CHAPTER 1

INTRODUCTION

1.1 Background

Microorganisms have historically been proven to be an exceptionally rich source of commercially useful chemicals, such as β–carotene from *Dunaliella*, Astaxanthin from *Haematococcus*. Since most of those chemicals are not naturally excreted into the environment but are accumulated within the cell, an equipment for taking those chemicals out of the cells is necessary. Although many methods have been applied for breaking cells in order to take useful substances out of the cells such as bead mill and homogenizer. These two methods are designed by using the principle of high mechanical shear for breaking down the micro organisms ranging from bacterial, fungal, yeast, algal and other eukaryotic cells. However, both of methods have some disadvantages on scaling-up and high investment cost, especially for homoginizer.

Three-phase fluidization is an operation using contact of gas, liquid, and solid particles. The solid particles are generally fluidized by upflow liquid, which is the continuous phase, accompanying with dispersed gas bubbles. Fluidization technology has been broadly investigated due to its versatile applications and merits of continuous operatability. Recently, three-phase fluidized beds have gained increasing attention in the area of biotechnology particularly in fermentations and wastewater treatment because they can provide favorable mixing and mass transfer. From previous research works, they have been found that three-phase fluidize bed is a powerful tool with high efficiency for breaking yeast cell up to 90 percent. However, the application of three-phase fluidized bed in disruption of microalgal cells has never been reported.

In this study, a three-phase fluidized bed with an agitator is proposed as a novel method for breaking microalgal cells. Air, microalgal suspension and glass bead, are considered as gas, liquid and solid phases, respectively.

1.2 Objective

The objective of this study is to investigate the influences of each operating parameter, namely, gas and liquid superficial velocity and agitation rate, on the disruption of some certain microalgal strains.

1.3 Scope

1. A laboratory-scale three-phase fluidized bed with agitator will be employed for a series of experiments in which microalgae cell concentration is varied between (9-15) $X10^6$ cells/cm^3. The main operating conditions to be varied and investigated are as follows;
   - Microalgal strains: *Chlorella ellipsoidea* TISTR 8260, *Chroococcus sp.* TISTR 8623 and *Chlorococcum sp.* TISTR 8509.
   - Superficial gas velocity: 0 – 0.4 m/min
   - Superficial liquid velocity : 0 - 0.4 m/min
   - Agitation speed: 500 – 3,000 rpm.

2) Relationship between operating variables and performance of cell disruption will be analyzed using the obtained experimental data.

1.4 Benefits

The prospects of this research are:

1. To understand the mechanisms of microalgal cells disruption which designed taking place inside the three-phase fluidized bed with agitator.
2. To investigate factor affecting microalgal cells disruption by the technique.