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August 26, 1993
ARCS I 93-337
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Ms. Gayle Garman
U. S. Environmental Protection Agency
Waste Management Division
JFK Federal Building (HPS-CAN 2)
Boston, MA 02203-2211

Subject: ARCS I - EPA CONTRACT NO. 68-W9-0034
WORK ASSIGNMENT NO. 12-1L43
NEW BEDFORD HARBOR - POST FS SUPPORT
WASTEWATER TREATMENT METALS EVALUATION

Dear Ms. Garman:

Attached please find a summary of the results of Ebasco's review of technical issues and potential costs associated with metals removal during treatment of wastewater resulting from future dredging and disposal of contaminated sediments at New Bedford Harbor.

If you have any questions, please contact me at (617) 451-1201.

Very truly yours,

Lewis Horzempa
Project Manager

LH/mec
Attachment

cc: D. King (letter only)
A. Fowler

FILE: ARCS PM 1.1

EBASCO SERVICES INCORPORATED
211 CONGRESS STREET • 8TH FLOOR • BOSTON, MA 02110-2410 • (617) 451-1201

4.1.15

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INTEROFFICE CORRESPONDENCE

ATTACHMENT A

DATE: August 27, 1993

DOC #: M93-310

TO: Lew Horzempa

FROM: Alan S. Fowler ASF

SUBJECT: ARCS I - EPA CONTRACT NO. 68-W9-0034
WORK ASSIGNMENT NO. 012-1L43
NEW BEDFORD HARBOR RI/FS
ION EXCHANGE AS AN EFFLUENT POLISHING STEP

As a follow-up to our meetings with EPA, I have conducted a brief evaluation of ion exchange as a potential polishing step to facilitate compliance with the Ambient Water Quality Criteria (AWQC) for copper prior to discharge. The findings of this evaluation are summarized in this memorandum and include a brief description of the ion exchange process and its applications and limitations. A brief description of a conceptual ion exchange system for the New Bedford application is also included along with the potential steps that would be required to fully evaluate the efficacy and economics of this process in meeting the AWQC.

Ion Exchange Overview

Ion exchange is a process of exchanging certain anions and cations that are electrostatically attached to a solid resin material for dissolved metal ions of similar charge in an aqueous solution or waste stream. The exchange occurs because the divalent and trivalent metal anions or cations in solution have an increased affinity for the charged sites on the surface of the resins. These resins are originally coated with weakly held monovalent anions or cations such as chloride, hydroxyl, sodium, or hydrogen ions. The exchange process is reversible, which allows for resin regeneration. The ion exchange process was originally developed to reduce hardness in domestic water supplies, but has recently been used to treat wastewaters.

Currently, the majority of ion exchange resins are constructed of synthetic organic materials. The resins are able to withstand a wide range of temperatures and pH and are capable of specific selectivity if the specific ions have a high exchange capacity. Both dissolved anions and cations can be removed from solution by

placing a cation exchange column and anion exchange column in series. Such a system has the capability to remove a wide range of inorganic and some organic dissolved contaminants, depending on the resins selected for use.

Wastes that are suited to ion exchange include:

- many metallic anions and cations such as $Cr_2O_7^{-2}$, SeO_4^{-2}, AsO_4^{-2}, Ni^{+2}, Cd^{+2}, Cu^{+2}, or Hg^{+2}
- inorganic anions such as halides, sulfates, and cyanides

The upper concentration limits for a waste stream to which ion exchange may be applied are 2,500 mg/l for dissolved ions and 50 mg/l for suspended solids. Higher concentration levels of dissolved ions will result in rapid resin exhaustion accompanied by excessive regeneration costs. High suspended solids concentrations in a waste stream will cause resin columns to clog or plug. The presence of oxidants in the waste stream should also be avoided. A concentrated backwash stream results from resin regeneration. The backwash stream will typically require treatment depending on the characteristics of the exchanged wastes and regenerants, such as acid, caustic, or brine.

Application to New Bedford Harbor

EPA's Proposed Plan for the New Bedford Harbor site includes hydraulic dredging with disposal of the PCB contaminated sediments in Confined Disposal Facilities (CDFs) constructed along the shoreline. Following construction of the CDFs, the contaminated sediment will be dredged and pumped as a dilute slurry into the CDFs where the sediment will settle out. The supernatant (wastewater) resulting from this process will undergo several treatment steps prior to discharge.

Some of the surface water data collected at the site suggests the total copper concentrations (dissolved plus particulate) exceed the AWQC at some locations. As such, the water treatment processes may have to try to attain the AWQC for copper prior to discharge (i.e., no dilution allowed). EPA's current estimate of effluent quality for copper without ion exchange is 7 parts per billion (ppb). If attainment of the AWQC for copper is considered a wastewater discharge goal, then the ion exchange process would be required to attempt to achieve the stringent AWQC for copper of 2.9 ppb.

Based on an estimated volume of 1,000,000 gallons per day (1 MGD) of dredge material slurry, the ion exchange process would reduce the copper inputs to the Acushnet River Estuary from the Superfund cleanup activities. The magnitude of this reduction is approximately 0.04 lbs. per day (0.06 lbs. per day to 0.02 lbs. per day). Both of these daily inputs are somewhat diminimus when viewed in light of the impacts of current and past copper loading to the Estuary and Lower Harbor from local point and non-point sources. Based on an average water depth of 3 feet for the approximately 160 acres of the Estuary below the low water line, and an assumed average copper concentration of 1.5 ppb, the current and past loadings suggest that approximately 2 lbs. of copper may be in the surface waters of the Estuary at all times.

The addition of ion exchange to facilitate compliance with the AWQC for copper would be conducted as a polishing step during wastewater treatment at New Bedford Harbor. The polishing step would be completed following the initial inorganic removal steps of coagulation, flocculation, precipitation and filtration; and, the treatment of the organics through UV-oxidation and/or carbon absorption. However, the high sodium concentrations in the wastewater effluent, which would be influent to this polishing step, may increase the difficulty of reducing copper concentrations to 2.9 ppb through ion exchange.

There are three ion exchange resins that could be considered for this application: a strong acid exchanger (Amberlite IR-120); a weak acid exchanger (Amberlite DP-1); and, a chelating weak acid exchanger (Amberlite IRC-718). Each of these resins has different properties and costs. However, given the combined factors of the low effluent goal for copper and exchange competition due to sodium, the chelating weak acid exchanger has the highest probability of success.

The net present worth costs for adding the ion exchange step to the current conceptual wastewater treatment system is on the order of $10 million. This includes the direct and indirect capital costs to construct and operate the process for the approximately 1700 work-days spread over a six and a half year period. Additional assumptions used to develop this estimate include a chelating weak acid exchange resin and a flow rate of 1 MGD.

From a technical perspective, the next step in evaluating the effectiveness of ion exchange in reducing copper concentrations to meet the AWQC prior to discharge is through bench and pilot scale studies. While bench scale studies are often sufficient for scaling up routine applications, the uncertainties surrounding the ultimate effectiveness and cost of this treatment process warrant a pilot scale test. The pilot test should be used in conjunction

with the water treatment facility that will be constructed to support the Hot Spot cleanup. This will also assist in evaluating whether treatment residuals associated with the UV-oxidation process will impact the effectiveness of the ion exchange process.

ASF/mec

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