GAS ANALYSIS OF THE RICE HUSK GASIFIER WITH AND WITHOUT GAS CONDITIONING UNIT

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Thanks be to God!!!

Now, we can know what will happen if gas conditioning unit is incorporated to the gasifier system to generate clean and quality gas that can be used for heating or for power application. Gas conditioning unit is basically incorporated in a rice husk gasifier system to make sure that the gas produced can be safely used when fuelled into an internal combustion engine. The aim of incorporating a gas conditioning unit is to remove tars and particulates from the gas stream so that it will not accumulate and not cause harm to the engine. However, its effect on the energy content of the gas is not clearly defined thus far.

Figure 1. Rice Husk Gasifier with Gas Conditioning Unit Attached.

A study was conducted to check the gas produced from the gasifier with and without the gas conditioning unit by taking 20 liters of subsamples of gases from the gas stream produced from a 40D rice husk gasifier equipped with 3-in-1 gas conditioning unit. That is, the gas conditioning unit consists of a wet scrubber, filter, and gas storage in one setup. The blower of the gasifier reactor was set at ½ opening and the temperature of the gas leaving the reactor and entering the gas conditioning was measured during the study. In the first treatment, subsamples of gases were taken from the set up without allowing gas to pass through the gas conditioning unit. In the second treatment, on the other hand, the gas from the gasifier was allowed to pass through the gas conditioning with the pump in the scrubber running; while in the third treatment, the pump of the wet scrubber was shut off and then gas samples were taken.

The samples of gases obtained during the study were allowed to cool inside the plastic bag to ambient air temperature before subjecting them for analysis. The Gasboard 100P, that gives the percentage amount of gases such as the carbon monoxide(CO), methane (CH_4), hydrogen

(H_2), carbon dioxide (CO_2), hydrocarbons (CnHm), and oxygen (O_2), was used. The heat energy content of the gas samples for the three treatments were also determined during the study from the data provided by the analyzer.

Figure 2. Sample of Gas Taken from the Gasifier and Gas Conditioning Unit and the Gas Analyser Used in the Study.

As shown in Table 1 below, the percentage content of gases obtained from the reactor without the gas conditioning unit are as follows: 19.26% for CO; 4.06% for CH_4; 11.28% for H_2; 14.10% for CO_2; 0.13% for C_nH_m; and 0.62% for O_2 gases. For the percentage content of gases taken from the gas conditioning unit with the pump running, the percentage content of gases obtained are as follows: 15.34% for CO; 1.76% for CH_4; 9.18% for H_2; 10.72% for CO_2; 0.01% for C_nH_m; and 3.12% for O_2 gases. When the pump, which immediately sprays water into the gas, was shut off, the amount of gases obtained are as follows: 15.39% for CO; 2.54% for CH_4; 8.16% for H_2; 13.15% for CO_2; 0.12% for C_nH_m; and 1.46 for O_2 gases.

The temperature of the gas that leaves the reactor and subsequently enters the gas conditioning unit varies from 259° to 320 °C. It can be observed from the results of the analysis that the quality of the gas obtained directly from the reactor averages at 1236.67 kcal/m^3, which is much superior compared when the gas passed through the gas conditioning unit. When the gas passes through the gas conditioning unit with wet scrubber and filter and the pump is ON, the percentage composition of CO, CH_4, H_2, and CO_2 decreased while the amount of O_2 increased. The percentage composition of CnHm also dropped indicating that the gas obtained from the gasifier was effectively cleaned as it passed through the scrubber and through the filter. The energy content or heating value of the gas obtained with the pump switched ON is 852.00 kcal/m^3. When the pump was shut OFF so that the gas will not be sprayed with water, however, the energy content of the gas slightly increased to 972.00 kcal/m^3. As can be observed, O_2 decreased which indicates that by spraying hot gas with water, oxygen is released in the process. Moreover, tar was observed at the outlet of the gas pipe indicating that the gas just passed through the scrubber without getting washed. This finding is further attested by the increase in C_nH_m value of 0.12% from 0.01% when the pump was switched ON. It was also observed during the test that the ring blower also had difficulty to rotate indicating presence of tar in it causing its bearings to clog.

Table 1. Compositions and Energy Contents of Gas Samples Taken from the Gasifier With and Without the Gas Conditioning Unit.

System	CO (%)	CH_4 (%)	H_2 (%)	CO_2 (%)	CnHm (%)	O_2 (%)	Gas heating Value ($kcal/m_3$)
Gasifier without Gas Conditioning Unit	19.26a	4.06a	11.28a	14.10a	0.13a	0.62a	1236.67a
With Gas conditioning Unit (Pump ON)	15.34b	1.76b	9.18ab	10.72ab	0.01a	3.12b	852.00b
With Gas conditioning Unit (Pump OFF)	15.39b	2.54b	8.16b	13.15b	0.12a	1.46b	972.00b

At 5% level of significance

Statistical analysis, at 5% level of significance, showed that the percentage gas composition obtained for Treatment 1 gas samples (e.i., gas obtained from the gasifier reactor without passing through the gas conditioning unit) is statistically different for CO, CH_4, and O_2 gas samples when operated with the pump switched ON. Furthermore, operating the pump either switched On or Off has no significant effect on the percentage composition of gases obtained during the experiment at 5% level of significance. Only the heating value of the gas obtained from the gasifier reactor was found to have highly significant differences at 5% level of significance.

It can be concluded based on the results of the study, that the energy content of the gas coming out of the gasifier decreases when immediately sprayed with water at the wet scrubber to cool and to remove hydrocarbons. Spraying the gas with water tends to increase oxygen content but reduces hydrocarbon content. Further studies need to be done to see if the same results can be obtained from other similar gasifier systems. Designing a gas conditioning unit for the gasifier that can provide high energy-content gas with low hydrocarbons is therefore vital in achieving breakthrough in gasifier development, especially for generating power using internal combustion engine.

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