# CHAPTER I

# INTRODUCTION

## 1. Rational for the study

Acetic acid is used in several industries and produced mainly by petrochemical processes. The processes cause pollution and use non-renewable raw material. The crisis arises because petroleum have reached such high prices and are consumed more rapidly than they are being replaced. Many researches have been reported on producing chemicals by microbial fermentation. Considerable interest has been focused on the development of fermentation processes utilizing carbohydrates derived from inexpensive lignocellulosic material as a means to replace many organic chemicals currently derived from petroleum products.

## 2. Statement of Problem

Acetic acid is an important industrial feedstock for many chemicals such as vinyl acetate monomer, cellulose acetate, acetic acid ester and acetic acid anhydride. At present approximately one-third of total production capacity of acetic acid is outside the United States, Western Europe and Japan, with the majority production in Asia. In the future, the capacity of acetic acid will be increased continually and substantially in Asia.

Acetic acid's future growth is tied largely to vinyl acetate monomer manufacture. Acetic acid requirements are forecasted to grow globally at a rate of 3.4% per year during 2002-2007. World consumption of acetic acid will be increased from 6.7 million metric tons to nearly 7.9 million metric tons by 2007[8].

Vinyl acetate monomer is the largest end use for acetic acid in the United States, Western Europe and Japan. Vinyl acetate monomer is forecast to grow at a rate of approximatly 3.0% per year. It was reported that by 2007 acetic acid will be requried for global vinyl aectate manufacture at 3.2 million metric tons [8]. Vinyl acetate capacity

growth will be primarily in the Asia Pacific region which will require additional local acetic acid production capacity.

At present, Acetic acid is produced mainly by chemicals process. Because the production of acetic acid by two-step vinegar process produced low yield and high capital cost. At the moment, the production of acetic acid by chemical process can be produced high yield and high acetic acid concentration. However, the chemical processes currently being produced from petroleum products cause pollution and use non-renewable raw material. In this reason, they are considerable producing acetic acid using *clostridium thermoaceticum* as microorganism to convert lignocelluloses material to desired product. *Clostridium thermoaceticum* has several important advantages compared to the vinegar process. It is an anaerobic process, and thus should be cheaper than aerobic process traditionally used for making vinegar. The process can convert glucose directly to acetic acid. The process can make use of at least three sugars (xylose, fructose and glucose) that can be derived from lignocellulosic biomass, and it can produce high yields of acetic acid and more efficient than the conventional method used for vinegar production. The theoretical process can convert 3 moles of acetic acid from 1 mole of glucose compare with two-step vinegar process which produces only 2 moles of acetic acid from 1 mole of glucose [6].

However, acetic acid production using *Clostridium thermoaceticum* as microorganism is limited. Since, it grows in plenty environmental of Carbon, amino and vitamin sources, so the production cost is still high. If we can reduce production cost by using the lower cost media ot replace the present media that is high cost, the cost of acetic acid production will be decrease. Therefore, develop of acetic acid production by using *Clostridium thermoaceticum* is the most important.

In this study, Molasses was used as the substrate for production of acetic acid, and the organism used was *Clostridium thermoaceticum*. *Clostridium thermoaceticum* is a spore forming, gram positive, obligate anaerobic bacterium. The bacterium is an obligate thermophile with an optimun growth temperature between 55 and 60°C and optimun pH between 6 and 8.5 [13].

Molasses, a by-product of the sugar extraction process, are a cheap raw material often used in fermentation. It is most economical source of carbohydrates for bacterial fermentation. It contains reduced polymeric sugar that can further react to from fermentable sugar during chemical and biological treatments. A normal cane molasses usually has a moisture content of 17-25%, a sugar content (sucrose, glucose, fructose) of 45-50% and polysaccharides (dextrin, pentosans, polyuronic acids) of 2-5% [3].

This statement of available technology combined with the economic fact of rapidly rising fuel prices, depletion of oil, gas and petroleum product reserves and the possibility of political barriers to supplies, has led to search for less expensive, more reliable domestic energy sources such as molasses that was used in the study.

## 3. Objective of the Study

3.1. To produce acetic acid from molasses by *Clostridium thermoaceticum*.

3.2. To determine optimum condition for growth and acetic acid production by *Clostridium thermoaceticum* from molasses.

3.3. To evaluate economic analysis and energy consumption of acetic acid production from molasses fermentation compare with petroleum process.

## 4. Scopes of the study

The study is carried out in laboratory, faculty of medical science, Naresuan University. The substrate used in this study is Blackstrap molasses, which is obtained from Phitsanulok sugar factory, Bangkatum, Phitsanulok, Thailand. The fermentation of this study is Batch fermentation.

## 5. Methodology

5.1. Review literature.

5.2. Setup experiment and collect data.

5.2.1. Culture and culture media.

5.2.2. Fermentation and determination of growth and acetic acid production.

5.3. Analysis of data.

5.4. Conclusion.

## 6. Expected result

Molasses can be substrate for *Clostridium thermoaceticum* to use for acetic acid production. This will be beneficial to replace use of petroleum products, and reduce the detrimental effect to the environment and increase value added to molasses.