Argonne NATIONAL LABORATORY

Office of Technology Transfer

Membrane-Based Separative Bioreactor Integrates Bioconversion and Downstream Processing

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Argonne researchers have developed a novel membrane-based separative bioreactor that has the ability to directly capture high-purity products from pH controlled fermentations without the need for neutralization. This technology can play an important role because as the fermentation progresses, the accumulation of acid lowers the pH until the organism stops producing additional acid. Currently, a base is added during the fermentation to neutralize the acid by converting it to a salt. The salt must then be converted back into the organic acid by reacting with another acid. Removing this neutralization and re-conversion step eliminates the cost of the acid and base used in the process, and the disposal of waste gypsum. Argonne's bioreactor uses electrical force to transport organic acids away from the biocatalyst across an ion exchange membrane and into a concentrate chamber, very similar to normal metabolism processes for handling acids. Although direct enzyme immobilization on membranes provided excellent product separations, insufficient enzyme density limited the overall performance. In order to increase the density, the scientists integrated Electrodeionization (EDI) into the process to produce electrically-driven desalination. The EDI technology molded loose ion exchange resin beads and enzyme capture resin beads into a resin wafer. Sugars were converted by the immobilized biocatalyst to the target acids, and the product was electrically transported into a concentrate channel. This resulted in reactions occurring without buffering or neutralization. Argonne's initial analysis indicates that its separative bioreactor will dramatically reduce the cost of producing chemicals by bioconversion.

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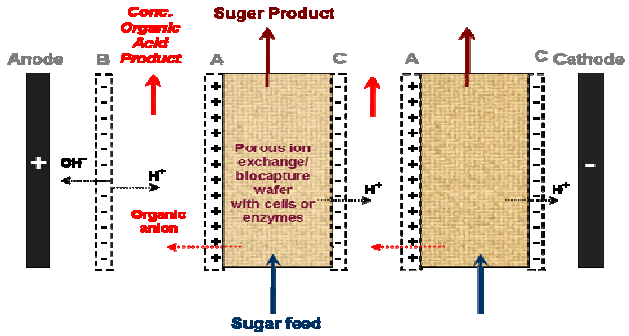

Electrodeionization (EDI) stack: Two cell pairs shown. Commercial: Up to 100 cell pairs with square-meter membranes.

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