CHAPTER I
INTRODUCTION

At this time, green technology is the most attractive topic in the field of energy and environmental science. Since the current global energy demand is mostly dependent on oil from fossil fuels which are depleting, in addition, the world is facing to severe pollution problems from by-products from fossil fuels uses (Marbán and Valdés-Solís, 2007). Because, when fossil fuels are burned in atmosphere, carbon dioxide and other pollutants are more generated and the excess carbon dioxide causes global warming. Thus, to overcome these problems, it is necessary to find alternative energy. Hydrogen is one of alternative energy, which is clean energy (when hydrogen is used as a fuel, it produces only water) (Chong *et al.*, 2009), there is a possessing a high energy yield (122 kJ g^{-1}) and does not contribute to the greenhouse effect (Koutrouli *et al.*, 2006) (no carbon dioxide emission). There are a lot of advantages of hydrogen utilization, such as its high conversion efficiency and its ability to be recycled. From these reasons, the energy from hydrogen exhibits perhaps the greatest potential to replace fossil fuels (Ren *et al.*, 2011).

Hydrogen can be produced under various processes, such as fossil fuels processing or by electrolysis using solar power or gasification. In contrast, those processes are highly energy intensive and expensive. So the attractive way to produce hydrogen is biological hydrogen production process because of less energy consumption.

Biological hydrogen production mainly includes photosynthetic and dark fermentative hydrogen production. Dark fermentative hydrogen production has more advantages than photosynthesis hydrogen production in rapid hydrogen production rate and simple operation (Levin et al., 2004; Kim *et al.*, 2009)

Microaeration was defined as an introduction of small amount of oxygen to enable the aerobic and anaerobic activities in anaerobic digestion under dark fermentation (Botheju *et al.*, 2011). It has been usually used for desulphurization of biogas (Fdz-Polanco *et al.*, 2009) and currently it was applied to enhance the hydrolysis of complex organic matter. Although oxygen is considered to inhibit methane-producing bacteria activities, there are many advantages of microaeration, for example, increasing in hydrolysis efficiency (Johansen and Bakke, 2006; Tartakovsky *et al.*, 2011; Botheju *et al.*, 2010) and improving methanogenic activity.

The objective in this work was to investigate the effect of microaeration on methane production performance under the separate bio-hydrogen and bio-methane production process via dark fermentation from ethanol wastewater using two-stage upflow anaerobic sludge blanket reactors (UASB). Firstly, the optimum condition for hydrogen and methane production from ethanol wastewater a different COD loading rates (2, 4, 6, 8 and 10 kg/m^3 d based on methane UASB tank) was studied. For the second part, the optimum condition of microaeration defined by oxygen supply load of 3, 4, 4.5 and 6 kg/m^3 d at optimum COD loading rate in the first part was applied to methane production tank. The system was operated at mesophillic temperature (37 °C) and pH 5.5 in hydrogen production, whereas without pH control in methane production tank. The effluent recycle ratio from methane tank to hydrogen tank was fixed at 1:1.