Enzyme immobilization by fouling in ultrafiltration membranes: Impact of membrane configuration and type on flux behavior and biocatalytic conversion efficacy

Enzyme immobilization in membranes accomplished by fostering membrane fouling was evaluated. Four different membrane configurations and five membranes were compared for immobilization of alcohol dehydrogenase (ADH) in terms of enzyme loading, permeate flux and final biocatalytic conversion. The membrane configuration impacted the efficiency of the enzyme-immobilization as well as the biocatalytic-membrane reaction, and the "sandwich mode", with an extra polypropylene support above the membrane skin layer, worked best due to its high flux and stable conversion. Among the membranes, a GR51PP polysulphone membrane allowed for the highest flux during the reaction with the enzyme-immobilized membrane. At the same time, the lowest enzyme loading and low reaction stability were achieved for this membrane. Satisfactory enzyme loadings, stable conversions, but low flux rates were obtained for the PLTK and PLGC regenerated cellulose membranes. With these two highly hydrophilic membranes, the ADH enzyme activity was fully retained even after 24h of storage of the membrane. Filtration blocking and resistance models were used to analyze the fouling/immobilization mechanisms and give explanations for the different results. The work confirms that fouling-induced enzyme immobilization is a promising option for enhancing biocatalytic productivity, and highlights the significance of the membrane type and configuration for optimal performance.