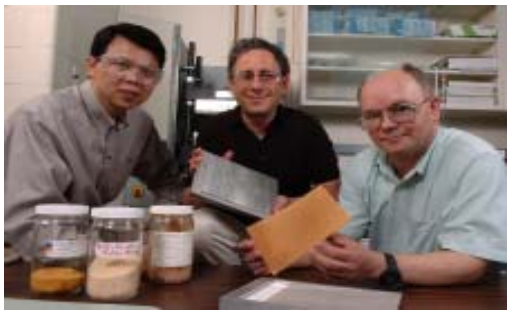
Argonne NATIONAL LABORATORY

Office of Technology Transfer

Maximizing the Potential of Electrodeionization Reducing the Costs of Biobased Products: The SEPARATIVE BIOREACTOR



The U.S. could make a large dent in oil imports by using biobased products to replace petrochemicals. With the high costs of oil, the main barrier is to reduce manufacturing costs. Argonne is developing technologies that could reduce the costs of manufacturing biobased products by a factor of two. Argonne's technology is based on a separative process called electrodeionization (EDI). EDI is an electrically-driven process normally associated with the production of ultrapure water for the pharmaceutical and semiconductor industries, due to its effectiveness in removing salts and other impurities from dilute aqueous streams. The process is usually carried out in a flow-through system, often termed the EDI "stack." In these stacks, ion-exchange resins (formed of beads, like fine sand) are sandwiched between special membranes that enable the removal of charged particles via the applied electric current. To improve efficiency, Argonne researchers set out to solve several problems that limit EDI's applicability. Argonne developed a series of flexible resin wafers that can be manufactured with specific dimensions, chemical composition, porosity, and conductivity. This development has allowed the Argonne researchers to combine the effectiveness of EDI contaminant removal with reactive steps such as enzymatic reactions, fermentations, and chemical reactions. For example, the **Separative Bioreactor** can be used to ferment, separate, and concentrate organic acids directly, without the need for acid neutralization. Coupled with a bacterial strain producing a valuable product, the new EDI stack provides a one-step process for product production and capture. The product is captured continuously during the fermentation of enzymatic reaction. This is particularly important if the product inhibits the biocatalyst. In another example, the technology was used to further react the organic acid with ethanol to produce an even more valuable ester in a single reaction unit. The fact that this technology allows both the continuous bio-production and collection of the desired product has earned the technology its unique name, the **Separative Bioreactor.**

Michael P. Henry removes a new resin wafer from the fabrication

Patents and Published Patent Applications

US 6797140 Electrodeionization method
US 6495014 Electrodeionization substrate, and device for electrodeionization treatment
US Patent Application Publication Number
US 2004/0060875 Immobilized Biocatalytic Enzymes in Electrodeionization

US 2005/6547A1 Single stage separation and esterification of cation salt carboxylates using electrodeionization
US 2006/0065540 Retention of counterions in the separative bioreactor

US Patent Applicaton Publication Number
PCT Patent Application Publication Number
US 2006/0063849
WO 2006/033954 Electronically and ionically conductive porous material and method for manufacture of resin wafers therefrom
US 2006/0062988
WO 2006031953 Devices using resin wafers and applications thereof

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For More Information

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