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ENHANCEMENT OF BIOGAS BY ABSORBPTION OF CO_2 USING CHEMSEP

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ABSTRACT

Biogas from anaerobic digestion of biological wastes is renewable energy resource. It has been used to provide heat, shaft power and electricity. Typical biogas contains 50-65% methane (CH_4), 30-45% carbon dioxide (CO_2), moisture and traces of hydrogen sulphide (H_2S). Presence of CO_2 and H_2S in biogas affects calorific value & engine performance adversely. Reducing CO_2 and H_2S content will significantly improve quality of biogas. Biogas is produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. For storing synthesized biogas & enhanced biogas tyre-tubes are used as easy to transport and economical. Chemical absorption of CO_2 by Amine solution in tray column was investigated. Enhancement of biogas highlights alternative energy source.

Keywords: CO_2, H_2S.

I. INTRODUCTION

Due to strategic and environmental reasons, currently, there is an increasing interest in biofuels as alternative energy source. Bio-alcohols and biodiesel are the alternatives been considered for auto- motion while biomass and biogas are the alternatives been considered for electrical power generation. Biogas is a medium- energy content fuel (22 MJ/kg) derived from the organic material decomposition. It can be obtained from landfills or from bio-digesters that transform manure and biomass into natural fertilizer in farms after 25-45 days of residence time. Due to its gaseous nature and the impossibility of producing it intensively, it is not attractive for large scale power generation. However CO_2 has a typical concentration of 50- 60%. This high CO_2 concentration reduces the engine power output proportionally to its concentration, limiting the use of biogas by internal combustion engines the high content of H_2S causes corrosion in the metallic parts at the interior of the engine. So removal CO_2 is necessary However, the application of upgrading treatments mainly aimed at reducing the CO_2 concentration of bio-gas, such as e.g. water or amine scrubbing, membrane separation and pressure swing adsorption, may allow to obtain a product with an increased methane content, thus termed bio methane, which can be used as vehicle fuel or fed into the natural gas distribution grid. CO_2 removal, in fact is one of the first measures required to increase the energy content of the gas. The lower heating value of biogas, typically ranging between 15 and 25 MJ/Nm^3 for gas with a 50–60% vol. CH_4 content, can be raised to values typical of natural gas (35 MJ/Nm^3) when a methane content of more than 96–97% is achieved. Several biogas upgrading technologies, based on absorption or adsorption processes are commercially available. Research in this field is however quite active and concerns mainly the evaluation of the use of alternative solvents for absorption processes.

II. METHODOLOGY

Synthesis of biogas

Two digesters of volume 65cm^3 (200 Lit) were made. The outlet of the digester was connected to a U-Tube Manometer where the difference in the pressure of the gas was observed and noted at fixed interval of time. The present project work has performed on pilot scale digester with single stage, mesophilic conditions. A minimum daily monitoring and management is necessary to operate the plant. Which includes, feed preparation and feeding the digester, taking a reading of manometer (water displacement), making sure there are no contamination in feed stream. Daily monitoring of amount of gas generated was calculated. By using ideal gas law volume of biogas produced was calculated. Similar arrangement was made for remaining digester. Soybean seeds were used as a substrate for this experimental run. It was made available from the Market yard, Pune. Then soybean seeds were crushed in mill and made in powder form. The culture used was a mixed culture consisting of Hydrolytic bacteria, Acidogenic bacteria, Acitogenic bacteria and Methanogenic bacteria.

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Procedure

1. Firstly prepared slurry of soya flour (42.3 gm) with ammonium chloride (0.6 gm) adding water of 1 lit, and then fed it to digesters per day at fixed interval of time.
2. After every 24hours a reading of manometer P1 and P2 (pressure in and out) was noted and the amount of gas produced was calculated.
3. After taking reading then substrate and water was added, in all digesters.
4. Average room temperature was noted down.
5. After creating large pressure difference, we removed gas from the digesters and calculate gas production.

Table 1: Production of gas per day

Tank 1(dh)(cm)	Tank 2(dh)(cm)	vol of gas in tank 1(L)	vol of gas in tank 2(L)	production tank1(/day)	gas production tank2(/day)
1.5	1.8	100.8337032	100.8044967	100.8337062	100.8045003
11.5	8.7	99.86918615	100.137386	100.0127051	100.3105756
22	12.2	98.87610472	99.80236052	99.96482709	100.6393192
30.7	20	98.06810523	99.06373752	100.1374029	100.2239145
33.5	27.5	97.81086102	98.36376047	100.7072693	100.2527849
33.5	39.4	97.81086102	97.27320437	0	99.83101214
		voi in m^3	vol in m^3	vol in m^3	vol in m^3
		0.100833703	0.100804497	0.100833706	0.1008045
		0.099869186	0.100137386	0.100012705	0.100310576
		0.098876105	0.099802361	0.099964827	0.100639319
		0.098068105	0.099063738	0.100137403	0.100223914
		0.097810861	0.09836376	0.100707269	0.100252785
		0.097810861	0.097273204	0	0.099831012

Problem statement

An Absorption column is used to enhance the composition of methane by absorbing carbon dioxide in Biogas having 60% methane & 40% Carbon Dioxide. Design tray Column having optimum no of stages.

Steps to solve the problem in ChemSep:

1. Create a new Blank Simulation
2. Addition of Components
3. Operating column Specifications:
4. Click next and select property package: According to the need and requirement of the compounds the property package should be selected.
5. Specify the Feed Conditions of Biogas:
6. Analysis of degree of Freedom:
7. Specify Pressure conditions:
8. Determine heat losses

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9. Specify Efficiency of stages
10. Other Specifications of Column

III. RESULTS AND DISCUSSION

The results and discussion may be combined into a common section or obtainable separately. They may also be broken into subsets with short, revealing captions. An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it. This section should be typed in character size 10pt Times New Roman.

Table 2. Result table

Stream	Biogas	Top	Botto m
Stages	12	1	12
Pressure (N/mm^2)	10132 5	10132 5	10132 5
Vapor fraction	1	0	0

Table 3. Result table

Temperature (K)	298.15 0	111.89 1	174.86 6
Total molar flow	100	61.026 5	38.973 5

Table 4. Result Table

Mole flows (kmol/s)	Feed	Top	Bottom
carbon dioxide	40.0000	1.72595	38.2741
methane	60.0000	59.3005	0.69946
monoethanolamine	0.000	0.000	0.0000

IV. CONCLUSION

The enhancement of methane in biogas using ethanolamine as solvent through tray column has successfully done with 99% removal of carbon dioxide.

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V. REFERENCES

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