Argonne NATIONAL LABORATORY

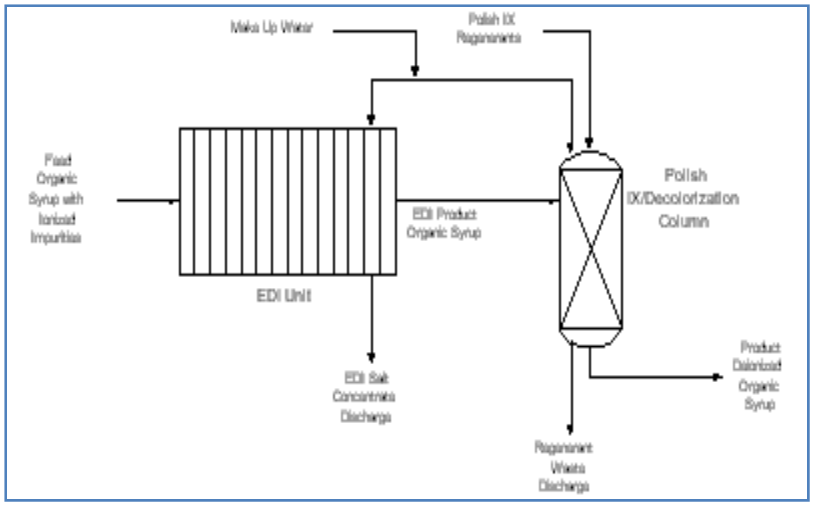
Energy Systems Division

Advanced Electrodeionization Technology for Product Purification, Waste Recovery, and Water Recycling

Laboratory-Scale EDI Module

The chemical industry has a need to purify non-ionized organics, such as dextrose, fructose, and sucrose from ionized impurities. These impurities originate as feedstock contaminants or as reaction catalysts/pH adjustment components. With existing technologies, such as ion exchange, product purification cannot be done efficiently. Large quantities of chemicals are consumed for resin regeneration and significant chemical and resin waste is generated.

Electrodeionization (EDI) is a separation process combining ion exchange and electrodialysis; the resulting hybrid process does not require regenerant chemicals.



Schematic of EDI Process for Organic Syrup

This technology has been commercialized for removal of ionic species in high-purity water applications but has not been used in chemical processes because of unacceptable leakage rates and product loss. Also, these commercial EDI modules are not readily serviceable. If these limitations can be overcome, EDI will be a promising technology for product purification and water recycling because it reduces or eliminates chemical usage and waste disposal and can greatly reduce energy consumption.

Argonne National Laboratory is working with several industrial partners -- EDSEP, Purolite, and a major corn wet miller -- to develop a new EDI technology that will enable the chemical industry to purify non-

ionized organics. A novel design has been developed and tested that fits the performance criteria required to apply the technology to chemical process streams. A device patent has been filed.

The objectives of the work were to:

- Develop an efficient and economical EDI-based, integrated process at the laboratory scale.
- Build a pilot prototype to demonstrate the process feasibility, with actual process streams.
- Demonstrate the process performance at a corn milling site.
- Transfer the technology to the chemical industry.

Major technical issues for this process included the development and mechanical design of the immobilized ion exchange resin for the pilot-scale prototype. In addition to technical feasibility, process economics are crucial to determine the viability of the proposed process. Currently, research efforts include the following:

- Process parameter optimization with industrial process samples at the laboratory scale.
- Module design for the pilot-scale prototype.
- Site preparation for the selected prototype assembly and test runs at Argonne before process demonstration at the milling site.

The feasibility of using EDI for product purification has been successfully demonstrated in initial laboratory-scale experiments using these effluent samples. Test results indicate over 85% deionization of organic syrups with minimal product loss. With the use of the immobilized ion exchange materials and the cleaning-in-place protocols, the EDI process performance meets technical and economic targets.