Experimental studies on various biomass using fluidized bed gasifier

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Abstract - *Applications of this project is gas lighting, streetlamps and the illumination of buildings in towns with a municipal gas supply, gas burners, Bunsen burner used in laboratory settings, gas heaters, camping stoves, and even to power vehicles. Biomass research is recently receiving increasing attention because of the probable waste-to-energy application. Aim of the project is to produce the fuel gas. Fuel gas is produced from the biomass by direct heating method. Producer gas is produced to run the IC engine. Gasification is the project that converts organic or fossil fuels based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide .It is the better method replacement for other fuels and increase the life time of the IC Engine and reduce the pollution.*

Keywords: Bio mass, Rice husk ,Fluidised bed gasifier, Fixed bed gasifier, continuous gasifier.

1. INTRODUCTION:

The proposed system with self circulating setup can be used to gasify various biomasses like Rice Husk, coir pith ,saw Dust, and Ground Nut shell are studied. The various biomass can be preheated before it reaches the bottom successfully used to process Al-5wt of the gasifier with the introduction of self circulation setup are studied. Gasification process is successfully carried out in the proposed system with self circulating system using rice husk and the producer gas is separated are studied .The gasification process starts and the producer gas is produced are studied. The overall gasification process timing is extended up to 35 minutes are studied. Scanning through history ,few topics have attracted the attention of humanity as much as energy and nothing has contributed more towards socio-economic development than what energy has done to the mankind .Energy –a fundamental issue to all people –permits every activity of human life. we depend on energy in some form or the other to meet all our essential and material needs. Energy in different forms and also in adequate quantities is absolutely essential for the rapid socio-economic transformation of a country. A study of world economic growth clearly establishes that increased use of energy leads to increased prosperity of the country .In simple language how much and how best we use our energy and energy resources indicate the level of prosperity and standards of living of the people of a country .The panacea for prosperity is to increase per capita energy consumption and it should be used efficiently and effectively.

2. LITERATURE SURVEY

Sethupathy subbaiah.et. al(2014)Above researcher conduct experiments on gasification of biomass using fluidized bed . The highest hydrogen yield per kg of biomass is achieved at the condition of temperature 800^{0}C ,S/B of 0.60 and equivalence ratio of 0.20. Salami N, et al.(2015): Above researcher conduct experiments on improve of produced gas quality by using air/steam in fluidized bed gasifier .the best quality of produced gas at the experimental conditions (ER=.02) are T101=830^{0}C. S/B =0.68.Tf1 is the higher the value. Reza Alipour moghadam .et al.(2013): Above researcher conduct experiments on hydrogen production from mixture of biomass and polyethylene waste in fluidized bed catalytic steam co-gasification process. The highest H2 content 76.18 vol% achieved at 800^{0}c using 25 wt %of PE mixed with PKS. Doyce Tesoro-Martinez .et al.(2014) Above researcher conduct experiments on use of fluidized bed technology in solid waste management .Fluidized bed technology applications have gone far beyond combustion ,gasification . Research Gap: Above researcher is not done with the various biomass can be preheated before it reaches the bottom successfully used to process Al-5wt of the gasifier with the introduction of self circulation setup and not researched over the overall gasification process timing is extended up to 35 minutes

3. EXPERIMENTAL DETAILS

3.1 Gasifier settings

Fig.1.Gasifier set up

The actual continuous rice husk gasifier which is made up of Mild steel pipes is shown in fig.1. This experimental unit consists of gasifier, orifice meter with manometer ,compressor, Air flow control valve ,Ash collector ,Burner. Air required for gasification is supplied by the compressor at high pressure .The flow rate of air is adjusted by the valves and that flow rates can be measured with the help of orifice meter connected to the inlet of the gasifier. The Ash collector was placed at the outlet of the cyclone separator for ash collection. The Rice husk was uniformly fed into the hopper and compressed air was supplied to the gasifier through the controlling valve .The air was sent continuously at the same time the husk was fed the hopper. A weighted quantity of Rice husk fed into the hopper per every minute ,thereby the feed rate of husk was calculated. The above experiment was repeated for various air flow rates with constant husk flow rate and the corresponding residence time and the Air fuel ratio was calculated .These measurements showed that always an air /fuel ratio greater than one could be maintained in the gasifier assuming a condition conduce for gasification

