CHAPTER I
INTRODUCTION

Nowadays, the global warming problem is a great concern to the world. Mainly, the reason for this problem comes from the greenhouse effect. It is actually a good effect to prevent incoming heat from the sun, from escaping back into space, and also to keep the global mean surface temperature suitable for organisms on the Earth. Without the greenhouse effect, the Earth would be too cold for living organisms to survive. The problems results from the intensified greenhouse effect, mainly due to the buildup of concentration of greenhouse gases in the atmosphere, and this is preventing more heat from escaping, leading to an increase in the Earth's temperature. The increase in the Earth's temperature affects the ecosystems and also can change the climate (Jacobson, 2002).

The main greenhouse gas is carbon dioxide as a result of fossil fuel combustion. Presently, fossil fuel utilization can affect global climate change, mainly due to the emission of pollutants, including CO_x, NO_x, SO_x, C_xH_x, and other organic compounds, into the atmosphere (Das *et al.*, 2001).

In order to avoid carbon dioxide production and emission, hydrogen has been suggested as the fuel for the future. There are a lot of advantages of hydrogen utilization, such as its high conversion efficiency, its ability to be recycled, and its non-pollution. After the hydrogen combustion, there is only water as the product. The heating value of hydrogen is higher than traditional fossil fuels (i.e. coal and petroleum). Moreover, hydrogen can be directly used to generate electricity through fuel cells (Lay *et al.*, 1999; Mizuno *et al.*, 2000).

Hydrogen can be generated using a number of methods. At present, it is produced mostly from fossil fuels, water, and biomass. Nearly 96% of worldwide hydrogen production depends on fossil energy resources (Das *et al.*, 2001). Alternatively, biological hydrogen production has also been studied for over a century and recently is drawing much attention. Furthermore, renewable resources can be utilized as substrates to produce hydrogen under mild operating conditions. In contrast, fossil fuels are not only non-renewable resources, but also large amounts of energy derived from fossil fuel combustion (Chen *et al.*, 2006).

In general, hydrogen production from biological methods is based on two biosystems: photochemical production and dark fermentative production. The photosynthetic microorganisms involved in hydrogen production are algae, cyanobacteria, and photosynthetic bacteria, while the fermentative microorganisms include facultative and anaerobic bacteria (Das *et al.*, 2001). Fermentative hydrogen production is an acceptable method compared with photosynthetic bacteria due to its high utilization of organic compounds or wastes as substrates to produce hydrogen (Chen *et al.*, 2006). In addition, fermentative bacteria can induce very high evolution rate of hydrogen, and it can produce hydrogen constantly through day and night from organic substrates (Das *et al.*, 2001).

So far, most studies on biological fermentative hydrogen production from carbohydrates using mixed cultures have been conducted in only conventional continuous stirred tank (CSTR) and batch reactors under mesophilic conditions (Gavala *et al.*, 2006). This study was conducted to design and construct the anaerobic sequencing batch reactor (ASBR) for investigating the effect of COD loading on biological hydrogen production and also to find the maximum COD loading at the optimum pH using mixed acidogenic cultures. Glucose was used as the model substrate for carbohydrates at the mesophilic temperature of 37°C.