cyclone Drum Incineration and Treatment System" are being closely followed to select a technique for ash immobilization.

II. INTERFACES WITH COMMERCIAL PLANTS

Contacts have been made with several commercial firms involved in various areas of the nuclear industry such as fuel reprocessing, handling and transportation, architectural engineering, and electric power. Firms in all these areas have expressed a strong general interest in the Cyclone Incinerator. Details will be made available as commitments are made.

Efforts are being made with each of these firms to characterize their wastes and determine volumes involved.

III. ADAPTATION OF ERDA CYCLONE DESIGN TO COMMERCIAL WASTES

A. Off-Gas Handling

This phase of the program is very closely related to interfaces at this stage. Complete characterization of waste is necessary for a complete understanding of the potential off-gas handling problems. Although an

extensive literature search has been conducted to ascertain the state-of-the-art in the determination and treatment of gaseous and particulate radioactive constituents of incinerator off-gases, literature searches will continue as more complete characterization of commercial wastes is made.

B. Liquid Feed Mechanism

A conceptual design was made for a system to incinerate a mixture of 30% tributylphosphate in kerosene. This mixture will simulate the waste solvent from solvent extraction radioisotope purifying systems used in fuel reprocessing plants. Purchase of the necessary hardware has been initiated.

IV. SELECTION OF ASH IMMOBILIZATION TECHNIQUE

A summary of work performed under Task II of the "TRU Waste Cyclone Drum Incinerator and Treatment" Program, has been included to describe work being performed at Mound on ash immobilization. Work performed under the "Volume Reduction System Solid and Liquid TRU Waste from the Nuclear Fuel Cycle" Program will supplement this project. A literature search has been initiated and several immobilization processes have been tested. The processes tested include mixing with portland cement, pressing as a ceramic, pressing as a cermet (ceramic-metal composite) and converting to a glass. The major effort has been made on conversion to glass. The glass form currently under study is a borosilicate type. The constituents of the ash (17% CaO, 22% Al₂O₃ and 24% SiO₂) are similar to those required for glass formation with the addition of borax (Na₂B₂O₃·10H₂O). Carbon (26%) is also present in the ash and is driven off as a gas by either preheating to 800°C in a furnace or during the glass-making process. Table I shows the various materials comprising the three types of feed burned in the incinerator. Glasses were made from each type of feed with several ash/additive combinations heated to various temperatures (Table II). Carbon was driven from the ash by sintering at 800°C before mixing except when indicated. Microscopic (3X) observation indicates nearly complete homogeneity was achieved in the 70% borax-30% ash samples. Small particles are unevenly disposed in the remaining glass samples. The fact that Type II ash requires a higher proportion of borax to attain melting than Types I and III is probably related to lower SiO₂ content for Type II ash as indicated by analytical

TABLE I
COMPOSITION OF INCINERATOR FEEDS

	<u>Type I</u> ¹	<u>Type II</u> ¹	<u>Type III</u> ¹
Paper	32	2	48
Plastics			
PVC	9	23	1
Polyethylene	29	9	6
Polypropylene	8	2	-
Rubber	13	3	26
Cloth	3	61	6
Leather	-	-	-
Wood	-	-	7
Metal	6	-	6

¹Weight %

results. Unsintered ash was mixed with borax and successfully melted to a glass. Weight loss calculations indicate that the carbon was driven off as a gas during heating. Actual carbon content will be determined analytically.

Further development efforts will be made on other immobilization techniques in order to establish which method produces a product with the most inert properties.

V. SELECTION OF COMPACTION TECHNIQUE FOR EMPTY WASTE CONTAINERS

A survey of commercially available drum compactors to assess possible adaptation to the requirements of this project is in progress. The possibility that a compactor will have to be engineered to meet the project's needs is growing from the apparent lack of an appropriate commercial compacting unit. The present goal is to compact 55-gallon drums so that they will fit into an uncompacted 55-gallon drum. The continuing review has found several compactors that reduce the vertical dimension but none that will reduce a drum's diameter as well.

A milestone chart depicting the schedule of activities is given in Table III.

TABLE III
MILESTONE CHART

ACTIVITY	FISCAL YEAR							
	FY-1977				FY-1978			
<u>PHASE I</u>								
a. Interfaces with Commercial Plants								▲
b. Adaptation of ERDA Cyclone Design to Commercial Wastes						▲		
c. Selection of Ash Immobilization Technique & Product Characterization						▲		
d. Select Compaction Technique for Empty Waste Containers			▲					
<u>PHASE II</u>								
e. Process Description & Design Criteria for Cyclone Incinerator								▲
f. Process Description & Design Criteria for Ash Immobilization & Waste Container Compaction Processes								▲
<u>PHASE III</u>								
g. Project Reports				▲				▲

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