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BIOCATALYTIC PRODUCTIVITY OF ALCOHOL DEHYDROGENASE (ADH) IN MEMBRANE BIOREACTOR: EFFECT OF pH

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ABSTRACT

The present study is to evaluate the effect of pH value on enzyme loading rate in membrane and to examine the effect of pH on permeate flux, observed rejection, filtration resistances and fouling mechanisms. Immobilization enzymes are necessary for increasing the biocatalytic efficiency. The main beneficial of immobilization of enzymes are enhancing productivity and enabling re-usability of enzymes which can be able by using enzyme membrane reactor. However, fouling is the main issues on membrane reactors and compromise the performance of the membrane in terms of separation efficiency and permeate flux. The fouling mechanisms are pore blocking, surface adsorption, cake formation and biological fouling. The membrane fouling and enzyme immobilization have sharing a number of similarities. So that, it can conclude deliberate promotion of fouling might be used as strategy for enzymes immobilization. In present study, pH values of 5.7, 7 and 8 are adjusting in order to evaluate effect of parameter (pH) in to the enzyme immobilization by using dead-end filtration. Besides that, mass balance was used in order to calculate the immobilization enzyme on the membrane surface. The concentration of ADH and NADH are measured by using spectrophotometer at absorbance 280 nm and 340 nm respectively. Then, the results were shows at low pH during immobilization the enzyme was liable to accumulate on the membrane surface due to the electrostatic adsorption and reduced the stability on enzyme. While when the solution of enzyme at high pH value (away from IEP) during immobilization, the membrane and enzyme was negatively charged and lead to much lesser accumulation on the membrane surface due to the strongest of electrostatic repulsion. Therefore, it will induce to lower fouling on the membrane. At the neutral pH (near IEP), the hydrogen bonding between enzyme and membrane was stabilized and might be lead to maintain the enzyme activity.

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CHAPTER 1

INTRODUCTION

1.1 Background/Overview

Enzymatic bio-catalysis is evaluated as green technology. Immobilization enzymes are necessary for increasing the bio-catalytic efficiency. Enzyme immobilization on membranes is beneficial where the compound can be separate by accomplished co-currently with the bio-catalytic reactions on the membrane reactors (Luo, Meyer, Mateiu, et al., 2014). Enzyme immobilization is an essential for many uses of the enzymes especially on industrial biocatalyst because the main purpose of the immobilization is to assist reusability of enzyme. Enzyme immobilization on membranes can be accomplished via adsorption, covalent bonding, cross-linking or entrapment (Luo, Meyer, Mateiu, et al., 2014). Enzymes are retained on membrane and separated from product solution by using enzymatic membrane reactor (EMR) (Luo, Meyer, et al., 2013). Furthermore, it has been reported that in some cases enzyme immobilization resulting of increase the stability of enzyme and activity (Sueb et al., 2017). Generally, the total of immobilized protein can be determined by using mass balance between the initial solution (feed) and the solutions after immobilization process which is either retentate or permeate (Mazzuca et al., 2006).

However, the membrane fouling commonly, compromise the performance of the membrane (Cabrera-padilla et al., 2009) in terms of efficiency the separation and permeate flux (Luo, Marpani, et al., 2014). The main type fouling membranes are physical adsorption, pore blocking of membrane, gel/cake formation and biofouling (Luo, Meyer, et al., 2013). which are caused by complex of interactions between membranes and foulants such as adsorption of hydrophobic and particle deposition/aggregation (Luo, Marpani, et al., 2014). Fouling is the major issues on membrane reactors as fouling result in dramatic permeate flux decline and changes in the selectivity of membrane (Sueb et al., 2017). To avoid fouling formation, the several parameters need to control such as adjusting pH and increase the shear rate on membrane.