CHAPTER I
INTRODUCTION

Considering global environmental, the global warming is reported as an important problem, which greatly affects many countries. The main concern about global climate change is the greenhouse effect. This effect is the increase in earth surface temperature due to the presence of various gases in atmosphere, such as water vapor, carbon dioxide, nitrous oxide, methane, soot, ash, and droplets of tars (Das *et al.* 2001) since these gases can reflect most of the heat released from the earth surface. As a matter of fact, the greenhouse effect is very important phenomenon being able to maintain the earth surface temperature at appropriate level for living organisms to survive. However, the global warming due to the greenhouse effect is resulted from human activities, such as industrial processes, fossil fuel combustion, and deforestation, which emit excess amounts of greenhouse gases released to the atmosphere, leading to higher earth surface temperature.

The potential way to reduce the greenhouse effect problem is to use alternative energy resources. Hydrogen is a promising clean fuel as it is ultimately derived from renewable energy sources, is environmentally friendly, gives high energy yield, and can be produced by less energy-intensive processes (Das *et al.* 2001). Hydrogen is defined as a clean burning fuel because it produces only water as a by-product when combusted, and it does not produce a greenhouse gas. Moreover, hydrogen has high energy content per unit mass (122 kJ/g), which could be directly used in fuel cells for generating electricity (Mizuno *et al.*, 2000; Han *et al.*, 2004).

Hydrogen can be produced from various processes. Most hydrogen is currently being produced from fossil fuel processing or electrolysis using solar power. Nearly 90% of hydrogen is produced from steam reforming of natural gas or light oil fractions (Das *et al.*, 2001). However, these processes are energy-intensive and not environmentally friendly (Mizuno *et al.*, 2000). Biological hydrogen production using fermentative bacteria is an alternative way to generate hydrogen because it is non-polluting and less energy-intensive process. It is even much more attractive if biomass and wastewater can be used as the raw material in the biological hydrogen production (Mohan *et al.*, 2007). Moreover, it can mostly be operated at ambient temperature and atmospheric pressure.

Biological hydrogen production by microorganisms can be divided into two main categories: (1) hydrogen production by algae or phototropic bacteria and (2) hydrogen production by anaerobic bacteria. Normally, hydrogen, carbon dioxide, volatile fatty acids (VFA), and sometimes alcohol, are simultaneously produced during the acidogenesis of organic wastes (Yu *et al.*, 2002). The non-photosynthetic anaerobic bacteria produce hydrogen by dark fermentation. This method is generally preferred because it does not rely on the availability of light sources and transparency of the mixed liquor of the wastewater stream (Hart, 1997, Hallenbeck *et al.*, 2002), and fermentative bacteria also have very high evolution rate of hydrogen (Das *et al.*, 2001). Compared with the light reactor, anaerobic fermentative hydrogen production is easier to conduct and suitable for the demands of sustainable development strategy (Liu *et al.*, 2007).

Recently, the feasibility and application of anaerobic fermentation to produce hydrogen from a lot of substrates, such as glucose, sucrose, and food waste, have been reported. Many types of reactor were studied, such as continuously stirred tank reactor (CSTR) (Ueno *et al.*, 1996, Horiuchi *et al.*, 2002), batch reactor (Cheong *et al.*, 2006, Gavala *et al.*, 2006, Zhang *et al.*, 2007), and anaerobic sequencing batch reactor (ASBR) (Lin *et al.*, 2003, O-thong *et al.*, 2007). Fermentative hydrogen production is affected by several factors, such as carbon source, pH, nitrogen level, phosphorous level, the nature of the microbial communities, and temperature (Cheong *et al.*, 2006). In this research, anaerobic sequencing batch reactor (ASBR) was used as the fermentor to investigate the effects of operational parameters, i.e. operational pH and COD:N ratio on the biological hydrogen production by mixed microflora from wastewater treatment plant and also to find the optimum conditions, which provided maximum hydrogen production. A glucose-containing wastewater was used as the organic substrate for hydrogen production. Moreover, the VFA composition in effluent was analyzed and compared with the previous work (Neramitsuk *et al.*, 2007).