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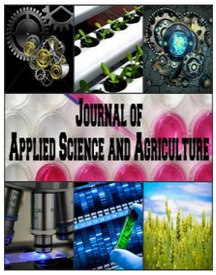

Resistance in Series Model for Ultrafiltration Xylose Reductase from Product Mixtures

B. Noor Suzana and A.M. Mimi Sakinah

Faculty of Chemical Engineering and Natural Resources, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan Pahang, Malaysia

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ABSTRACT

This study investigates the fouling mechanism in ultrafiltration membrane during separation of xylose reductase from product mixtures. The Resistance – In – Series Model was used in order to identify the responsible hydraulic resistance. The resistance against the flux was assumed to be comprised as membrane hydraulic, adsorption, pore pugging and fouling resistance. The profile of total resistance and corresponding flux decline were calculated and compared with the experimental data. The result showed that adsorption resistance (Rad) was the main contributed the rate of flux decline. Moreover the significant organic fouling that contribute during xylose reductase separation revealed that the fouling potential was Rad > Rpp > RF. The measure flux recovery of filtration xylose reductase was 93%.

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INTRODUCTION

Xylose reductase (XR) is an intracellular enzyme commonly found in yeast and filamentous fungi, often in several isozyme forms in the same species. This enzyme occurs in the cytoplasm of microorganisms, where it catalyzes the first step of D- xylose metabolism by reducing xylose to xylitol with the concomitant oxidation of NAD (P) H to NAD (P) + (Ronzon *et al*., 2012 and Zhao *et al*., 2009). The obtainment of the enzyme xylose reductase is an essential step in the development of the enzymatic process. This enzyme present in different species of yeasts and is responsible for the process of oxidation of xylose into xylitol by these microorganisms (Yokoyama *et al*., 1995). This enzyme has the potential applications in the biotechnological production of xylitol, sorbitol, and ethanol from xylose, which make the enzyme a focus of interest. The applications of enzyme have demanded an efficient and large scale enzyme separation technique.

Membrane technology has been applied in biotechnology industries since last two decades. It is gradually emerging as a powerful bioseparation process for purification, fractionation, separation and concentration of bioproducts such as therapeutic drugs, enzymes, hormones, antibodies, fruit juice and cheese. Ultrafiltration (UF) is a powerful separation technique based on the sieving mechanism of retentive or partly permeable membranes. UF is widely used in biotechnology for the concentration of macromolecules, e.g. enzymes in aqueous solutions. Therefore, in this study, ultrafiltration membrane can be alternative method used in order to separate XR from the product mixtures (Choi *et al*., 2005). Despite the fact that there are numerous points of interest offered by membrane, the application of membrane technology is still limited. This is due to the fouling problem which reduces the membrane performance. In addition, membrane fouling reduces the production rate and increases complexity of membrane operations. Different models were proposed to investigate and foresee the flux behavior during filtration of macromolecular solution. This can be classified as osmotic pressure controller, gel layer controlled and resistance – in- series models (Rai *et al*., 2006).

The reason that membrane process is not utilized on much large scale is the flux decline during the separation process (Sakinah *et al*., 2009). Flux decline cause the several phenomena in, on and near the membrane (Derradji *et al*., 2005). The flux decline during separation by UF is the cumulative effect of several mechanisms which is adsorption of solutes on the membrane surface, pore plugging (Sakinah *et al*., 2007) and concentration polarization (Ko and Pellegrino, 1998). Adsorption of membrane

Corresponding Author: B. Noor Suzana, Faculty of Chemical Engineering and Natural Resources, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan Pahang, Malaysia