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Thermal Gasification Concept Using In Production Bio-SNG

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ABSTRACT:
Bio methane or Synthetic natural gas (Bio SNG) produced using thermal gasification concept from gasified renewable woody biomass is alternative option for replacing fossible natural gas. The complete exchangeability with natural gas in all its traditional application such as in power generation, transportation and other industry.
This work present result from a extensive process integration study of different process alternative for Bio-SNG production from gasified Biowast. The impact of main conversion steps in the process chain as, Drying, Gasification, Gas cleaning, Methanation and than gas upgrade . On the overall process performance is check up.

KEYWORDS -- Gasification Vessel, Woody Biomass

1. INTRODUCTION:

India was the fourth largest energy consumer in the world after China, USA, and RUSSIA. Primary energy consumption in India has more than double between 1990 to 2012 SNG (synthetic natural gas) is defined as a gas which contains mostly CH4 (> 95 % vol) with similar properties to natural gas which can be produced with the help of thermo chemical gasification or using thermal gasification concept conversion efficiency of biomass to SNG is higher than the efficiency to liquid fuel overall efficiency of conversion from biomass to SNG can be up to 70 % energy .

2. PREVIOUS METHODOLOGY:

2.1 BIOGAS:

Biogas is a widely used source of energy in Asia and India. It has been a renewed interest in biogas owing to rising concerns over the green house effect. Biogas is produced by bacteria through the bio-degradation of organic materials under anaerobic condition. Various natural conditions of biogas are an important part of Bio-geochemical carbon cycle. It can be used in rural and urban areas .

Chemical composition of biogas (TABLE 1)

Compound	Household %	Waste water treatment %	Agriculture waste %	Waste of agrifood industry %
CH4	40-60	55-77	55-75	≈ 68
CO2	40-35	19-30	19-30	≈ 26
N2	0-5	0-1	0-1	.....
O2	0-1	Less than 0.5	Less than 0.5	.....
H2O	6 at 40 degree	6 at 40 degree	6 at 40 degree	6 at 40 degree

Composition of biogas depends upon feed material

2.2 NATURAL GAS:

Natural gas is naturally occurring hydrocarbon gas mixture consist mainly methane but commonly including varying amount of other alkenes, sometimes small percentage of CO_2 and nitrogen and hydrogen sulphide. Natural gas is found in deep underground rock formation associated with other hydrocarbon.

Chemical composition of natural gas (TABLE 2)

Components	Range %
Methane	81-95
Nitrogen	0.2-5.5
Carbon dioxide	0.1-1.0
Oxygen	0.01-0.2
Ethane	1.2-7.5
Propane	0.1-1.5

3. PRODUCTION PROCESS OF BIO-SNG GAS:

Generally process setup for BIO-SNG production is thermo-chemical gasification process .

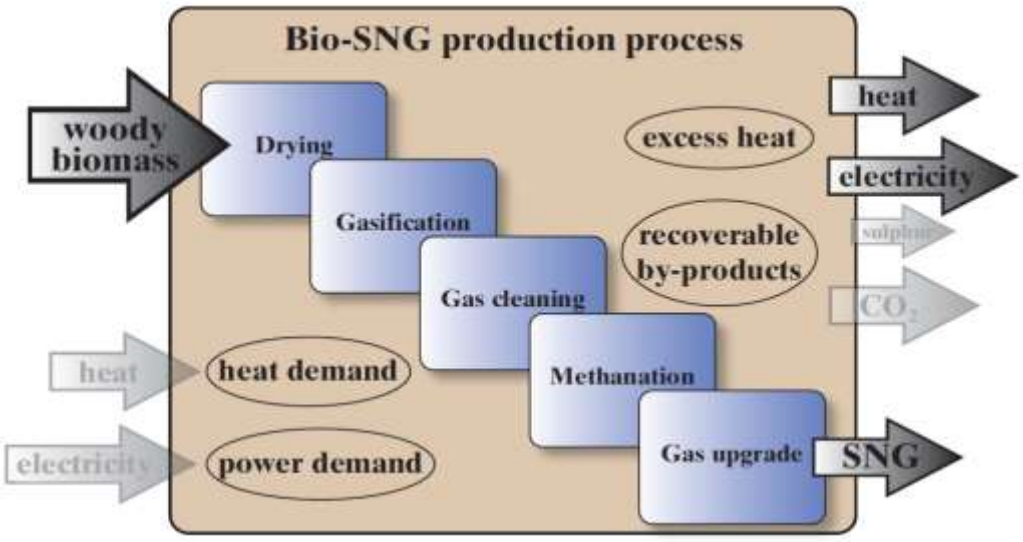

Figure 1: BIO-SNG PRODUCTION PROCESS

This process release substantial amount of excess heat

3.1 DRYING:

Generally natural moisture content of woody biomass is usually around 50-55 % natural drying at the place of harvest storage of biomass can reduce the moisture content considerable. A drying process is generally used to reduce the moisture content using low quality heat these by avoiding providing drying heat at the elevated temperature level of the thermal conversion process.

