CHAPTER 1

Introduction

Anaerobic digestion is a biological process used to treat high-strength wastewater (Lettinga, 1995). This process has several advantages over aerobic process. Anaerobic digestion process consumes low energy and can treat high-strength wastewater about 5-20 kg COD/m^3/d compared to 0.5-3 kg COD/m^3/d in aerobic process. Hence, anaerobic digestion can reduce reactor volume and space requirement that affect overall cost of operation (Lema and Omill, 2001). This process also produces biogas which serves as a renewable energy. Biogas is an alternative energy for consumer because of its lower price and only gasoline is not enough for high demand on energy consumption (Ziemiński and Frąc, 2012). Anaerobic digestion is a multi-step process performed by various groups of microorganisms in absence of oxygen. This process consists of 4 main steps: hydrolysis, acidogenesis, acetogenesis and methanogenesis. First, complex organic compounds are hydrolyzed to simple compounds by hydrolytic and fermentative bacteria. Hydrolyzed substrates are then digested by acidogenic bacteria, resulting in short chain fatty acids and hydrogen. Short chain fatty acids with more than two carbon atoms are further oxidized to acetate, carbon dioxide and hydrogen by acetogenic bacteria. In the final step, methanogenic bacteria convert these products to methane and carbon dioxide. The performance of anaerobic digestion depends on many factors such as pH, temperature, nutrient and type of reactor, which relate to microbial community within the reactor. Therefore, successful biogas production is based on stable, adaptation and activity of microbial community which depends on environmental conditions in the reactor (Gerardi, 2003).

Currently, energy demand of pig farm in Thailand has increased as pig farm is developing to the automatic feeding system. In addition, electric sale price of the Electricity Generating Authority of Thailand is increased. However, the potential of biogas production from only pig manure is limited. Therefore, it is necessary to

increase biogas production yield in the system. One interesting strategy for improving biogas production is co-digestion. This process involved the digestion of two or more substrates in the same reactor. It can increase biogas yield due to improvement on nutrient balance and pH buffer capacity enhancement (Mata-Alvarez *et al*., 2000; Yadvika *et al*., 2004; Esposito *et al*., 2012). Co-digestion of animal manure with organic wastes or crops has been extensively studied (Callaghan *et al*., 2002; Lehtomäki, 2007). However, the investigation of microbial community structure in the anaerobic co-digestion is still lacking. Thus, microbial community study in the co-digestion system using available co-substrate from nearby pig farm such as food waste and grass is of interest. This information will increase and improve our knowledge regarding microbial community in anaerobic co-digestion.

The proposed research is carried out on the anaerobic reactor codigesting pig manure with fresh Napier grass or food waste in a channel digester-upflow anaerobic sludge blanket (CD-UASB) and completely stirred tank reactor (CSTR). The study focuses on the following objectives.

1. Investigation of the microbial community structure in anaerobic reactor codigesting pig manure with Napier grass or food waste in lab-scale CD-UASB and CSTR.
2. Determination of hydraulic retention time (HRT) effect on microbial community in anaerobic reactor codigesting pig manure with Napier grass or food waste in lab-scale CD-UASB and CSTR.

The thesis includes the following 7 chapters.

Chapter 1: general introduction

Chapter 2: reviews background knowledge in anaerobic digestion, microbial consortium and method for investigate the microbial community structure in the reactor.

Chapter 3: describes material and method for investigate the microbial community structure in the reactor.

Chapter 4: describes microbial community structure under different HRT in the reactors both CD-UASB and CSTR codigesting pig manure with Napier grass.

Chapter 5: describes microbial community structure under different HRT in the reactors both CD-UASB and CSTR codigesting pig manure with food waste.

Chapter 6: discusses the data obtained from this study.

Chapter 7: conclusion