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REMOVAL OF MERCURY FROM WASTE WATER: LARGE SCALE PERFORMANCE OF AN ION EXCHANGE PROCESS (U)

by

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An abstract of a paper proposed for presentation at the
Second International Conference on Waste Management in the Petrochemical Industries-Toxics Management
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The Integrated Defense Waste Processing Facility (DWPF) Melter System (IDMS) located at the Savannah River Site (SRS) was designed and constructed to provide an engineering scale, non-radioactive demonstration of the DWPF. The IDMS is the first facility at the SRS which is capable of processing mercury on an engineering scale. Waste water (condensate and sump water) generated during IDMS process demonstrations is treated by ion exchange to reduce the mercury content to below the permitted level of 10 ppb for subsequent processing. This paper presents information on the process characteristics, performance, and problems encountered during operation of the Ion Exchange Facility (IEF). A qualitative summary is given below; quantitative information will be given in the final paper.

The feed to the IEF first undergoes pH adjustment (final pH ≈ 12) with caustic to precipitate most of the solids, it then passes through a 0.02 micron ultrafilter and is finally stored in a Waste Water Collection Tank (WWCT). The feed in the WWCT contains a varying concentration of mercury (0.2 to 50 ppm), a considerable amount of Na, and ppm levels of Zn, Al, Li, B, P, and Si. The feed is passed through two columns which are operated in series and at a flow rate of 2 to 3 gpm. Each column contains approximately 14 ft^3 of Duolite™ GT-73 resin.

The IEF routinely reduces the mercury content of the IDMS waste water to less than the permitted level of 10 ppb. Effluent concentrations are consistently 1 to 5 ppb. This range also seems to be a lower limit for mercury removal by Duolite™ GT-73 resin for this waste stream. Both during bench-scale tests and operation of the IX facility effluent concentrations below 1 ppb have not been observed.

Two operational problems were also encountered: 1) the stated capacity of the resin for mercury was not being achieved, and 2) the facility was temporarily shut down because the mercury content of the treated waste water could not be reduced to below 200 ppb.

The abnormally low capacity of the resin for mercury was traced to analytical laboratory waste which was intermittently treated by the IEF. That waste contained hydrochloric acid, stannous chloride, and potassium permanganate, among other chemicals. It is known that chlorine generated in this waste oxidized the thiol (SH) functional groups on the resin and rendered them inactive. Residual chloride concentrations were high enough to also effect partial elution of the mercury already adsorbed on the column. The net effect was that the resin had to be replaced more frequently than anticipated.

The temporary shut down of the IEF was caused by slow settling solids composed mainly of iron which apparently adsorbed some of the mercury and allowed it to pass through the IEF untreated. The high level of iron in the waste water (2 to 3 ppm) was not typical of previous batches and most likely resulted from an IDMS process cooling water spill into the IDMS sump. The solids were presumed to be a result of post precipitation in the feed to the IEF since adequate time for precipitation prior to filtering was not available under normal operating conditions.