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Research paper

The Usage of Biogas as a Renewable Energy and its Impact on Environment in Malaysia

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Abstract

Air degradation and energy insecurity are currently critical worldwide issues and to encounter these issues, new sources and development of renewable energy and its impact on the environment should be explored. The aim of this study is to analyse the feasibility of using biogas from a cow's dung for energy production. This study adopted the experimental lab research at National Defence University of Malaysia using lab scale radiator to test the effect and effectiveness of biogas usage for the environment. Biogas contains 50–80% methane and 40–50% carbon dioxide and it can be potentially altered to 95% methane prior to the usage of biogas. On managing biogas for power and fuel, two scenarios were focused: 1) impact to the environment and 2) impact on sewage water quality. This study contributes to the resource analysis of the biogas derived from cow's dung, the economics of biogas production and biogas renewable energy policy in order to promote the green and healthy environment.

Keywords: *Air Degradation, Biogas Scenario, Environmental Impact, Renewable Energy*

1. Introduction

Fuel is important items to every country. The stability of the price and resources is the most crucial factor. There are varies of power resources such as fossil, coal, biogas, solar and hydro. The overdependence on fossil fuels as primary energy source has derived to global climate change, environmental pollution and degradation, thus leading to human health problems due to emission of carbon monoxide and oxygen. In the year 2050, the world as predicted will have 13 – 15 billion people that need power supply to live. The growth in the world's population has resulted in a surge of energy demand and for far more than two centuries, the world's power supply has highly dependent on non-renewable energy derived from fossil fuels, out of which 90% is estimated as being consumed for energy generation and transportation [4]. This has now led the world to be presently confronted with environmental issues. These realities have led a boost to the search for renewable and sustainable alternatives to fossil fuels. Moreover, the recent instability in prices of oil and natural gas may drive the current economy toward alternative renewable energy sources. One approach for renewable and sustainable alternatives is biogas. [3] concluded in their researched, biogas is a readily available energy resource that significantly reduces greenhouse-gas emission compared to the emission of landfill gas to the atmosphere. Malaysia is one of example of agricultural country turned industrial and still in heavy progress to develop. Food demand and live style of new generation required government to be more creative on to fulfill the food demand. With that development and concentrations more centralized and big scales livestock were developed which derived to the requirement of study on sewage management that will provide more friendly to communities and environment, there is growing public concern over potential impact on environmental quality caused by big scales farmers which contributed to air pollution and source of flies that generated from mismanage wastes. In response to this, regulatory agencies are scrutinizing animal waste management practices and revising regulations to reduce environmental impact. Handling these wastes in compliance with stricter environmental regulations can have a significant economic impact which required more expenditure. To reduced, here researcher going to introduce the innovative approach to manage waste that will convert wastes into higher value products. One approach to increasing the value of waste is to use it as an energy resource and the sludge will be convert to fertilizer and filtered the water to recycle as farm consumption which very clean and environment friendly. The amount of waste produced varies with the type of animal, but generally ranges from 25 to 30kg (wet basis) for cattle and around 30 kilograms per 1, 000 kg for chicken mass per day in intensive production systems. Fermentation anaerobic digestion also has some advantages for a waste treatment management. Nitrogen and phosphorus contents are not changed absolutely by fermentation process, is amenable to further treatment for the removal and so, coliform bacteria, other pathogens, insect eggs and internal parasites are destroyed or reduced to acceptable levels. As biogas has 70% methane, it could be used as a source of energy. The slurry produced in the process of biogas production also used in agriculture as bio-fertilizer to increase crop production and to decrease fertilizer cost. Biogas can contribute to the reduction of greenhouse gas emissions by substituting fossil energy sources. As a result, production of biogas has got tremendous attention for mitigation harmful effects of carbon on environment.

2. Material and method

Air and water pollution in general have been associated with various diseases like ocular and respiratory diseases. Numerous studies reported that exposure to polluted air is a significant cause of health problems such as acute respiratory infections, chronic obstructive lung diseases such as chronic bronchitis and asthma, lung cancer and pregnancy-related outcomes. Potential of scientific utilization of biogas energy as an alternative source of energy, and the ecological, social, cultural and economic impacts of biogas technology was studied by various researchers all over the world. Source of cow dung and chicken manure slurry prepared for this research work was collected from the cow farm and chicken farm around Balakong area which close to the National Defence University of Malaysia (NDUM). For preparing the experiment, both slurry with 1:1 ratio content was maintained. 30 liter dough slurry with additional 50 Grams yeasts were considered to be optimum due to the objective for this research is to analyzed the industrial scale biogas production from cow dung and chicken manure.

Experimental set-ups were made to investigate the production of biogas from the constructed anaerobic digestion of cow dung and chicken manure using yeast as catalyst. Where first experiment was used for cow dung slurry anaerobic digestion with yeast as catalyst and second experiment was used for chicken manure anaerobic digestion with yeast. The set-ups were placed in normal lab of room temperature in Chemical laboratory NDUM. Same experiment conducted by [6] investigated the production of biogas from kitchen wastes. They analysed different ratios of kitchen waste in a metal made portable floating type biogas plant. In their study, the temperature, solar radiation and relative humidity have been measured. They also analysed the constituent of biogas, pH, volume and rate of biogas production at different level of temperature observation on daily basis. [7] performed an anaerobic digestion of a mixture of cheese whey, poultry waste and cattle dung. They used various adsorbents to improve the digester performance. The adsorbents appeared to improve the digester performance, for example about a two-fold enhancement in total gas production with 17% enriched methane content were achieved with the addition of 4 g of silica gel.

