



Electrodialysis - Ion Exchange for the Separation of Dissolved Salts



Developer: WASTREN, Inc.
Contract Number: DE-AR21-95MC32112
Crosscutting Area: ESP



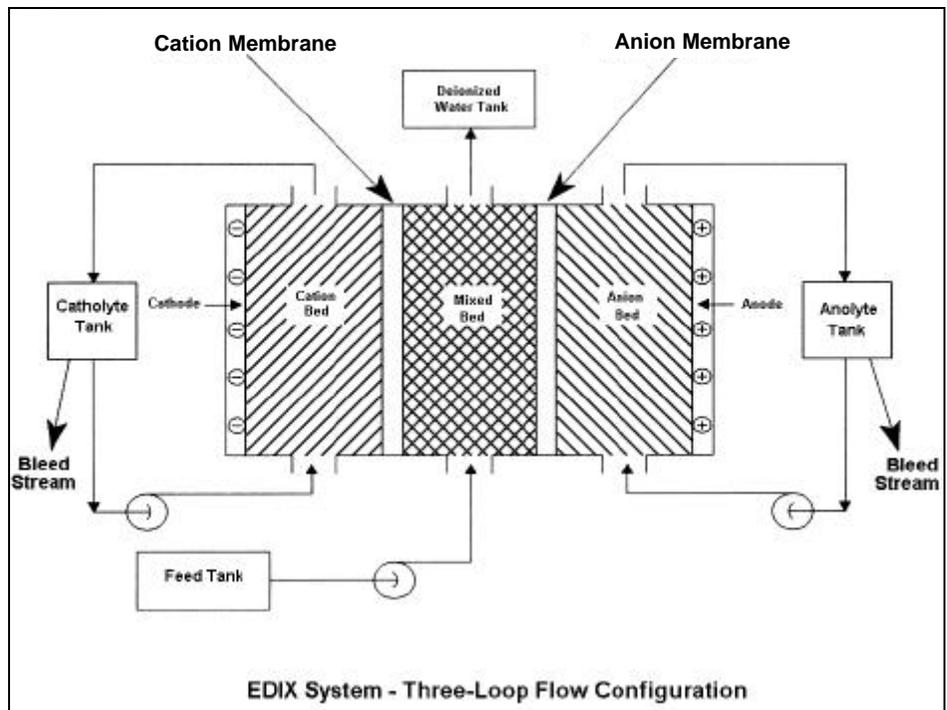
Problem:

Government and industry generate large volumes and varieties of aqueous waste streams that must be treated before being discharged to the environment. Because they are waste streams, government and industry are continuing to look for simple and inexpensive means of treating the streams. Some of the streams contain hazardous and/or radioactive materials and the concentration of these constituents must be reduced to very low levels before the stream can be discharged to the environment.

Many processes are available for treating the large variety of waste streams. Some of the processes are expensive, complicated, and produce large volumes of wastes that need additional treatment. The ideal process would be simple, yield high-quality water, generate low volumes of wastes, and be inexpensive. Developing such a process is highly desirable, especially for the wastes containing radioactive materials.

Solution:

One possible method of solving the problem is the electrodialysis-ion-exchange (EDIX) process. The



process combines operation electrodialysis and ion exchange in one-step. The process will yield a high-quality aqueous product stream and two small side streams; one containing the anions and the other containing the cations that were in the feed stream. This process should be simple and should yield very small waste streams that need further processing.

Benefits:

►EDIX should be capable of processing in one step a variety of aqueous streams, even those

containing high levels of dissolved salts

►EDIX is a simple one-step operation that can yield a high-purity product stream and two very small secondary streams that contain the hazardous or radioactive anions and cations

►Under certain conditions, the secondary streams may yield a usable product rather than a waste

►The technology is a combination of proven and commercially available systems, and thus, once the



operating parameters are established, no major development is required

►The capital cost for the system should be similar to that of an electro dialysis system. However, the product quality should be higher at an operating cost that is less than a two-step electro dialysis and ion-exchange system

Technology:

This project included integration of electro dialysis and ion exchange into one simple process that should be suitable for treating a variety of aqueous waste streams. The technology involves placing ion-exchange resins in the channels of the electro dialysis cell. By proper selection of the resins and membranes, and by effective operation of the unit, it should be possible to produce water that meets drinking water standards, a small stream containing the anions as acids, and a small stream containing the cations as hydroxides. Depending on the composition of the feed stream, it should be possible to utilize the anion and cation streams rather than to consider them as wastes.

Project Conclusion:

EDIX has been successfully demonstrated on a laboratory scale using a solution containing sodium nitrate and nitric acid for Rocky Flats. This contract was to determine whether EDIX might be suitable for treating waste water containing low levels of radioactivity, acids, heavy metals, dissolved salts, and soluble organics and, if successful, to design a 30

gpm system and determine the overall economics of the process.

A series of 37 bench scale tests were run to select the most suitable resins and membranes and to establish the conditions necessary to produce a product stream of the desired quality when starting with feed solutions containing 20 - 200 ppm sodium ion, 30 - 3000 ppm nitrate ion, 20 - 200 ppm hexavalent and/or trivalent chromium ion. The combination of hexavalent chromium (as chromate ion) and nitric acid destroyed the anion membranes and the trivalent chromium hydroxide precipitated in both the feed and catholyte compartments when testing a feed solution containing trivalent chromium nitrate.

Although some useful data was obtained, the principal objectives of the program were not met and the program was terminated in November 1996.

Contacts:

WASTREN, Inc., is an engineering and consulting company specializing in radioactive and hazardous waste management. It is a recognized leader in radioactive waste management, safety and health, quality assurance, mixed waste characterization, and packaging and transportation. Most of these activities are performed for the Department of Energy (DOE). WASTREN Remediation, Inc., is a wholly-owned subsidiary that provides remediation services for the federal government and private industry.

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