CHAPTER I
INTRODUCTION

Today, global energy requirements are essentially dependent on fossil fuels, such as oil, natural gas, and coal, but they are limited. Moreover, the combustion of fossil fuels, releasing many pollutants like CO_x, NO_x, SO_x, C_xH_x, soot, ash, droplets of tars, and other organic compounds into the atmosphere, has caused a global warming effect (Das and Veziroglu, 2001 and Yokoi *et al.*, 2002). With the unavoidable depletion of fossil fuels, alternative energy resources are a possible way to reduce these problems. Hydrogen is one of interesting renewable energy resources for substituting fossil fuels. It is an odorless, colorless, tasteless, and non-poisonous gas. When the hydrogen is burnt, there are no pollutants due to no CO_2 emission and generating only water. Besides, it has high energy yield of 122 kJ/g, which is 2.75 times greater than hydrocarbon fuels. However, owing to the high hydrogen production and storage cost, it is a challenge to realize hydrogen as a potential alternative fuel in the future (Kapdan and Kargi, 2006 and Chong *et al.*, 2009)

At present, there are many ways to produce hydrogen, mainly from fossil fuels, biomass, and water. Nearly 90 % of hydrogen production processes are steam reforming of natural gas, the reactions of natural gas or light oil fractions with steam at high temperature. Other methods for hydrogen production are coal gasification and electrolysis of water. Nevertheless, these hydrogen generation processes give low amounts of hydrogen and are operated at high temperatures (> 850°C), thus energy intensive and not always environmentally friendly. Accordingly, biological hydrogen production processes are of interest because they can be operated at ambient temperatures and pressures (Das and Veziroglu, 2001).

Biological hydrogen production processes can be divided into two types: photosynthetic (photo-fermentation) and anaerobic (dark fermentation) processes. Since the photo-fermentation mainly uses sunlight to produce hydrogen and carbon dioxide, while the dark fermentation does not, a high constant hydrogen production rate throughout the day and night can be achieved from the dark fermentation. For the anaerobic fermentation, the first step is hydrolysis of high-molecular-weight organics in wastewater to smaller organics. Then, they are further fermented in the second step to produce volatile fatty acid (VFA), hydrogen, and carbon dioxide (Sreethawong *et al.*, 2010a). Because hydrogen production via the dark fermentation process uses wastewater as a substrate, a type of wastewater is an important parameter that affects yield of hydrogen production. Previous studies show that carbohydrate is suitable for producing hydrogen because they can be decomposed to glucose, which can produce 4 moles of hydrogen for 1 mole of glucose. However, the use of raw carbohydrates, like cassava or corn, for hydrogen production is not economically feasible due to their high cost. Thus, industrial organic wastewater carrying high concentration of carbohydrate is a possible alternative as a substrate for the hydrogen production.

Alcohol distillery wastewater is one of attractive raw materials for the hydrogen production process because it consists of carbohydrate-rich materials. The use of alcohol distillery wastewater not only provides hydrogen as a renewable source but also improves the wastewater treatment process. In addition, biohydrogen production from alcohol distillery wastewater in an anaerobic sequencing batch reactor (ASBR) has been scarcely reported. In this research, wastewater from an alcohol distillery production process was used as a substrate for biohydrogen production in an ASBR Effects of organic loading were investigated for its roles on the hydrogen production rate by using a mixed culture of hydrogen-producing bacteria under thermophilic condition.