CHAPTER I

INTRODUCTION

Statement of the problem

Globally, countries are facing severe environmental problems and energy crisis. One of the major environmental problems is global warming due to emission of greenhouse gases [1, 2] . According to Boyle , the major cause of greenhouse gases is carbon dioxide due to combustion of fossil fuels [2, 3]. The surface temperatures have increased by 0.8 °C and will continue to increase by the end of the 20^{th} century if the usage of fossil fuels continues [3]. Several studies have shown that renewable energy provides the solution to the problem of fossil fuel depletion and reduction of greenhouse gases. Twedel and Weir defined Renewable Energy as "energy obtained from natural and persistent flows of energy occurring in the immediate environment" [3]. These fuels contribute less greenhouse gases to the atmosphere. Hence, renewable energy is environment-friendly and has a high potential in mitigating and preventing global warming [3, 4]. One form of renewable energy is biomass energy which produces an environment–friendly fuel [5]. It is produced through the anaerobic digestion process in which wastes such as animal dung, municipal wastes, industrial waste and agricultural waste are digested by bacteria in the absence of oxygen, subsequently producing biogas. The use of animal dung as a feedstock for biogas production is well known however, some researchers have observed that there is a decrease of animal population due to introduction of farm mechanization [6]. In addition, there are some areas with less or without animals to use its dung as feedstock for biogas production. Therefore, there is a need to look for alternative feedstock for biogas production to replace or to supplement animal dung [6]. Food waste is one of the alternative feedstock for biogas production because it has more biodegradable organic matter such as protein, carbohydrates and lipids , high moisture content (76.2-83.5 %), high carbon/nitrogen ratio (79.7-89.6 %), high chemical oxygen demand (13.6-26.7 %) and more nutrients available for biogas production [6]. Further, the potential of biogas production from food waste is higher because it is readily available unlike energy crops which need to be planted hence requiring high investment cost

and occupy precious lands. On the other hand, food waste freely accumulates in the commercial or public areas such as hospitals, schools, universities, prisons and restaurants in the form of eaten and uneaten food [5]. The handling and disposal of food waste have been an environmental concern in many countries, and some countries have banned its disposal in the landfill [5, 7] .The disposal of food waste in the open space does not only contribute to poor sanitation, but also contributes to greenhouse-gases such as methane which has 21 times higher heating factor than carbon dioxide [7]. Naresuan University admits more than 25,000 students per year and has more than five cafeterias which generate a lot of food waste daily. These generated food waste could be used to generate electricity that can provide energy for cooking at the same facility. To accelerate the promotion of biogas production from food waste, there is a need to improve/enhance biogas production from food waste to make it technically and economically viable. There are several techniques that are used to increase the yield of biogas production such as use of additives, recycling of slurry and variation in operation parameters (temperature, hydraulic retention time, particle size and total solids) [8]. Some of these techniques are very expensive and energy intensive therefore, this study focused on the optimization of the total solids and particle size. Other parameters such as temperature, pH and C/N ratio have been optimized previously by other researchers and their effects on biogas production are well documented in the literature [9, 10]. However, previous studies have not focused much on the influence of food waste particle size and total solid content on biogas production from food waste and the effect of these two parameters on economic evaluation. The particle size of the substrate is very important because it enhances biogas production due to an increase in surface area hence rendering them accessible to microbial activities. Total solid concentration is a similarly important parameter because it has influence on water/solid dilution ratio. Water is important because it helps in the movement of the bacterias and nutrients. If the waste is over diluted, solids will settle down at the bottom hence reducing biogas production. Likewise, if too thick it hinders the flow of gas. In addition, these two parameters have an influence on economic considerations such as cost of the digester, operational cost, labor cost and land requirement [11]. Grinding of food waste prior to biogas production will require energy and labor cost for grinding.

Therefore, this research study was conducted with the aims of evaluating the influence of particle size and total solid on biogas production from food waste and their influence on economic evaluation. Further, this study determined the suitable particle size and total solid of food waste on anaerobic digestion process to increase the efficiency of biogas production.

Objectives of the study

1. To assess the influence of the particle size and the total solid content of food waste on biogas production

2. To analyze economic evaluation of biogas production from food waste using different particle size.

Scope of the study

Activities

1. Assessment of the quantity of food waste generated at the Naresuan university cafeterias

2. Collection of food waste samples for physical composition analysis and chemical parameters assessment such as chemical oxygen demand, biological oxygen demand, volatile solids, total solids, moisture content and pH

3. Conduction of batch anaerobic test on influence of particle size

4. Conduction of batch anaerobic test on influence of total solid

5. Calculation of the economic evaluation on biogas production from food waste using different particle size and biogas use.

6. Data collection and analysis (Quantity and quality of biogas per day)

Location

The study was conducted at the school of renewable energy technology, Naresuan University in Phitsunulok, Thailand.

Benefits of the study

1. Suitable parameters of particle size and total solid content that can increase the biogas yield from food waste were determined.

2. Basic knowledge for developing and improving biogas production from food waste.

3. Improvement of sanitation at the university campus and at the same time to provide energy for both heat (cooking) and electricity.

4. Prevention of the emission of methane to the atmosphere due to the disposal of food waste.

5. Prevention of diseases associated with air and pollution produced from food waste disposal.

6. The slurry produced could be used at the university farm as a fertilizer.

7. Economic evaluation of biogas production from food waste was calculated.