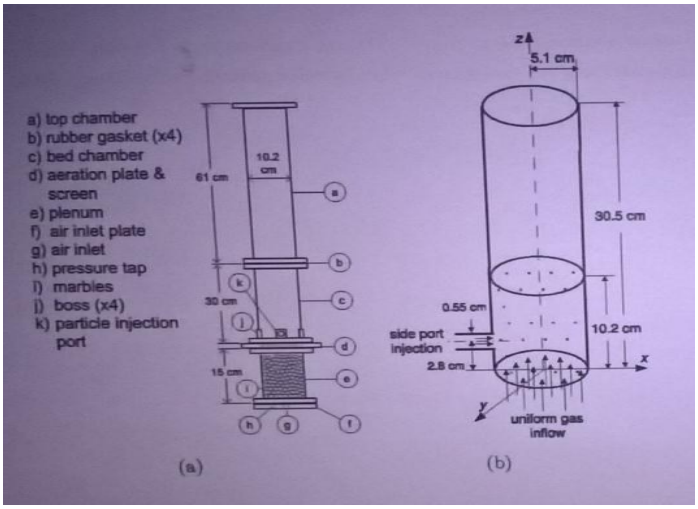

Fig.2. 2D diagram for Experimental setup

Fig.3.Producer Gas and Unburnt biomass

Fig.4.PRODUCED FLAME

4. METHODOLOGY

4.1SYSTEM DESCRIPTION

COMPONENTS OF ACTUAL GASIFIER

- This actual gasifier was made with the similar dimensions of the preliminary model. the modified one is the hopper was fixed at the side of outer pipe and the air inlet pipe has the length of 60cm and diameter of 6cm with a self circulating plate in which surrounded in it.The outer has the diameter of 18cm and length 70cm.
- The entire gasifier system was made up of mild steel pipes. This unit consists of compressor, Gasifier ,control valve and Manometer .At the bottom of the inner pipe the tire placed in which charcoal was kept.
- The compressor supplies the air required for gasification ,the air flow rate was controlled by using valve .The flow rate was calculated with the help of U-tube manometer.
- The husk was fed in the hopper, the continuous air supply was given to the system, so that the combustion of charcoal was continuously done in the inner pipe. The ash coming out of the system was collected in the ash collector. The producer gas was continuously come out through the cyclone separator.

INSTRUMENTATION

- For measuring various values in the gasifier system, some of the conventional instruments were used.
- Air flow rate was regulated by valve provided in the compressor air line.These flow rates are measured using U-tube manometer.

Table-1.Operations of gasifier

S.NO	OPERATIONS OF CONTINUOUS GASIFIER
1.	Starting of the system
2.	Shut down the system

STARTING OF THE SYSTEM

- The entire operations such as from the cold state to the normal operating conditions can be achieved in about 16-17 minutes.
- This gasification studies were carried out at different flow rate of air with the constant husk flow rate 4.4 kg/hr.

SHUTDOWN THE SYSTEM

- After completion of the ecperimental trails the following procedure is adopted for shutting the plant ,first the feed is stopped.
- Then the compressed air flow was kept at the maximum level .This will gradually reduce the temperature of the system. After certain time the system will attain the room temperature.

