



Performance Evaluation of Water Scrubbing With Cyclone Scrubber for Bio Gas

Choudhary Amit Mukund¹, Nagendra Pandey²

1 Mechanical, Parul Institute Of Engg. And Tech.

2 Mechanical, Parul Institute Of Engg. And Tech.

Abstract

Nowadays a scarcity of fuel, social and economical problem related to energy and pollution are the challenging issues in front of the world and in such scenario alternative fuel technology which may be economical and ecofriendly is need and demand of time. The India is the county where almost 70% of the total pollution is related to agricultural activities and so to convert the biomass available in terms of agricultural waste and cow dung can be used for generation of methane/biogas using anaerobic digestion process content around 20% carbon dioxide to remove such carbon dioxide water scrubbing and cyclone scrubbing are used and results are compare with methane analyzer is the main objective of present work.

1. INTRODUCTION

Most of the energy used in the world is supplied by fossil fuels and due to burning of the fossil fuels generates waste materials, mainly emissions to the atmosphere in the form of combustion fuel gases and dust and ash etc. These waste materials have hazardous effects on the environment. The continuous use of large amounts of fossil fuels pose a serious threat to the environment, also the fuels themselves are finite in quantity. At the beginning of the 21st century almost half of the fossil fuels had already been consumed. Another problem with petroleum is the emission of pollutants in environment, such as CO₂, NO_x, CO and hydrocarbons (HC). So, the world had to search for other such sources of fuel and now a day which are the most useful and eco-friendly source are gaseous fuels. Gaseous fuels have wide flammability limits and can easily form a homogeneous mixture with air for good combustion. The one the less pollutant and eco-friendly fuel is bio gas.

Biogas is an attractive source of energy in the rural areas. It can be produced from cow dung and other animal waste and also from plant matter such as leaves and water hyacinth – all of which are renewable and available in rural area. The main composition of biogas usually lies within the following ranges: 50-70% methane (CH₄), 25-50% CO₂, 1-5% H₂, 0.3-3% N₂ and various minor impurities, notably hydrogen sulphide (H₂S). Hydrogen sulphide provides the biogas its bad odor and also responsible for corrosion. The presence of carbon dioxide in the biogas reduces the combustion which ultimately affects the performance of the engine. Percentage of methane and carbon dioxide in biogas varies with the maturities of feed stock, temperature, water content, loading rate of raw material and bacterial actions. Biogas is a clean-burning, easily produced, natural fuel that is becoming a more important source of energy in rural, developing countries for cooking and heating.

Hilkiah Igoni [1] studied the Effect of Total Solids Concentration of Municipal Solid Waste on the Biogas Produced in an Anaerobic Continuous Digester. Kumar et al. [2] investigated the reactivity of methane. They concluded that it has more than 20 times the global warming potential of carbon dioxide. Shalini Singhet al. [3] studied the increased biogas production using microbial stimulants. Tri Ratna Bajracharya, Alok Dhungana, Nirajan Thapaliya, Gogan Hamal [4] studied and developed chemical scrubbing methods for biogas cleaning.

S.S. Kapdi [5] et al. made efforts to improve the quality of biogas by scrubbing CO₂ and the results obtained. There is a lot of potential if biogas could be made viable as a transport vehicle fuel like CNG by compressing it and filling into cylinders after scrubbing and drying. S.S. KAPDI suggested varieties of processes are being used for removing CO₂ from natural gas in petrochemical industries, Like Physical absorption, Chemical absorption, Adsorption on a solid surface, Membrane separation, Cryogenic separation, water scrubbing etc.

E. Porpatham [6] et al. studied experimentally influence of reduction in the concentration of CO₂ in biogas on performance, emissions and combustion in a constant speed spark ignition (SI) engine. The tests covered the range of equivalence ratios from rich to the lean operating limit at a constant speed of 1500 rpm and at compression ratio of 13:1.

The removal of carbon dioxide from the biogas is called scrubbing of bio gas and in the present work two methods 1. Water Scrubbing and Cyclone Scrubbing are compared for bio gas purification.

2. EXPERIMENTAL SET UP

Components for Water Scrubbing

Name of Component	Dimension
MS pipe	6" diameter and 6' height
Submersible Pump	10' head 1500LPM discharge
Metal Mesh	300 μ m
PVC Flexible pipes	0.5" diameter
Methane Analyzer	-

Components for Cyclone Scrubbing

Name of Component	Dimension
MS sheet	1 mm thick
PVC Flexible pipes	0.5" diameter
Methane Analyzer	-
Ball Valve	1/2" diameter brass made



Fig 1 Water Scrubbing Unit



Fig 2 Cyclone Scrubbing Unit



Fig 3 Top View of Cyclone Scrubbing Unit



Fig 4 Methane Analyzer

2.1 Methodology

In case of water scrubber first of all the flexible pipes are connected to scrubber with the water supplied lines with submersible pump and water drain system also pipes are fitted with bio gas inlet and collection unit of scrubbed bio gas. The gas is purged from the bottom of MS pipe and water is sprayed from the top of the pipe and gas coming out from the top of pipe is collected and analyzed using methane analyzer.

In case of cyclone scrubber the gas purged from top left side of the cyclone separator and due to density difference the purified methane comes out from the outlet provide at the top of cyclone scrubber.

3. RESULT AND DISCUSSION

With the help of methane analyzer the scrubbed gas in both the scrubber is analyzed and results obtained are as follows

Scrubbed Methane in Water Scrubber	Scrubbed Methane in Cyclone Scrubber
5 %	36 %

In case of water scrubber more moisture is found in comparison of cyclone scrubber and so moisture removal medium like silica gel has to be used for the gas scrubbed from water scrubber. Compare to water scrubber cyclone scrubber technology is simple and easy to handle also no need of any medium like water in case of cyclone scrubber so which again a benefit for cyclone scrubber.

CONCLUSION

In comparison of water scrubbing technology cyclone scrubbing technology is more compact and easy to handle and results are also better as far as biogas scrubbing point of view.

REFERENCES

1. Hilkiyah Igoni, M. F. N. Abowei, M. J. Ayotamuno and C. L. Eze (2008), Effect of Total Solids Concentration of Municipal Solid Waste on the Biogas Produced in an Anaerobic Continuous Digester.
2. Kumar, S., Gaikwad, S.A., Shekdar, A.K., Kshirsagar, P.K., Singh, R.N. (2004) Estimation method for national methane emission from solid waste landfills.
3. Shalini sing, sushilkumar, M.C. Jain, Dinesh kumar (2000), the increased biogas production using microbial stimulants Atmospheric Environment. 38: 3481–3487.
4. Er. Tri Ratna Bajracharya, Er. Alok Dhungana, Er. Nirajan Thapaliya, Er. Gogan Hamal, "PURIFICATION AND COMPRESSION OF BIOGAS: A RESEARCH EXPERIENCE", Journal of the Institute of Engineering, Vol. 7, No. 1, pp. 1-9
5. S.S. Kapdi, "Biogas scrubbing, compression and storage: perspective and prospectus in Indian context Centre for Rural Development and Technology", Indian Institute of Technology, New Delhi, India (2004).
6. E. Porpatham, A. Ramesh and B. Nagalingam, "Investigation on the effect of concentration of methane in biogas when used as a fuel for a spark ignition engine", Fuel, vol. 87, pp. 1651–1659, (2008).