Electricity Cogenerator from Hydrogen and Biogas

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Abstract. This research studied about electricity cogenerator from Hydrogen and Biogas and the factors that cause that effecting Hydrogen from Aluminium which was a cylindrical feature. By using a catalyst was NaOH and CaO, it was reacted in distilled water with percentage of Aluminium: the catalyst (NaOH and CaO) and brought to mix with Biogas afterwards, that have been led to electricity from generator 1 kilowatt. The research outcomes were concentration of solutions that caused amount and percent of maximum Hydrogen was to at 10 % wt and 64.73 % which rate of flowing of constant gas 0.56 liter/minute as temperature 97 degree Celsius. After that led Hydrogen was mixed by Biogas next, conducted to electricity from generator and levelled the voltage of generator at 220 Volt. There after the measure of electricity current and found electricity charge would be constant at 3.1 Ampere. And rate of Biogas flowing and Hydrogen, the result was the generator used Biogas rate of flowing was highest 9 litter/minute and the lowest 7.5 litter/minute, which had rate of flowing around 8.2 litter/minute. Total Biogas was used around 493.2 litter or about 0.493 m³ and Hydrogen had rate of flowing was highest 2.5 litter/minute.

Keywords: Electricity, Hydrogen, Biogas

1. Introduction
Hydrogen gas for generate electricity by feeding fuel cells [2]. In the present, researchers around the world have given great interest in the development of fuel cells for applications in different areas. Since fuel cells are much more effective than other power generation equipment, then hydrogen energy is another alternative that can replace wasteful energy. At the same time, Mahasarakham province is a province with a large population with careers of agriculture and raising livestock. The sewage caused by the agricultural system and waste from the excreta and urine from the animals which is still not yet systemized has resulted in environmental pollution such as smell, sewage, flies and various vectors of disease [3]. Thus, there should be a system to eliminate waste within the community and an appropriate method should be applied to help reduce pollution mentioned above. The removal of excrement and urine of the animals with a biogas system is considered a method suitable and widely used. In addition, after the treatment, methane gas (CH₄) [4] that gives heat can be a gemstone by being able to be used as energy for cooking. The research team has recognized the importance of renewable energy therefore have brought knowledge of producing hydrogen has and biogas to produce small electricity for household use.

2. Theory
2.1 Biogas
Biogas is a complex degradation process which includes carbohydrates, proteins and fats which are used as nutrients in the livelihood of non-aerobic bacteria. This is by which bacteria within the
anaerobic wastewater treatment systems can be divided by reactions into three groups, which are [5]

Acid Former Bacteria: This group of bacteria will dissolve organic matter in wastewater into various organic acids.
Methane Former Bacteria: serves to degrade organic acids into methane gas and carbon dioxide.
Sulfate Reducing Bacteria, SBR: The amount of these bacteria is dependent on the concentration of the sulfate (SO₄) in the wastewater by absorbing oxygen from sulfate compounds. This changes sulfate in the form of sulfate to hydrogen sulfide (H₂S).

2.2 Hydrogen Gas
The concept of molecule separation process to produce hydrogen energy has been developed due to the confidence that this process can be a source of sustainable hydrogen energy. The source of substrate that is used in producing energy in this process includes water which is an unlimited energy source that can be found. In addition, hydrogen energy that can be produced from this process does not contain any other environmental pollutants; however, since this reaction is a reaction that uses high energy in separating water into hydrogen gas, the source of energy used to separate water must have enough amounts and does not affect the environment. Solar energy is a renewable energy source although has many limitations in terms of use. The use of light in speeding semiconductor reaction to use in the process of producing hydrogen is a process researchers give interest to. Japanese researchers has led the titanium electrode (TiO₂) used in the electrochemical process that is induced by light [6] for separating water molecules. However, nevertheless in reality, hydrogen cannot be produced efficiently upon the surface of titanium that has not been refined. The concept of using aluminium waste as a substrate material in creating hydrogen energy because majority of canned garbage contains a great amount of aluminium [7], if this can be used to produce energy it will reduce garbage and create inexpensive and environmental friendly energy. The hydrogen producing process uses available, cheap and light materials. Thus, aluminium waste is chosen in producing hydrogen gas. There is a chemical formula, 2Al + 6H₂O = 2Al(OH)₃ + 3H₂. This calculates the reaction rate of hydrogen gas by using thermodynamics and NaOH as a reaction catalyst. In the experiment, the hydrogen gas reaction rate is controlled by regulating temperature, pressure, substrate concentration and the size of the reaction pot. This is done by using statistical programs to design experiments.

