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**Volume Reduction of Tritiated
Liquid Wastes with Super Slurper**

Marie A. Condron and Sam S. Freeman

October 14, 1977

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Miamisburg, Ohio
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**UNITED STATES ENERGY RESEARCH
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Abstract

A method of packaging low-specific-activity tritiated waste water was developed which could reduce the volume of this kind of waste shipped from Mound Laboratory by 20%. This was accomplished by reducing the amounts of cement and attapulgite which are currently added to the waste water for immobilization and adding a highly adsorbent polymer called super slurper.

Introduction

Currently at Mound Laboratory low-specific-activity tritiated waste liquids are packaged in drums and immobilized by adding cement and attapulgite, an absorbent. A highly absorbent starch graft polymer called super slurper was investigated as a means of reducing the volume of this waste shipped from the site. The goal was to determine the feasibility of using this material in the waste packaging process.

In addition, an effort was made to optimize the quantities of ingredients and determine the maximum amount of water which could be packaged into a 55-gal drum and still produce a free-standing solid.

Material

Chemically, super slurpers are identified as hydrolyzed starch-polyacrylonitrile graft copolymer. They are being developed by the United States Department of Agriculture for use as absorbents, thickening agents, and soil additives. In this study, however, super slurper was used in conjunction with cements and other absorbents to produce a free-standing solid capable of retaining more waste water than is absorbed by the current solidification process.

When super slurper and water are mixed, the particles of super slurper enlarge, absorbing water until saturated, resulting in a gel-like mass. The absorbency varies with

water characteristics such as hardness, ionic strength, and pH. Some of the different brands of super slurpers can absorb as much as 2,000 times their own weight in distilled water [1].

Super slurper is produced in many different forms: a particle, mesh size ranging from 0.5 to 100; a flake; or a film [2]. Currently, the material is available in developmental quantities. Full production by one supplier of the material is scheduled to begin in spring 1978 at an estimated cost of \$1.25 per pound.

Initial Investigation

The initial work was performed with tap water which has a composition of dissolved solids similar to the tritiated waste (Table I). Attempts to solidify the gel (water plus super slurper) by adding cement alone failed. Upon contact with dry cement, the super slurper gel broke down, almost completely reliquefying and absorbing only 10 to 15 times its weight. When the water and cement were mixed together first and then a quantity of super slurper added, the super slurper seemed to absorb more. Next, the dry cement and super slurper were mixed together, and then the water added. This procedure provided not only better absorption, with the super slurper absorbing approximately 25 times its weight, but also resulted in a homogeneous product. These initial

Table 1 - COMPOSITION
OF TAP WATER USED

Total Hardness	120	mg/liter
Chloride	125	mg/liter
Dissolved Solids	590	mg/liter
Sodium	180	mg/liter
Residual Chlorine	0.12	mg/liter
Phosphate	0.455	mg/liter
pH	8.5	

samples were not suitable as water would issue from them when pressure was applied.

When the attapulgite absorbent that is currently being used in conjunction with cement at Mound Laboratory to package liquid tritiated wastes was added, it had the effect of increasing the absorbency, the volume, and the strength of the sample. Possibly the attapulgite acts as an aggregate for the cement mixture. The result was a sample with increased strength and hardness. This sample represented an apparent absorption of water by the super slurper of approximately 25 times its weight. This resulted in the equivalent of 30 gal of waste water per 55-gal drum, an increase of 20% over the present method which can immobilize only 25 gal of waste water per drum. At this point the feasibility of reducing the volume of waste with the use of super slurper was proven.

Optimization of Process

The study was then directed toward optimizing the mixture of super slurper, cement, and attapulgite, that is, determine the maximum amount of water that could be immobilized in a 55-gal drum.

Samples were prepared using the mixture of ingredients that were proven to give a solid product with increasing increments of water

equivalent to about a half gallon. It was found that 30 gal of waste water per drum was the maximum using this formula.

Also, other cementing materials such as plaster of Paris and gypsum were tested. Super slurper, when used with these materials, behaved in a similar fashion as when used with just portland cement except that the end product did not hold its shape and broke apart.

It was postulated that the destabilizing effect on the super slurper gel was due to the free calcium ions from the cement. Several different sodium salts were used as additives to the mixture in order to complex the calcium ions thereby deionizing the liquid and creating an environment in which the super slurper could absorb more water. The test confirmed this as shown in Figure 1.

However, the limiting factor is probably the water-to-cement ratio. As is true with concrete, a high water-to-cement ratio results in a reduction of strength. In order to absorb more water, more cement was required to solidify the sample. Since the volume is limited by the size of the drum, it was not possible to further increase the volume of waste water absorbed per drum.

At this point the investigation was terminated. An acceptable process had been achieved and laboratory tested using actual tritiated waste. Further investigation would produce only a negligible increase in the volume of waste water per drum.

Results

The optimum mixture is, in terms of a 55-gal drum, 30 gal of waste water, one

FIGURE 1 - Effect of salt additives on the absorption properties of the super slurper in the presence of cement.

and a half bags of dry portland cement, one bag of attapulgate,* and 10 lb of super slurper**. The following procedure yields the best results: mix the super slurper, cement, and half of the attapulgate; add the water and stir; then add the remaining

*The material used in this study is marketed by the Floridin Company, Pittsburgh, Pennsylvania.

**The super slurper which produced the best results is produced by the Grain Processing Corporation, Muscatine, Iowa, and has a grain size ranging between 60 and 100 mesh.

attapulgate and mix in. The total weight of the package is 450 lb plus the weight of the drum, 140 lb less than the current package and an increase of 5 gal of waste water per drum. The cost to produce and dispose of the total package is approximately \$79, \$5 more than the current process. However, counter balancing the cost increase per drum, this method reduces by 20% the number of drums of waste per year. Based on an output of 15,000 gal of low-specific-activity tritiated wastes per year, the total cost savings will be approximately \$6250 per year (Table 2).

Table 2 - COST COMPARISON INCLUDING MATERIALS,
LABOR, TRANSPORTATION, AND BURIAL FEE

<u>Existing Process</u>	<u>Cost/drum (\$)</u>	<u>Improved Process</u>	<u>Cost/Drum (\$)</u>
Drum 17-H 55 gal	20.86	Drum 17-H 55 gal	20.86
Staging, Inspection and Loading	2.16	Staging, Inspection and Loading	2.16
25 gal H ₂ O	-	30 gal H ₂ O	-
3 Bags Cement	8.46	1.5 Bag Cement	4.28
2 Bags Florco	5.88	1 Bag Florco	2.94
Labor	8.94	Labor	8.94
Transportation	13.58	Transportation	13.58
Burial	13.73	Burial	13.73
	<u> </u>	10 lb Super Slurper	<u>12.50</u>
Total/Drum	73.61	Total/Drum	78.99
At 600 Drums/Yr = \$44,166		At 480 Drums/Yr = \$37,915	
Cost Savings = \$6,250/Yr			

References

1. The Agricultural Research Service, United States Department of Agriculture, Super Slurper Compound with a Super Thirst (June 1975).
2. Weaver, M. O., Montgomery, R. R., Miller, L. P., Sohns, V. E., Fanta, G. F., and Doane, W. M., A Practical Process for the Preparation of Super Slurper, A Starch-Based Polymer with A Large Capacity to Absorb Water, Peoria, Illinois (March 23, 1977), available from the U.S. Dept. of Agriculture.

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