CHAPTER 1

INTRODUCTION

Butanol is used primarily in the manufacture of lacquers, rayon, detergents, brake fluids and amines for gasoline additives. It can also be used as a solvent for fats, waxes, resins, shellac and varnish. In addition to its use as an industrial chemical, butanol can also be used as a fuel in mixtures with either petrol or diesel. Furthermore, it has potential use as a cosolvent in Methanol/Petrol mixtures (1,2), to prevent phase separation at low temperature. Butanol has many characteristics which make it a better liquid fuel extender than ethanol. Three of the more important characteristics which make butanol a better liquid fuel extender are:

(a) its low vapor pressure,

(b) its low miscibility with water and

(c) butanol, unlike ethanol, is completely miscible with diesel fuel even at low temperatures (see Table 1.1)

There are two well-known processes to produce n-butanol, they are the fermentation process and the petrochemical process. With the advent of petrochemical processes and low cost petrochemical feedstocks, the fermentation based processes became economically unattractive. However, interest has been revived in recent years due to the uncertainly regarding the price and supply of oil and the better point that we can convert pentose sugars such as xylose and arabinose of wastes generated by agriculture and industry to acetone-butanol by fermentation. But the old fermentation processes were batch processes with low productivity and solvent concentration. In batch operation, end product inhibition limits end product concentration and

fermentation time is quite long (50-100% longer than for ethanolic fermentation). Volumetric productivety, however, can be increased if the fermenter is operated continuously. Higher productivities may be expected for continuous processes base on coupling with process of increasing the concentration of microorganisms in the fermenter, for instance by cell recycling. In this study, the continuous acetone-butanol fermentation was improved by coupling with an ultrafiltration system. The process consists of passing the fermentation liquor through an ultrafiltration (tubular membrane) to remove the suspended solids. The retentate concentrate of suspended solids composed mostly of vegetative organisms, is used as a cell recycle stream for the fermenter. From this operation, we can increase the concentration of cells in the fermenter, the productivity is therefore expected to be improved from this process.

The objectives of this work

The principal aim of the study was to improve productivity of acetone-butanol fermentation by application of ultrafiltration.

The scope of this work

1. Set up the experimental apparatus.

2. Study the characteristics of the ultrafiltration to find the optimum condition for application in cell recycling system.

3. Study the continuous acetone-butanol fermentation with cell recycling system by UF to find the optimum condition for producing solvent.

4. Compare the productivity from the cell recycle system with other processes.

Table 1.1 Characteristics of Chemically Pure Fuels (1)

Fuel	Molecular weight	Specific gravity	Boiling point (°C)	Vapor pressure at 37.7 °C (p.s.i)	Combustion energy (kj kg^{-1})	Latent Heat (kj kg^{-1})	solubility (parts in 100 parts H_2O)	Stoichiometric air-fuel ratio
Methanol	32	0.79	65	4.6	23,864.8	1170.0	$\propto$	6.5
Ethanol	46	0.79	78	2.2	30,610.6	921.1	$\propto$	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