The digesters made of stainless steel conical drum of 30 litres capacity was used for each. The schematic diagram of the set-up is shown in Fig.1. The digesters were connected with displacement water tank as gas production indicator. After 6 days of cow dung slurry and 10 days of chicken manure with same quantity of yeast 50 grams the slurry in the container produced biogas. Even though at day 6 and day 10 the capacity of gas not be able to give enough pressure to move the barometer but there are gasses produced due to burning experiment at the outlet tube. The capacity of productions shows cow dung is more productive than chicken manure. The quantum of gasses from cow dung slurry were harder pressure than chicken manure but the production is consistence until day 23 before its shows weaken. The slurry from cow dung produced highest pressure at day 10 until day 15 and chicken manure are consistently produced with consistent average pressure started day 12 until day 16. Methanogenic micro-organisms are very sensitive to yeast. Industrial type gas hose was used to connect the digesters and the displacement tanks. Digestion was done at ambient temperature. During the investigation the volume of the produced gas was measured with the help of water displacement method, considering the volume of the produced biogas was equivalent to the displaced water in the water collector. The digesters were operated manually. At the time of experiments, these study only to be carry out just to check the effectiveness of the yeast and the comparison of slurry. [1]stated that the biogas production was done by adding domestic sewage to the municipal wastes. In that experiment, [1]able to produce biogas about 68%-72% of biogas production. They performed biochemical methane potential experiments for two different waste concentrations which are 30 g/l and 60 g/l[1]. The results showed that cotton wastes can be treated anaerobically and an effective source of biogas. [8] stated that biogas production from water hyacinth, their experiment obtained the biogas yield of 1681.08 m3 /day. It was also established that using the dry water hyacinth would produce more biogas in comparison to the fresh water hyacinth. [5] observed the anaerobic co-digestion for biogas production. Kitchen wastes were used with cattle manure for their research purpose. Biogas production using batch anaerobic digesters at the mesophilic and thermophilic temperatures was also studied, they performed the thermophilic digestion test with four different feeds to inoculum ratios and the mesophilic digestion was conducted at one feed to inoculum ratio (3:1). The results showed that the feed to inoculum ratio significantly affected the biogas production rate. In their experiment, 80% of the biogas production was obtained during the first 10 days of digestion. They obtained the biogas yields as 430, 372 and 358 mL/g, whereas the methane yields were 185 mL/g. studied on batch and continuous biogas production from animal wastes. Both processes were conducted within the mesophilic temperature ranges. In their setup, they found that maximum biogas yield was 3.603 and 2.685 litres in the continuous process and batch process at a temperature of 370°C and 400°C respectively. Biogas production using rice husk has also been performed. It was studied on different parameters like water dilution, initial pH, heavy metals and nitrogen sources on digester performance. Biogas was produced at a rate of 30 mL/day and 69 mL/day for the control and poultry droppings, respectively, after two days while urea gave 8 mL/day on day four. They used poultry droppings (PD) as nitrogen supplements. In the study, they established that rice husk offers an alternative source of energy to agricultural farmers. [2] conducted an experiment to produce biogas from sawdust, co-digested with cow dung and water hyacinth. They produced biogas at a rate of 0.045 litre when about 11.48 gm of sawdust waste was digested in a fixed amount of cow dung and water hyacinth of 7 gm. The optimization of biogas production from chicken droppings with cymbopogon citratus was also performed. Chicken droppings were carried out for a period of 30 days at an average ambient temperature of 33.1 ± 2°C. They experimented these in identical reactors (A-C). The result suggested that chicken droppings produced on the average 1.8 L/kg/day of biogas, co-digestion of chicken droppings and C. citratus produced 1.3 L/kg/day of biogas while C. citratus alone produced 1.0 L/kg/day with estimated average methane content of 41.71%, 66.20% and 71.95% for reactors A–C respectively. Their result suggested that despite the higher biogas volumetric yield from chicken droppings digested alone, the co-digestion of chicken droppings with C. citratus had better gas quality.

3. Result and discussion

After 22 days of fermentation both slurry cow dung and chicken manure, the process automatically remove the smell and so, kills bacteria, pathogens, insect eggs and internal parasites. The smell was reduced to attracted flies. After filtered process, sludge water was clean, clear and no odour. Sewage filter set is shown in Fig 1. Biogas is considering reliable, easy and economically feasible source of alternative for renewable energy. With The available sources and simple innovation this approached be able to solved environment issues. By adoption of this model, its will benefits the country as a whole. These study manage to proof the positive outcome and will be able to improve communities living condition, reduced the flies and reduced disease caused by smoke and solved environment issues. Flame Test in close room resulted that biogas was found to be flammable and almost no smoke amuses, colorless and odor. Even though biogas technology has been introduced and developed quite a long time in Malaysia but for sewage management it is consider a pioneer project, however, the potential on industrial level will be explore in more details as research conducted. As an agricultural going to industrial country, Malaysia has developed the way of managing livestock farm which more concentrated and produced more waste. These approach of managing waste will definitely improve issues on environment. These new approach of waste management from livestock sources could be converted to useful energy forms for sustainable growth of local farmers and benefited to all Malaysians.

Fig. 1: Sewage Filter Set

4. Conclusion

In conclusion, these successful management waste systems could uplift the socio-economic status of its users because of its multiple benefits to the farmers at any level in Malaysia. It will indirectly give some impact on economy, health, environmental and agriculture. The prospects of these new system and approach are very good to be introduced in Malaysia for the benefits of farmers and society surrounding which at the same time provide positive development for new innovation in managing waste management.

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