CHAPTER I
INTRODUCTION

1.1 Background

At present, global warming is a major problem in the world that consensus greenhouse gas comes from combustion of fossil fuel use for develop industry and economic. In the world the major energy uses fossil fuel, which emits pollution such as CO_x, SO_x, C_xH_x, soot, ash, and organic compound has the component of greenhouse gas. Hydrogen is a promising energy alternative, because it is clean and renewable. Hydrogen gives the high energy yield (121 KJ/g), which is about 2.75 times higher than that of hydrocarbon fuel. Hydrogen can be directly used to an electricity by fuel cell. Hydrogen production can be generated in various methods, such as water electrolysis, thermochemical process, photolysis, and biological processes, etc (Lay et al., 1999; Mizuno et al., 2000 ; Das and Veziroğlu, 2001). Biological processes are the most environmental friendly and less energy, when compared to other processes. Biological hydrogen production processes can be classified into three major categories: biophotolysis of water using algae and cyanobacteria; photodecomposition of organic compounds by photosynthetic bacteria (Photo-fermentation); and fermentative hydrogen production from organic wastes (Dark-fermentation) (Hallenbeck and Ghosh, 2009). Dark-fermentation is the one method generating efficient H_2 gas production from a large carbohydrate obtained as refuse or organic waste (Kotay and Das, 2008). However it is difficult to establish a high hydrogen yield, because the amount of fermentative products is significantly influenced by various factors such as pH, temperature, and F/M ratio, etc. (Lay et al., 1999). Dark-fermentation producing hydrogen from low value biomass is also one advantages of biological hydrogen production (Bio-hydrogen production). In terms of substrates, food waste is one of current hydrogen studies, considering as a source of carbohydrate-rich for utilizing waste to energy (Han and Shin, 2002).

Thus, this research focuses on the study of bio-hydrogen production from food waste and the optimum of environmental condition under anaerobic fermentation process for enhancement of the maximum bio-hydrogen production.

1.2 Objectives of the research

1.2.1 To study the optimum of environmental conditions (Initial pH, temperature condition, initial iron concentration, and initial F/M ratio) on bio-hydrogen production from food waste using anaerobic fermentative process in order to maximize the bio-hydrogen production

1.2.2 To study the variation of pretreatment methods (Heat, repeated heat, chloroform and ultrasonication) of food waste and seed sludge in batch reactor for enhancing bio-hydrogen production from food waste.

1.3 Conceptual framework

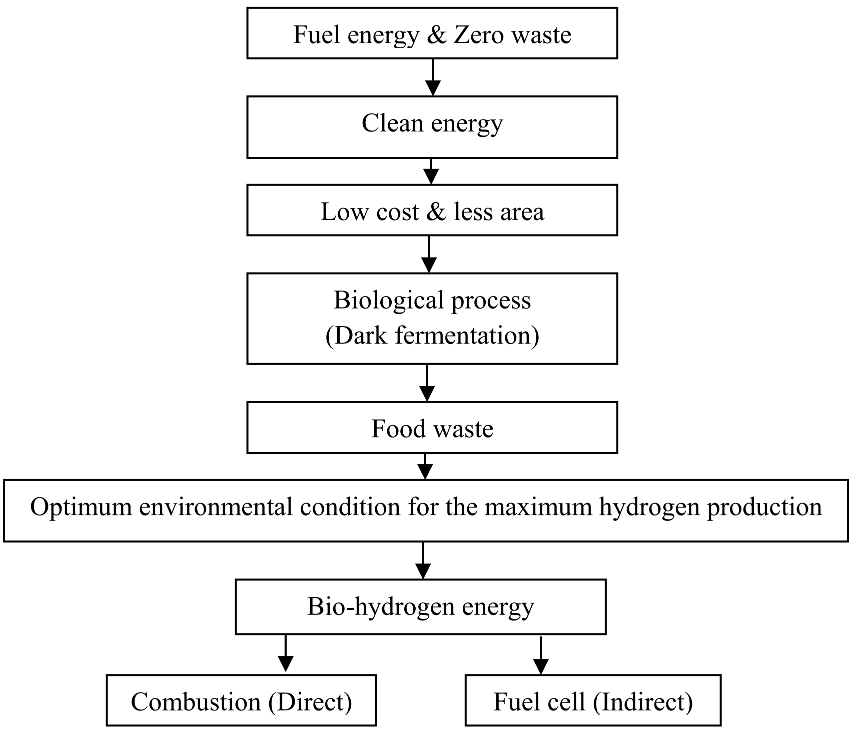

Figure 1.1 Conceptual framework

1.4 Hypothesis

1.4.1 Change in initial pH, temperature condition, initial F/M ratio and initial ferric concentration could affect on hydrogen production of food waste

1.4.2 Different of pretreatment methods could affect on an elimination of H_2 consuming bacteria and enhance the H_2 production.

1.5 Scopes of the research

1.5.1 Food waste was collected from central cafeteria of Mahidol University (Salaya campus), Thailand

1.5.2 Seed sludge was taken from anaerobic digestion of municipal excrement treatment plant in Nonthaburi, Thailand.

1.5.3 Study in a lab-scale. The experiments were carried on in lab-scale using batch system and anaerobic dark-fermentation process.

1.6 Variable

1.6.1 Independent variables

1) The initial pH of 4, 5, 6, 7, 8, 9, 10, 11 and 12 of the reactor under mesophilic (35±2°C) and thermophilic (55±2°C) condition.

2) The initial F/M ratios of 4, 6, 8, 10 and 12.

3) The pretreatment methods of heat, repeat heat, chloroform, and ultrasonication.

4) The initial ferrous ion concentrations of 0, 100, 200, 300, 400 mg Fe^{2+}/l.

1.6.2 Dependent variable

1) Bio-hydrogen yield

2) Volatile fatty acid

3) pH

1.6.3 Stable variable

1) Control the temperature and determine of optimal pH.

2) Control the optimal pH and temperature condition, and determine the proportion of F/M ratio.

3) Control the optimal pH, temperature condition and F/M ratio, and determine the proportion of iron concentration.

4) Control the optimum of pH, temperature condition and F/M ratio, and determine the variation of pretreatment methods.

1.7 Expected outcome

1.7.1 To obtain the optimum of environmental condition of anaerobic fermentation process for support the maximum bio-hydrogen production from food waste.

1.7.2 To select the pretreatment method of food waste, which can enhance the maximum bio-hydrogen production.

1.8 Definition

Bio-hydrogen production	Hydrogen gas production from fermentation process under anaerobic condition
Dark-fermentation	Fermentation process under environmental condition, which no light

Food waste	Food scraps from central cafeteria at Mahidol University (Salaya campus) in Thailand
Optimal factors	The best environmental condition can generate from food waste to maximum hydrogen yield production using fermentation process
F/M ratio	The proportion of food waste to microorganism
SRB	Sulfate-reducing bacteria
NRB	Nitrate-reducing bacteria