

## Short Communication

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# POLYESTER MICROENCAPSULATION OF DECONTAMINATION CHEMICALS

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## Introduction

One of the features of current industrial growth is an increasing awareness to prevent pollution of the environment by hazardous industrial wastes. A basic approach in waste management is to develop processes for the conversion of hazardous residuals in the form of liquids or semisolid sludges to solids, for safe handling, transportation and storage with minimal potential for contamination of the environment. Immobilization of the waste is primarily concerned with its incorporation into a solidification agent. The feasibility of immobilizing hazardous wastes in a polyester matrix through microencapsulation has been investigated over a considerable period of time in the laboratories at Washington State University. By finely dispersing the waste solution, slurry or solids in a water-extensible polyester resin, each waste particle or droplet is individually encapsulated inside a thin skin of the resin matrix. Addition of an initiator polymerizes this resin matrix to produce a rigid monolithic solid suitable for land burial. A full description of the process and more recent studies are described in the literature [1–3].

There is current interest in the application of the polyester immobilization process toward the immobilization of decontamination chemicals, for example as used in the nuclear industry. The results of laboratory evaluations on such chemicals are presented here.

## Decontamination chemicals

Several types of decontamination chemicals are currently being used in the process and nuclear industries. These chemicals facilitate the removal of radioactive contaminants and corrosion products from various metal surfaces; the chemicals themselves possess low penetration values. Some decontamination chemicals [4] evaluated in our study were:

1. A highly alkaline powder containing potassium permanganate (for example, DECON 4502®);

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2. An inhibited, phosphoric acid type liquid, containing no fluorides or chlorides (for example, DECON 4512A<sup>®</sup>);
3. An inhibited, acid powder containing oxalate, citrate and ammonium ions, surfactants and foam suppressants (for example, DECON 4521<sup>®</sup>);
4. An inhibited, mildly acidic powder, containing no fluorides or chlorides (for example, DECON 4306D<sup>®</sup>).

### Experimental procedure

Separate 100 ml solutions at the concentrations projected by industry [5] (2.9%, 1.25%, 0.95% and 0.10%, respectively) were prepared for each chemical listed above, using water as solvent. This waste solution was then slowly added to a plastic beaker containing the polyester resin where high speed mixing forms the emulsion. Two parts waste to one part resin were used. If a stable emulsion was formed, the peroxide catalyst was added in a concentration of 1% (weight) of the resin used. The emulsion was then left to solidify. If solidification did not occur the waste solution was partially neutralized using sodium hydroxide or hydrochloric acid, as required. The degree of neutralization depended on the particular chemical being evaluated. After neutralization, the emulsification and solidification processes were carried out as before. The resin used was Aropol WEP-661P from Ashland Chemical Co. The initiator was Lupersol Delta from Pennwalt.

### Results

Two of the four chemicals tested required no neutralization, DECON 4502 and DECON 4306D. The emulsions were easily formed with both these chemicals, and uniform, homogeneous solids were obtained.

DECON 4512A solution was around pH 1 and would not solidify until neutralized to pH 5. The emulsion formed with the unneutralized DECON 4502 was very unstable even when extra resin was added. The emulsion continued to be unstable at pH 2, 4 and 4.5, but at pH 5 became stable. The surface of the solid formed at pH 5 was shiny and of a different color from the rest of the solid. When a solid at pH 6 was formed, it was more uniform in color and texture.

The solution of DECON 4521 at pH 4 formed an emulsion only with difficulty, was unstable, and failed to solidify. When neutralized to pH 5.5, the bottom third of the emulsion solidified while the rest separated as a liquid phase. The emulsion was still fairly difficult to form at pH 6 and about three quarters of the emulsion solidified while the rest separated as a liquid again. At pH 6.5 total solidification occurred with only a thin film left unsolidified on the top. This film persisted regardless of pH.

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## References

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- 3 R. Mahalingam, R.K. Biyani and J.T. Shah, Simulation of solidification temperature profiles in the polyester process for immobilization of hazardous wastes, *I & EC Proc. Des. Dev.*, 20 (1981) 85.
- 4 DECON Reference Book, Turco Products Technical Data, Bulletins #136-13, 23, 24, 27.
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