CHAPTER I

INTRODUCTION

Diminishing natural oil and gas resources is an important problem in the world. We can see that there are many researches to find other forms of energy to substitute them, such as solar energy and energy from biomass. Alternative energy such as alcohol from biomass will be the one of the interested source in the future especially for agricultural countries.

One of the oldest fermentation processes on an industrial scale is the production of acetone and butanol from raw materials containing starch or sugars. At present, the fermentation process is not yet competitive with the petrochemical process due to low productivity and expensive material used in the fermentation process. However, in the near future it will be possible to improve its economy.

Butanol and acetone are used not only as a chemical feed stock and reagent in many reactions, but also as a fuel on mixture with either petrol or diesel. It also has a potential use as a cosolvent in Methanol/Petrol mixture (1,2) to prevent phase separation at low temperature. The advantages of butanol over methanol (Table1.1) as a liquid fuel extender are its low vapor pressure and its low

miscibility with water. Especially butanol is completely miscible with diesel even at low temperature.

$C_4H_{10}O$ is a chemical formula of butanol that is a heavy alcohol. It is produced from both petrochemical process by Oxo process and fermentation process which are alternative energy sources. Problem of acetone-butanol fermentation process is low conversion (about 30%). Due to this reason, acetone-butanol fermentation process has to be developed.

Firstly, fermentation processes were batch processes with low productivity due to an end product inhibition effect and long fermentation time. However, solvent productivity can be increased by using a continuous fermentation. But problem of single-stage continuous fermentation is that specific growth rate depends on dilution rate. Because of a high dilution rate, cell was wash out. So that microfiltration was used. Microfiltration is used for two reason. First, it is used as a cell recycling unit in order to increase cell concentration in fermentor. Therefore, the dilution rate does not limit the specific growth rate. Second, it is used in a microfiltration system in order to separate solvent from fermentation broth to prevent butanol inhibition effect. Cell recycle system that does not control cell concentration will not be found solvent productivity at steady state. Because solvent productivity increases with cell concentration, and if the cell concentration is not constant, solvent productivity will not be the steady state value.

The objectives of this work :

1. To study effects of dilution rate and cell concentration on fermentation.

2. To find the maximum solvent productivity at steady state of acetone-butanol continuous fermentation process.

The scope of this work :

1. Find the optimum condition of acetone- butanol continuous fermentation.

2. Study effects of various parameters on solvent productivity as follows

   2.1 Dilution rates

   2.2 Cell concentrations

3. Comparing solvent productivity of the controlled biomass concentration in a continuous fermentation to those of the uncontrolled biomass concentration in continuous fermentation.

Table 1.1 Characteristics of Chemically Pure Fuels. (1)

Fuel	Molecular weight	Specific gravity	Boiling point (°C)	Vapor pressure at 37.7 °C (psi.)	Combustion energy ($kJ.kg^{-1}$)	Latent Heat ($kJ.kg^{-1}$)	Solubility (parts in 100 parts of H_2O)	Stoichiometric air-fuel ratio
Methanol	32	0.79	65	4.6	23,864.8	1170.0	∞	6.5
Ethanol	46	0.79	78	2.2	30,610.6	921.1	∞	9.0
Butanol	74	0.81	117	0.3	36,681.0	432.6	9	11.2
Octane	114	0.70	210	1.72	48,264.5	360.5	insoluble	15.2
Hexadecane	240	0.79	287	3.46	47,264.3	-	insoluble	15.0

*Data from Comprehensive Biotechnol, 3(1985):915-931