2.3 Generator Baker Generator
An electric generator is a mechanical device used to convert mechanical energy into electrical energy by a working principle that when a magnetic field shifts and cuts the coil, or if a coil shifts and cuts the magnetic field, then electricity will be produced. An electricity generator consists of two important parts which are the area that creates the magnetic field which is called the field, and a part that creates voltage which is called the armature in the DC generator. The field is a part that stays in its place whereas the armature is a part that rotates. However, in a small electricity generator with an alternating current, the field and armature can be both in its place and rotating. On the other hand in a large electricity generator, it can only create an armature that stays in place for the reason that problems will be less than the pressure produced in the generator, which the amount is depending on two important factors which are speed and magnetic force lines in a direct current generator. We can increase voltage by adjusting the intensity of the magnetic field and increasing the speed of the generator. In an alternator, however, increasing pressure by speed is impossible because it would change the frequency of the pressure. Only adjusting the intensity of the magnetic field can be done. [8]

3. Procedures
3.1 Creating reaction to produce hydrogen gas.
Placing prepared aluminum into a Reactor bin Add solution into the bin and close the bin valve for the solution to flow into the reactor bin with the amount of 320 ml. by experimenting four times with concentrations of 20, 15, 10, and 5 %wt.

3.2 Electricity
Start the generator by using oil. Produce hydrogen gas in accordance of the procedures above, as well as install a 2 meter gas transmission line into the spiral. Connect the 2 meter biogas line into the inner spiral and open the valve. After the generator is working, close the oil valve and open the gas valve. Once the generator is working by using biogas and hydrogen gas as fuel, adjust the flow rate of the biogas and hydrogen to have the generator working most stable.

4. Analytical results
Producing co-generating electrical power between hydrogen gas and biogas by using a 1KW generator, which has an adjusted voltage of 220V to be equivalent to the amount of voltage used in general households, can be described as the following. In studying the flow rate of hydrogen as and biogas adjusts the generator to have a steady static voltage of 220V for the general amount of voltage used in households.
From figure 5 it shows that once adjusted the generator to 220V, the generator will use hydrogen gas with a maximum flow rate of 2.5 L/min and a minimum rate of 1 L/min. On the other hand, for biogas the generator will use gas with a maximum flow rate of 9 L/min and a minimum rate of 7.5 L/min. When allowing the generator to generate for 1 hour, the total electricity consumption of hydrogen gas is about 0.104 cubic feet, as well as a total electricity consumption of biogas of about 493.2 liters or about 0.493 cubic feet. It can be seen that the generator has a co-usage rate of 10 L/min; therefore, it is clear that by using hydrogen gas the generator can use all hydrogen gas that a hydrogen generator can produce. As for biogas, the generator will use biogas when hydrogen gas is low or high. From figure 6 when the machine uses hydrogen gas with a maximum rate of 2.5 L/min and a minimum rate of 7.5 L/min, it is found that the generator gives a voltage power of 22 volts. From figure 7 it is found that once adjusted the generator to a voltage power of 220 volts by which the generator is using hydrogen gas with a maximum rate of 2.5 L/min and a minimum rate of 1 L/min, as for biogas the generator uses the gas with a maximum rate of 9 L/min and a minimum rate of 7.5 L/min, which makes the electricity about 3.1 amperes with an electric potential of 220 volts, the generator will provide electricity of about 660 watts. Find from the relationship $P = IV$.

5. Conclusion
The best concentration for solution is 10 %wt., 6.8 liters of hydrogen gas with a temperature of 93.1 degrees Celsius and a total amount of 69.4 liters of hydrogen gas. Total yield of hydrogen gas is 64.73 %. The amount of biogas after the addition of pig manure on day 1, 2 and 3, it is found that on day 2, the biogas had a highest amount of 0.221 cubic meters. Using hydrogen gas and biogas in producing electricity by using a 1KW generator, which generated for 1 hour and adjusted the voltage to 220 volts, it is found that the electricity value is fixed at 3.1 amperes. After having measured the biogas and hydrogen gas flow rate, it appeared that the generator used biogas to a maximum flow rate of 9 L/min and a minimum rate of 7.5 L/min which the average flow rate is about 8.2 L/min by using a total amount of biogas of about 493.2 liters or about 0.493 cubic meters, as for hydrogen gas, the maximum flow rate is 2.5 L/min and a minimum rate of 1 L/min, which the average flow rate is about 1.75 L/min by using a hydrogen gas with a total of about 104 liters or about 0.104 cubic meters. The electric power the generator can produce is about 660 watts.

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