

UNIVERSITY OF WASHINGTON

Box 352700

September 12, 1997

Dr. Ramoncita Massey
U.S. Dept. of Energy
EM-64/Forrestal Building
Washington DC 20585

Dear Dr. Massey,

This informal letter report for project DE-FG07-96ER62313. Please contact me at (206) 543-7645 if you have questions.

The goal of this research is the development of a treatment system for the separation of contaminants in low-organic Hanford tank wastes into sub-groups that can subsequently be processed and appropriately disposed of. Since many of the contaminants of concern are associated with solids, initial experimental work has focused on characterizing the particulate matter in Hanford waste and understanding the filterability of this waste through membranes. Removal of some of the soluble contaminants by adsorption has been studied as well. The experimental work conducted to date can be divided into four categories: speciation calculations; solid/aqueous phase partitioning; membrane filtration experiments; and sorption experiments. The work was conducted using two simulated Hanford wastes (SHWs), one that contained strong complexing agents (citrate and EDTA) and one that did not.

The speciation calculations were carried out using the chemical equilibrium computer program MINEQL+. The equilibrium speciation of SHW constituents at three different pH values near the actual pH of the SHW was calculated. The objectives of this simulation were to gain an understanding of how the various contaminants in SHW might partition between the solid and aqueous phases and also to determine the extent of metal complexation with EDTA in the waste.

Experiments were subsequently conducted to assess the actual partitioning of the SHW constituents between the solid and aqueous phases. The particle size distribution (PSD) of the solids in SHW was assessed. The PSD is useful for determining an appropriate pore size range to use in membrane filtration. In addition filtration experiments were conducted to learn how the various metal constituents of SHW are distributed between particles of various sizes and the aqueous phase.

Two systems were built to study membrane filtration of SHW: a dead-end filtration system and a cross-flow filtration system. Permeate flux and metal removal efficiency in the systems were measured to gain an understanding of how effective these filtration

processes are in treating SHW, and to establish baseline performance levels for subsequent experiments using membrane filters precoated with adsorbent particles.

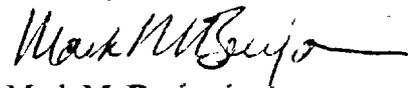
The adsorption of Sr and Cs onto various media was explored as a function of pH, as well as the stability of the adsorbent media with respect to dissolution at high pH. Both crystalline and non-crystalline forms of iron oxides were tested as adsorbents in dilute suspensions, along with iron-oxide-coated sand (IOCS), a novel adsorbent developed in our laboratory.

Results to date have been moderately encouraging. Much of the first half of the year was devoted to overcoming analytical problems attributable to the complex mixture and extreme basicity of the SHW. However, these problems have largely been overcome or circumvented, and work is proceeding well at this time.

The vast majority of the heavy metals in the complex waste are soluble, apparently because of strong complexation with OH ions, and these metals are not strongly attracted to any of the sorbents tested under the conditions extant in the SHW. Strontium, however, can be sorbed from the extremely high pH test solutions onto hematite ($\alpha\text{-Fe}_2\text{O}_3$) or IOCS, but not particularly well onto either goethite ($\alpha\text{-FeOOH}$) or amorphous ferrihydrite ($\text{am-Fe}(\text{OH})_3$). We are therefore proceeding with tests using the two successful adsorbents to separate Sr from other constituents of the SHW. The IOCS can be used in a packed column arrangement, and we are beginning experiments exploring the feasibility of regenerating the media after it is saturated with Sr. Hematite is being used in suspension, and we are currently exploring the feasibility of separating the adsorbent from the treated solution with ultrafilters, with the key issue being the tendency of the SHW and/or the hematite to foul the filters. Experiments are underway to explore the possibility of interfering with the fouling process by pulsed backflow that is induced either hydrostatically or by electro-osmosis.

Cs is not sorbed onto any of the adsorbents studied to date. One of the key components of the research is an investigation of Cs removal using hexacyano-ferrates. A new researcher is joining our group at the end of September, 1997 to initiate this aspect of the project.

Sincerely,



Mark M. Benjamin
Professor of Civil Engineering