ISSN: 0128-7680
Pertanika J. Sci. & Technol. **17 (2)**: 399 – 408 (2009)

Production of Ethanol by Fed-Batch Fermentation

Ngoh Gek Cheng[1*], Masitah Hasan[1], Andri Chahyo Kumoro[2], Chew Fui Ling[1] and Margaret Tham[1]

[1]Department of Chemical Engineering, University of Malaya, 50603, Kuala Lumpur, Malaysia

[2]Separation Engineering Research Group, Department of Chemical Engineering, Faculty of Engineering, Diponegoro University, Prof. H. Sudharto, SH Road, Tembalang – Semarang, Indonesia

[*]E-mail: ngoh@um.edu.my

ABSTRACT

The production of ethanol, from glucose in batch and fed batch culture, was investigated. In the fed batch culture, the glucose feeding was added into the culture at 16th hour of fermentation. The effects of different glucose concentration feeding rates on ethanol fermentation were investigated for fed batch culture. The 2$gL^{-1}hr^{-1}$ glucose concentration feeding rate was found to give higher ethanol yield (2.47 g ethanol g $glucose^{-1}$), with respect to substrate consumed as compared to 8 $gL^{-1}hr^{-1}$ (0.23 g ethanol g $glucose^{-1}$) and 4 $gL^{-1}hr^{-1}$ (0.20 g ethanol g $glucose^{-1}$). The ethanol yield with respect to substrate consumed obtained in batch culture was 0.81 g ethanol g $glucose^{-1}$. The fed batch culture at 2 $gL^{-1}hr^{-1}$ glucose concentration feeding rate was proven to be a better fermentation system than the batch culture. The specific growth rate, specific glucose consumption rate and specific ethanol production rate for the fed batch fermentation, at 2 $gL^{-1}hr^{-1}$ glucose concentration feeding rate, were 0.065 hr^{-1}, 1.20 hr^{-1} and 0.0009 hr^{-1}, respectively.

Keywords: Batch culture, ethanol, fed batch culture, fermentation, glucose feed rate, *Saccharomyces cerevisiae*

INTRODUCTION

Due to a rapid depletion of the world's petroleum reserves and its rising prices day by day, new sources of hydrocarbons must be found to supply chemical and energy needs (Sitton and Gaddy, 1980; Lee *et al*., 1983). In this context, ethanol fermentation offers promising alternative as it can be produced from various sources of raw materials. In view of increasing importance of ethanol, as an alternative source for chemicals and liquid fuel, a great deal of research interest in ethanol fermentation has been generated in the last two decades (Vega *et al*., 1987; Converti *et al*., 1985). Many different types of processes for ethanol fermentation have been proposed including batch fermentation, continuous fermentation, continuous fermentation with cell recycling, fed-batch and repeated-batch culture (Yoshida *et al.*, 1973). The fed-batch culture with the intermittent addition of glucose and without the removal of fermentation broth is one of the most common methods for the production of ethanol in the industry. One advantage of this process is the reduction of substrate inhibition. A high concentration of sugar in fermentation medium inhibits growth and ethanol production. Other advantages of this process are higher productivity, higher dissolved oxygen in the medium, decreased fermentation time and reduced toxic effects of the medium components, which are present at high concentrations (Stanbury and Whitaker, 1984).

Received: 28 February 2008
Accepted: 16 May 2008
[*]Corresponding Author