Reverse Electro-Enhanced Dialysis for lactate recovery from a fermentation broth

A model based investigation is performed on the potential lactate recovery under current reversal conditions in a dialytic module. This technology has been referred to as the Reverse Electro-Enhanced Dialysis (REED). A description of the process, operation modes and antifouling mechanism is presented. A previously developed first principle dynamic model is employed to perform simulations. The model can describe simultaneous transport of ions through anion exchange membranes and Nernst diffusion layers in a section of the REED module. The approach leads to a system of multiregion partial differential equations that are solved numerically. The ion fluxes are studied predicting preferable ion transport at the interfaces, transient flux inversion and accumulation/depletion of ions within the membranes. These phenomena can explain the moderate loss of current efficiency during current reversal operation, which has been experimentally demonstrated. The average lactate productivity is estimated as a function of the reversal time. Experimental data are used to regress a simple electrical potential build up model and calculate the module energy consumption. This value is compared to a similar experimental setup. The trade off between the current efficiency loss and energy consumption is identified, which defines an optimal reversal time. Potentially, the model can be applied to optimize the design and the operation of the REED module for different production scenarios.