

## CONTENTS

	<b>Page</b>
<b>ACKNOWLEDGEMENTS</b>	<b>iii</b>
<b>ABSTRACT (ENGLISH)</b>	<b>iv</b>
<b>ABSTRACT (THAI)</b>	<b>v</b>
<b>LIST OF TABLES</b>	<b>ix</b>
<b>LIST OF FIGURES</b>	<b>xi</b>
<b>CHAPTER I INTRODUCTION</b>	<b>1</b>
1.1 Background	1
1.2 Objectives of the research	2
1.3 Conceptual framework	2
1.4 Hypothesis	3
1.5 Scopes of the research	3
1.6 Variable	3
1.7 Expected outcome	4
1.8 Definition	4
<b>CHAPTER II LITERATURE REVIEWS</b>	<b>6</b>
2.1 Processing of hydrogen productions	6
2.1.1 Thermo chemical technology	6
2.1.2 Electrochemical technology	7
2.1.3 Biological hydrogen production	7
2.2 Food waste	11
2.3 Seed sludge	12
2.4 Effect of environmental factors on anaerobic fermentation process under a dark condition	12
2.4.1 Mixed culture	12
2.4.2 pH	13

## CONTENTS (cont.)

	<b>Page</b>
2.4.3 Temperature	14
2.4.4 F/M ratio	14
2.4.5 Iron concentration	15
2.5 Related researches	16
<b>CHAPTER III MATERIALS AND METODS</b>	<b>22</b>
3.1 Experimental apparatus and procedure	22
3.1.1 Apparatus	22
3.1.2 Chemicals	24
3.1.3 Preparation of food waste	24
3.1.4 Preparation of seed sludge	24
3.1.5 Experiment setup	25
3.1.6 Operating procedure	26
3.2 Monitoring	27
3.3 Analyses	27
3.3.1 Gas analysis	27
3.3.2 Liquid analysis	27
3.3.3 Data analysis	28
3.3.4 Statistic Analysis	28
<b>CHAPTER IV RESULTS AND DISCUSSIONS</b>	<b>29</b>
4.1 Characteristics of food waste and seed sludge	29
4.2 Phase I: Investigation of the optimal environmental condition	29
4.2.1 Step I: Investigation of initial pH (4–12)	29
4.2.2 Step II: Investigation of initial F/M ratios	36
4.2.3 Step III: Investigation of initial ferrous ion concentration	40

**CONTENTS (cont.)**

	<b>Page</b>
4.3 Phase II: Investigation of the variation of pretreatment method	45
<b>CHAPTER V CONCLUSION AND RECOMMENDATION</b>	<b>48</b>
5.1 Conclusion	48
5.2 Recommendation	49
<b>REFERENCES</b>	<b>50</b>
<b>APPENDICES</b>	<b>56</b>
Appendix A Methodology of analysis	57
Appendix B Gas chromatograph's standard gas	66
Appendix C Volatile fatty acid (VFA)	70
Appendix D Data of biogas production	73
Appendix E ANOVA statistic of hydrogen analysis	76
<b>BIOGRAPHY</b>	<b>89</b>

## LIST OF TABLES

<b>Table</b>		<b>Page</b>
2.1	Hydrogen-producing and hydrogen-consuming reaction present in anaerobic	10
4.1	Characteristics of food waste and seed sludge	29
4.2	Biogas production and biogas component at various of initial pHs under mesophilic condition	30
4.3	Biogas production and biogas component at various of initial pHs under thermophilic condition	31
4.4	Cumulative hydrogen production ( $H_{max}$ ) under mesophilic condition by Gompertz equation	31
4.5	Cumulative hydrogen production ( $H_{max}$ ) under thermophilic condition by Gompertz equation	32
4.6	VFA production at various initial pHs under mesophilic condition	36
4.7	VFA production at various initial pHs under thermophilic condition	36
4.8	Biogas production and biogas component at various initial F/M ratios	37
4.9	Cumulative hydrogen production at various initial F/M ratios by Gompertz equation	37
4.10	VFA production at various initial F/M ratios	39
4.11	Biogas production and component at the variation initial ferrous ion concentrations	40
4.12	Cumulative hydrogen production at initial ferrous ion ( $Fe^{2+}$ ) concentration by Gompertz equation	41
4.13	VFA production at various ferrous ion concentrations	43
4.14	Hydrogen yield production under optimal condition	44
4.15	Hydrogen yield production from other reseaches	44

**LIST OF TABLES (cont.)**

<b>Table</b>		<b>Page</b>
4.16	Biogas production and biogas component of different pretreatment method	45
4.17	Cumulative hydrogen production of different pretreatment method	45
4.18	by Gompertz equation	47
	VFAs production and butyrate/acetate ratio of different pretreatment method	

## LIST OF FIGURES

<b>Figure</b>		<b>Page</b>
1.1	Conceptual framework	2
2.1	Bio photolysis (green algae-cyanobacteria)	8
2.2	Photo-fermentation (Photosynthetic bacteria)	9
2.3	Pathway hydrogen role in anaerobic degradation of organic matter	11
3.1	Diagram of experimental methodology	23
3.2	Diagram of batch reactor	25
4.1	Cumulative hydrogen production at various initial pHs under mesophilic condition	33
4.2	Cumulative hydrogen production at the various initial pHs under thermophilic condition	34
4.3	Percentage of COD removal under mesophilic and thermophilic conditions at various initial pH	35
4.6	Cumulative hydrogen production at various initial F/M ratios	38
4.7	Percentage of COD removal of initial F/M ratios on bio-hydrogen production from food waste	39
4.8	Cumulative hydrogen production at various initial ferrous ion concentration	42
4.9	COD removal of the variation of initial ferrous ion	43
4.10	Cumulative hydrogen production of different pretreatment method	46
4.11	Percentage of COD removal in the of different pretreatment method	47