Basically three drying technique are applied in bio energy sector

1. Low temperature air drying
2. Steam drying
3. Flue gas drying

3.2 GASIFICATION AND GAS CLEANING:

After drying process biomass is feed into gasification process for the major conversion step within the BIO-SNG process converting solid biomass into product gas . For conventional thermal gasification some technology alternative exist shown in figure..

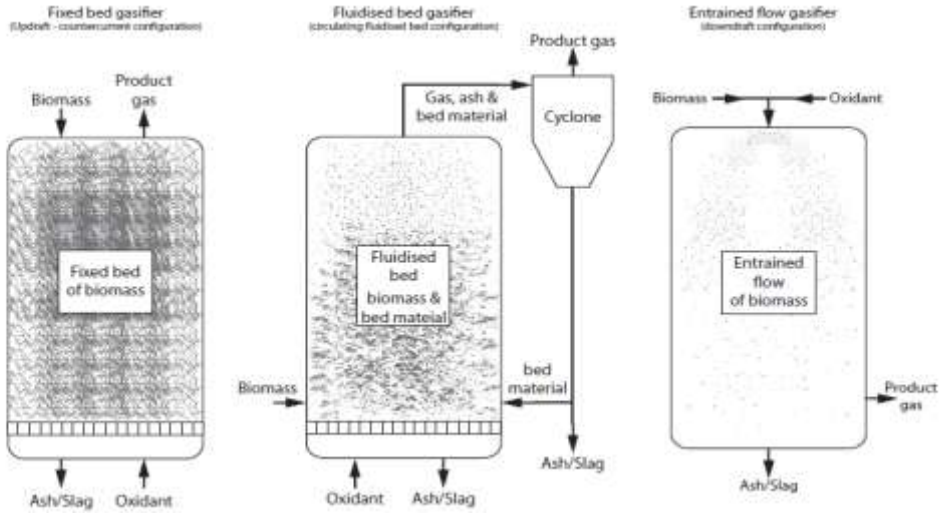

Figure 2: DIFFERENT TYPE OF THERMAL GASIFICATION TECHNOLOGY

Thermal gasification of bio mass basically proceeds in some major steps . firstly remeanin fuel moisture is evaporate by pyrolysis converting the biomass into a char as well as permanent and condensable gases The major chemical reactions occurring in gasification are listed here,

BIOMASS FEEDSTOCK →

→ char + tars + CO_2+ H_2O + CH_4 + CO + H_2 + (C_2 − C_5) + impurities

C + $^1/_2$ O_2 → CO $\quad \Delta H_r^{298\ K}$ = -109kJ/mol

C+ CO_2 ↔ 2CO $\quad \Delta H_r^{298\ K}$ = +172 kJ/mol

C + H_2O ↔ CO + H_2 $\quad \Delta H_r^{298\ K}$ =+131 kJ/mol

CH_4 + H_2O↔ CO + $3H_2$ $\quad \Delta H_r^{298\ K}$ =+159 kJ/mol

CO + H_2O ↔ CO_2+H_2 $\quad \Delta H_r^{298\ K}$ =-42 kJ/mol

3.3 METHANATION:

Clean product gas is converted to methane in following steps there are several method produced BIO-SNG. The main reaction occur during methanation is the conversion of carbon monoxide and hydrogen to methane and water.

$$CO + 3\,H_2 \rightarrow CH_4 + H_2O \qquad \Delta H_r^{298\ K} = -206 \text{ kJ/mol}$$

The optimal ratio between hydrogen to carbon monoxide prior to methane is 3:1

$$H_2O + CO \rightarrow H_2 + CO_2$$

$$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O \qquad \Delta H_r^{298\ K} = -164 \text{ kJ/mol}$$

3.4 GAS UPGRADE:

Gas produced by methanation is the mixture of methane carbon dioxide, water and some percentage of nitrogen, hydrogen and carbon monoxide. Most important steps in gas upgrade is separation of carbon dioxide. This is an energy intensive process with several technique solutions available

Finally the gas needs to be dried of any remaining moisture and then compressed. Drying process achieved by a glycol wash unit using trithylene glycol as a solvent.

4. RESULT:

The result of the process comparison indicates that the pressurised process of the gasification reactor achieves high exegetic performance within the whole parameter investigated. Chemical composition of bio gas is shown in table 1. Chemical composition of natural gas is shown in table 2. Bio-SNG production process are shown in figure 1 and gasification technology are shown in figure 2 .

5. APPLICATIONS:

1. Electricity generation,
2. Transportations fuel,
3. Process heating

6. CONCLUSIONS:

The present result of this work clearly show that the importance of a holistic approach in order to identify efficiency Bio-SNG production process. Basic importance process step for Bio-SNG process is the feed stock drying prior to gasification low temperature drying and steam are technology that after good opportunities for integration.

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