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Enzymatic hollow fiber membrane bioreactor for penicilin hydrolysis

I.G. Wenten*, I.N. Widiasa

Department of Chemical Engineering, Institut Teknologi Bandung, Jalan Ganesha 10 Bandung, Indonesia, 40132
email: igw@che.itb.ac.id

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Abstract

Continuous enzymatic reaction has been proven as an efficient technique for several industrial applications. In this study, a type of hollow fiber membrane bioreactor where penicillin acylase entrapped within membrane pores was applied to continuously hydrolyze Penicillin G. The influences of various operating conditions on immobilization and enzymatic reaction processes were assessed. A mathematical model of the reactor behaviour at steady state condition was also developed. The immobilization results show that penicillin acylase was entrapped more than 90% (100,000 u.a m^{-2}). Due to the much smaller size of 6-APA compared to the membrane pore, the solute diffuses freely through the membrane. However, the immobilized enzyme membrane retained around 35% of the solute. In addition, K_m of immobilized penicillin acylase (8.04 mM) was slightly higher than that of free penicillin acylase (7.75 mM). The theoretical results indicated that convective transport was the main mechanism of mass transport even in the case where flux was very low. Low flux rate is important to avoid gel formation or enzyme release from membrane pores and to maximize the degree of conversion.

Keywords: Hollow fiber membrane bioreactor; Penicillin hydrolysis; Penicillin acylase

1. Introduction

In most enzymatic reactions, batch or continuous, the recycle of enzyme in a reactor system is important to reduce production cost. Enzyme membrane reactor, in which an enzyme reactor coupled to ultrafiltration or dialysis membrane with a suitable molecular weight cut-off, is capable to keep enzyme and other larger components, while low-molecular-weight-molecules, e.g. products and/or inhibitor, are allowed to pass freely through the membrane. This reactor has been used in wide range of applications, i.e. saccharification of

*Corresponding author.

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