GAS HEATING VALUE AT DIFFERENT SUPERFICIAL GAS VELOCITY IN A 40D MOVING-BED RICE HUSK GASIFIER

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Glory to God!!!

At last we can now determine the optimum superficial gas velocity (SGV) inside the gasifier reactor that determines the heating value of gas! Knowing the right SGV for the gasifier would lead to a design of the gasifier reactor diameter that will give the optimal heating value for the gas produced. With the right SGV, the size of air-moving device can be easily established.

Figure 1. The Gasboard 3100P Gas Analyzer.

This study was conducted using a 40-cm diameter gasifier reactor without the gas conditioning unit. The gasifier was operated at different blower settings and the velocities of the air delivered by the blower were determined using Extech thermo-anemometer. The SGV at the reactor was then calculated after the airflows for the various blower settings were defined. This was done by dividing the airflow with the cross sectional area of the gasifier reactor. For each measurement, samples of the gas were obtained from a sampling tube installed right next to the particle separator of the gasifier using an empty plastic bag. Each sample contains around 20 liters of gas which is then cooled to ambient air before subjecting for gas analysis using Gasboard 3100P Gas Analyzer. The percentage composition of each combustible gases, which includes carbon monoxide (CO), methane (CH_4), and hydrogen (H_2), was determined. Moreover, the percentage composition of non-combustible gases such as carbon dioxide (CO_2), hydrocarbons (CnHm), and oxygen (O_2) was also measured. The corresponding heating value of gases were then determined from the combustible gaseous elements obtained from the analyser.

Table 1 below shows the results of the study for the various compositions of gases at different SGVs. For CO gas, the percentage amount varies from 18.28 to 19.51%. Although there was no

Table 1. Composition of Gas at Different Superficial Gas Velocity on a 40 Rice Husk

SGV (cm/sec)	**CO** (%)	**CH_4** (%)	**H_2** (%)	**CO_2** (%)	**CnHm** (%)	**O_2** (%)
2.35	18.28a	4.11a	7.81a	12.64a	0.16a	1.51a
2.95	19.23a	3.59a	10.26ab	12.26a	0.10ab	1.09a
3.68	19.13a	3.32a	9.98ab	12.28a	0.10ab	0.71a
3.91	19.51a	3.18a	10.42ab	11.97a	0.06ab	0.80a
4.02	19.27a	2.65a	11.11b	11.79a	0.03b	0.70a

At 5% level of significance

trend observed in the percentage composition of gas with respect to SGV, the highest was obtained at 3.91 cm/sec SGV. For CH_4 gas, on the other hand, the percentage amount varies from 2.65 to 4.11% where the highest SGV was obtained at 2.35 cm/sec. It can be observed here that as SGV increases, the percentage composition of CH_4 gas decreases. For H_2 gas, it was also observed that there is no definite trend obtained for the gas composition with respect to SGV. As shown, it varies from 7.81 to 11.11% with the highest percentage composition at 4.02 cm/sec SGV. For non-combustible gases, moreover, the CO_2 gas obtained varies from 11.79 to 12.64% with the highest at 2.35 cm/sec SGV. Similarly with CH_4 gas, an inverse relationship between the gas and the SGV was observed, that is, as SGV increases the percentage composition of CH_4 gas decreases. Also, for CnHm gases, a decreasing trend in the percentage

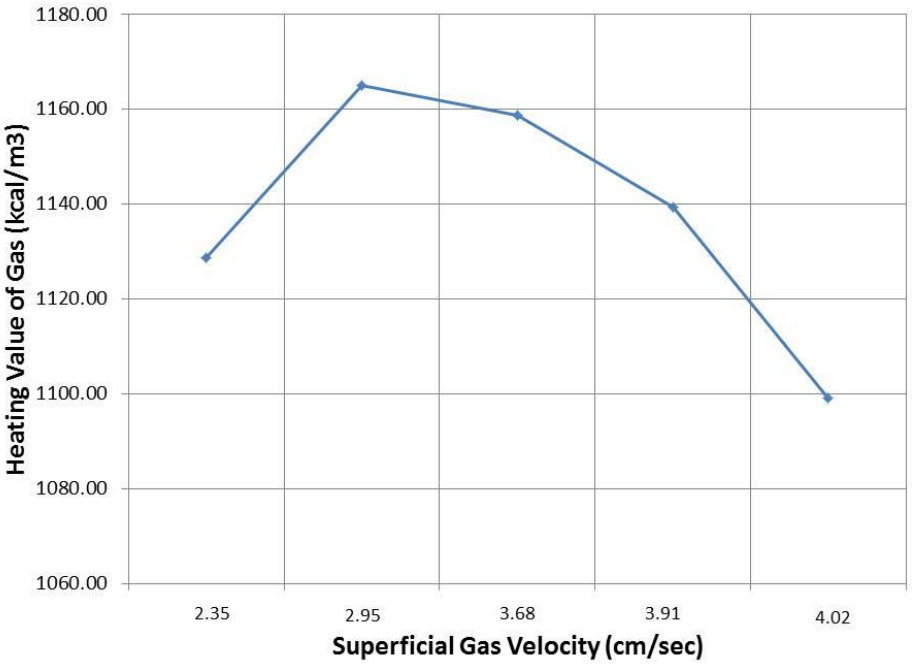

Figure 2. Heating Value of Gas at Different Superficial Gas Velocities on a 40D Rice Husk Gasifier.

composition was observed as SGV increases. Values obtained range from 0.03 to 0.16% with the highest at 2.35 cm/sec SGV. The values obtained for CO_2 gas range from 11.79 to 12.64% with the highest at 2.35 cm/sec SGV, too. For 0_2 gas, furthermore, the percentage composition varies from 0.70 to 1.51% with the highest at 2.35 cm/sec SGV. However, statistical analysis shows that there are no significant differences in the percentage composition of CO, CH_4, CO_2, and O_2 gases at different SGV's. Nevertheless, significant differences were obtained in the percentage composition of H_2 and C_nH_m gases at 5% level.

Figure 2 above shows the heating value of the gas at different SGVs. Results show that at 2.95 cm/sec SGV gave the highest heating value for gas of 1,165.00 kcal/m^3 followed by 2.35 cm/sec SGV with 1,128.67 kcal/m^3 heating value for gas. At 3.68, 3.91, and 4.02 cm/sec SGVs obtained 1,158.67, 1,139.38, and 1,099.00 kcal/m^3 heating value for gas, respectively.

It is recommended therefore that the 40D rice husk gasifier reactor must be designed at 2.95 cm/sec SGV to obtain gas with high energy content during operation. For further study, tests must also be conducted for the different reactor diameter to determine their optimum SGV, that is, the SGV level that yields the highest energy content for the gas, as well as to see if similar trend and range of velocity also appears for all the gasifiers.

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