Table-2.Problems in Gasification

S.NO	PROBLEMS ARISED IN GASIFICATION
1.	Control of air flow rate
2.	Volatile matter present in the rice husk
3.	Ash collection

5. RESULT AND DISCUSSION

5.1 HYDRODYNAMIC STUDIES

Hydrodynamic studies were conducted in the self circulating fluidized bed gasifier .From these studies, the residence time of bio –masses and air fuel ratio of this system was calculated for various flow rates of air .These results gave approximately equal air fuel ratio whatever obtained in the preliminary model .For entire studies ,the feed rate of husk was maintained as constant

Table -3. HYDRODYNAMIC EXPERIMENT FOR MASS FLOW RATE

S.NO	Height of water(h_w) m	Height of air(h_a)m	Air flow rate (kg/hr)	Mass flow rate (kg/s)
1.	0.035	28.22	4.4	26.01
2.	0.025	20.16	3.8	29.04
3.	0.015	12.09	2.9	31.85

TABLE-4. HYDRO DYNAMIC EXPERIMENT FOR A/F RATIO

Sl. NO	Vol.flowrate of rice husk(m^3/hr)	Vol.flow rate of air +rice husk(m^3/hr)	Residence time (sec)	A/F ratio
1.	0.052	4.45	0.79	0.18
2	0.038	3.74	0.93	0.21
3.	0.024	2.89	1.21	0.25

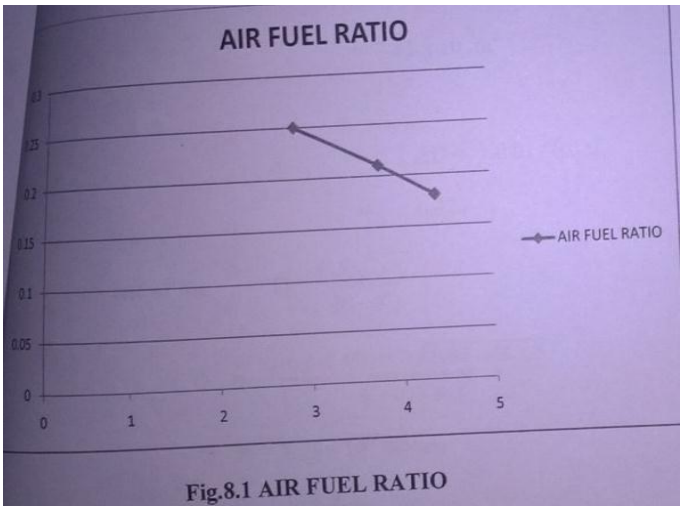

Fig.5.AIR FUEL RATIO

From the above experiments and graphs the following observations are made

- If the air flow rate increases the air fuel ratio also decreases.
- If the air flow rate increases ,the residence time decreases .
- If the fuel flow rate increases the air fuel ratio decreases
- If the circulation rate of husk increase the combined volumetric flow rate of air +rice husk increases.

Table-5. Formulas

Calculation of air flow rate	$Q=C_0S_b\sqrt{2gh_a}/\sqrt{(1-\beta^4)}$
Calculation of circulation rate of rice husk	Amount of Rice husk filled in 10cm height(kg) / Time taken by rice husk to travel of 10cm height (sec)
Calculation of residence time	Volume of the central tube/volumetric flow rate of air +Rice husk
Calculation of air fuel ratio	Flow rate of air / circulation rate of husk
Gasification	η =η amount of gas produced lcv of gas /Quantity of husk level x lcv of biomass.

Table-6. COST ESTIMATION

DESCRIPTION	AMOUNT
MATERIAL COST	6070.00
LABOUR COST	3500.00
OTHER EXPENSIVE	1100.00
TOTAL COST	10670.00RS

6. CONCLUSIONS

The proposed system with self circulating setup can be used to gasify various biomasses like Rice Husk, coir pith ,saw Dust and Ground Nut shell.

The various biomass can be preheated before it reaches the bottom successfully used to process Al-5wt of the gasifier with the introduction of self circulation setup.

Gasification process is successfully carried out in the proposed system with self circulating system using rice husk and the producer gas is separated .

The gasification process starts and the producer gas is produced.

The overall gasification process timing is extended up to 35 minutes.Thus the gasification process is carried out successfully.

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