CHAPTER I

INTRODUCTION

Cassava wastewater is one of carbohydrate-rich wastewaters. The large volumes of wastewater come from washing and starch extraction processes. Treatment of the cassava wastewater is a necessary step according to the environmental concern.

The biological wastewater treatment process, especially anaerobic process, is an environmentally friendly method for the cassava wastewater treatment because it can be operated at ambient temperature. Dark fermentation process has more advantages than photosynthetic process since it is less energy-intensive, and a variety of organic substrates can be used. Moreover, gaseous products of the process, i.e. hydrogen and methane, are important energy resources. Waste or wastewater rich in carbohydrates, which are the main source for fermentative processes, can be considered as potential sources of hydrogen (Antonopoulou *et al.*, 2008). Moreover, gaseous products of the process, i.e. hydrogen and methane, are important energy resources. Therefore, this work focused on feasibility of two-step hydrogen and methane production from cassava wastewater by dark fermentation process, which is anaerobic operation in the absence of oxygen. Firstly, organic wastes were converted mostly hydrogen, carbon dioxide, and organic acids with fermentative (acidogenic) bacteria. After that, the produced acids were converted further to methane by methanogenic bacteria.

Two identical bioreactors were separately used to optimize bacterial growth for each step to obtain the highest hydrogen and methane production. The growth of the acidogenic bacteria required a low pH (pH 5-6) and a high organic loading rate in the first bioreactor, while the slower growth of the methanogenic bacteria in the second bioreactor preferred a neutral pH and a lower organic loading rate (Cooney *et al.*, 2007). The bioreactors for the anaerobic process can be continuously stirred tank reactor, or CSTR (Wang *et al.*, 2006, Zhang *et al.*, 2006, Lin *et al.*, 2006), anaerobic contact filter reactor (Vijayaraghavan *et al.*, 2005), anaerobic sequencing batch reactor, or ASBR (Arooj *et al.*, 2007), anaerobic fluidized bed reactor or AFBR

(Zhang *et al.*, 2007), or upflow anaerobic sludge blanket reactor, or *UASB* (Han *et al.*, 2005, Zhao and Yu, 2008, Chang and Lin, 2004). Galava *et al.*, (2006) studied biological fermentative production of hydrogen from glucose using mixed culture in a continuous stirred tank reactor (CSTR) as compared to an upflow anaerobic sludge blanket reactor (UASB). They found that the UASB configuration is more stable than the CSTR regarding hydrogen production, pH, glucose consumption, and microbial by-products (volatile fatty acids) at all hydraulic retention times under mesophilic condition.

Therefore, in this research, upflow anaerobic sludge blanket reactor (UASB) was applied as anaerobic treatment system for cassava wastewater because it has been widely employed for treating various organic wastewaters with high efficiency, even in treating high strength wastewater.

Two-step treatment process of cassava wastewater using UASB system was studied under mesophilic condition (37°C). The real cassava wastewater was fermented in the first bioreactor at various different COD loading rates from 10 to 30 kg COD/m^3d to produce hydrogen under a controlled pH of 5.5. Afterwards, the effluent from the first bioreactor was further fermented in the second bioreactor to produce methane without pH control.