IMPROVED WASTE WATER POLISHING IN THE NORTH ANNA CLARIFIER USING DURASIL™ ION EXCHANGE MEDIA

Mr. M.C. Hensley
Liquid Radwaste Coordinator
North Anna Power Station
Virginia Power Company

Dr. Herbert G. Sutter
Technical Director
Duratek Corporation
Greenbelt, Maryland

ABSTRACT

On December 26, 1985, forty-one cubic feet of ion exchange media provided by Duratek was loaded into the North Anna clarifier demineralizer. As of the writing of this manuscript (February 6, 1986), processing using this single loading has continued for 42 straight days without breakthrough. To date, some 5.89 million gallons have been processed at an average flow rate of 140,200 gal/day. Throughputs are 143,700 gal/cu.ft. and still climbing. These figures represent improvements of a factor 20 over the run times experienced with organic resins immediately prior to the introduction of the new materials. This paper decribes the testing program of Durasil™ ion exchange media carried out at North Anna by Duratek which lead to this dramatic improvement in performance.

INTRODUCTION

The North Anna clarifier station is the final processing station for radwaste water before it leaves the site. Four streams are combined prior to processing: steam generator blow down; laundry water; radwaste processing effluent; and mats sump[a] water. The average total flow through the clarifier based on the first 6 months of 1985 is about 158,400 gallons per day (4,752,000 gal/mo) or 57,000,000 gallons per year. The water is processed through 40 cubic foot demineralizers prior to release. Process rates through the beds are 180-250 gallons per minute. Two demineralizers are available for use. Generally, one is in service at any given time, but both can be brought into service simultaneously, either in parallel to handle high flows or in series to handle hard-to-clean water. Prior to late December 1985, mixed bed organic resins were being used for the processing.

The water, as it enters the clarifier demineralizers, is generally of low specific conductivity (<10 umho), neutral in pH (approx. 7.0), low in boron (<10 ppm) and other dissolved species (<1 ppm for Na, Cl and SiO_2). The isotopes of Cs (134, 137) and I (131, 132, 133, 135) are usually present in concentrations of E-5 and E-6 uCi/ml. The removal of these isotopes is the major concern during clarifier processing. The mixed bed organics generally break through on Cs first and are removed from services when they begin to elute Cs.

An average throughput of 770,000 gallons per 40 cubic foot charge was achieved in early 1985. This throughput was high for organic resins by normal radwaste water standards. Nonetheless, the high flows result in frequent changeouts (4.9 days on average), large volumes of media (2960 cubic feet projected for 1985), and high costs. By the end of 1985, throughputs had dropped to 300,000-500,000 gal/charge necessitating changeouts every 2-3 days and resulting in even higher volumes and costs.

On December 26, 1985, forty-one cubic feet of ion exchange media provided by Duratek was loaded into the North Anna clarifier demineralizer. As of the writing of this manuscript (February 6, 1986), processing using this single loading has continued for 42 straight days without breakthrough. To date, some 5.89 million gallons has been processed at an average flow rate of 140,200 gal/day. Throughputs are 143,700 gal/cu.ft. and still climbing. These figures represent improvements of a factor 20 over the run times experienced with organic resins immediately prior to the introduction of the new materials, resulting in substantial savings of time, waste volume and money at North Anna.

This paper describes the testing program of Durasil™ ion exchange media carried out at North Anna by Duratek which resulted in this dramatic improvement in performance.

THE DURATEK TEST PROGRAM

In June 1985 the Duratek Corporation began a program of testing its Durasil™ ion exchange media at North Anna. A small test stand was connected to a sample point immediately before the clarifier demineralizers. A schematic of the test system is given in Fig. 1. The stainless steel system consists of two columns, a flow meter and totalizer, pressure gauges, a throttle valve to regulate flow and sample points before and after each column. The columns are 3 inches in diameter and have a l/d ratio of 1.7 when

[a] The mat sumps prevent ground water incursion into the containment building.

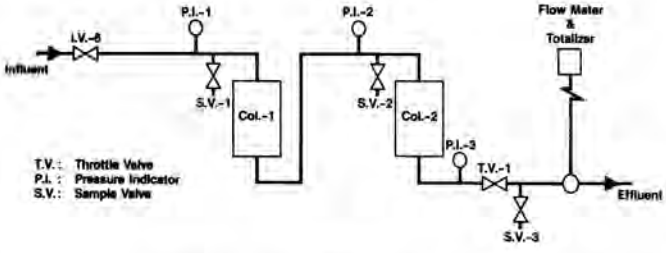

Fig. 1. Test Skid Schematic

filled with 600 ml of media. Flow was regulated to the equivalent of the 150-250 gallons per minute flow through the clarifier demineralizers. A number of Durasil™ media were tested during the program. These media are designed to be highly selective in removing radionuclides in the presence of non-radioactive species. Those tested at North Anna were designed specifically to remove I and Cs. A brief listing of the materials tested and their properties is given in Table I.

TABLE I

DURASIL™ MEDIA TESTED AT NORTH ANNA

DURASIL	ION REMOVED	BASE MATERIAL	PARTICLE SIZE
190	Cs	Glass	20-60 mesh
230	Cs	Inorganic Oxide	20-50 mesh
60	I	Carbon	50-200 mesh
260	I	Carbon	50-200 mesh

The initial test started on June 7, 1985, and used Durasil™ 60 media in Column 1 and Durasil™ 190 media in Column 2. On June 18, the initial charge of Durasil™ 190 was replaced with a second charge of the same material. On July 3 both columns were recharged, the first with Durasil™ 260 media and the second with Durasil™ 230 media. This final charge was run until August 23 when tests were terminated.

RESULTS

The results of the testing are summarized in Table II. Figures for organics in use in the clarifier are included in the table for comparison. The first two lines for organics are taken from beds in service during the test program. The third line is based on the yearly figures given in the introduction which were supplied by plant personnel. The bed volumes and gallons per cubic foot are given for the individual type of resin (cation or anion for the organics). Bed Vol. = gals process/ gals media used.

TABLE II

TEST RESULTS

MEDIA	BED VOLUME	GAL/CU.FT.
Organic	4,360	32,700
Organic	4,752	35,640
Organic	5,135	38,515
Durasil 60 (I)	24,249	181,870
Durasil 260 (I)	45,900	344,295
Durasil 190* (Cs)	7,000	52,500 [a]
Durasil 190** (Cs)	8,100	60,900 [b]
Durasil 230 (Cs)	47,788	358,400

a. First Test

b. Second Test

The following conclusions can be gleaned from Table II:

1. All Durasil™ media outperformed the organics.

2. The Durasil™ 230 and 260 media gave exceptional throughputs. This combination offers lifetimes almost 10 times those of the organics. The overwhelming superiority of this combination in the clarifier is illustrated in Table III which compares the average figures for organics based on the yearly data with the Durasil™ 230 and 260 values.

TABLE III

DURASIL™ MEDIA VS. ORGANICS

Media	Gal/Bed [a]	Days/Bed [b]	Cu.Ft./Yr. [c]
Organic	770,330	4.9	2,960
Durasil (230 + 260)	7,024,300	44.3	325

a. 40 cu.ft.
b. 158,400 gal/day
c. Based on 57 million gallons/year

The Durasil™ media clearly offers an increase of almost a factor 10 in throughput and a corresponding decrease in burial volume.

It must also be noted that media optimization is not complete. It is expected that some additional improvement in the Durasil™ media figures will occur.