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Comparative Study on Gasification of Chicken Litter with Rice Husk and Saw Dust

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Abstract

In India, poultry industry is one of the agro based industry growing with a rate of 7.3%, which is found to be better than any other agro based industries. The chicken litter is usually available in the poultry farms in the mixed state with rice husk or saw dust, which are spreaded over the ground to reduce the moisture inside the farm and also to maintain hygiene. Hence in the present study gasification of chicken litter and saw dust and also with chicken litter with rice husk is done in the fluidized bed Gasifier and the producer gas obtained from it is analyzed for optimization.

Keywords: Gasifier, Chicken Litter, Fluidized Bed.

Introduction

In India, poultry industry is one of the agro based industry growing with a rate of 7.3%, which is found to be better than any other agro based industries. India contributes 10% of the world's chicken population, with 3rd largest egg producers (53 million eggs per year) after China and USA and 5th largest meat producers of the world [1]. With this population of chicken in India, it contributes nearly 137 million tones of litter [2]. The disposal of such a huge quantity waste is a big headache for the poultry farmers. The chicken litter can be disposed as a fertilizer, but if mixed with underground water it leads to nitrate contamination. Consumption of such water leads to blue baby syndrome, lung cancer etc [3]. The proximate and ultimate analysis results of chicken litter [4] signify the energy value of it. The Ash content is found to be very high in comparison with other values and the ash deformation temperature is lower. The studies conducted [5][6] to utilize the chicken litter as energy source signifies that fluidized bed gasification process is found to be better in comparison with other techniques. In this regard the fluidized bed gasifier is designed and developed in our laboratory for a feed rate of 0.4 kg/hr with inside diameter of 6cm.

The chicken litter is usually available in the poultry farms in the mixed state with rice husk or saw dust, which are spreaded over the ground to reduce the moisture inside the farm and also to maintain hygiene. Hence in the present study it is planned to analyze the fluidized bed gasifier in blends with

chicken litter and saw dust and also with chicken litter with rice husk.

Experimentation

Procedure of conducting the experiment:

100 Kg of chicken litter was collected from a nearby poultry farm and dried in an open field to achieve the required dryness. Then it was ground and sieved to 850 μ m of 30 mm. The gasifier chamber was filled up to a height of 30 mm with 850 μ m of sand. The gasifier was initially heated to a temperature of 700 – 8000 C using a Kandal A1 coil. When the coil reached a temperature of 8000 C, the air required for fluidization of sand particles was supplied by using an air compressor and then the sample (chicken litter+ rice husk or chicken litter + saw dust) prepared for the purpose was added through a manual feeder. The producer gas inside the gasifier chamber was at a slightly higher temperature; hence its temperature had to be reduced to the required level. The gases obtained were passed through a heat exchanger, to be cooled down. The gases consisted of a certain amount of moisture; they had to be reduced before they are utilisation as an energy source. Hence it was made to flow through a calcium chloride chamber. Then, through the vacuum pump, the producer gas generated was made to pass to the four-gas analyzer. The gasifier was operated continuously for 3-4 hours and the average value of the results obtained was tabulated. Figure-1 is a

schematic representation of the experimental process undergone during the gasification.

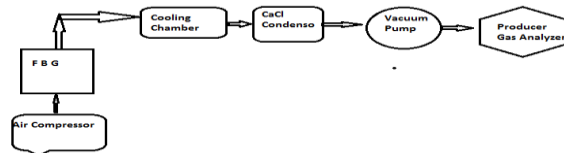


Figure-1: Schematic representation of production of producer gas and its analysis

Results And Discussion

The chicken litter obtained from the poultry farm will be a mixture of sawdust or rice husk with chicken litter. The experiment was conducted for the gasification of chicken litter with different proportions of rice husk and sawdust.

Experimental results for gasification of CL with RH

The fluidized bed Gasifier was tested for gasification of chicken litter with different blends of rice husk (90% CL + 10% RH, 80% CL + 20% RH, 70% CL + 30% RH, 60% CL + 40% RH, 50% CL + 50% RH). The cold gas efficiency and heating value of the producer gas calculated are plotted in the figure 2 and 3 respectively. The compositions (CO%, CO₂%, CH₄ % and H₂%) of the producer gas are plotted in the figure 4, 5, 6 & 7 respectively.

The heating value (4634.4 to 1564.4 KJ/ N m³) and the cold gas efficiency (79.16% to 20.96%) of the producer gas obtained were found to decrease with increase in the equivalence ratio (0.16 to 0.3) and also with the increase in the blend composition. It signifies that blending the chicken litter with rice husk decreases the heating capacity of the producer, because the heating value rice husk get heated up faster and that heat is absorbed by the chicken litter for further processing. Of these blends 30% rice husk and 70% chicken litter were found to give better result in comparison with other blends.

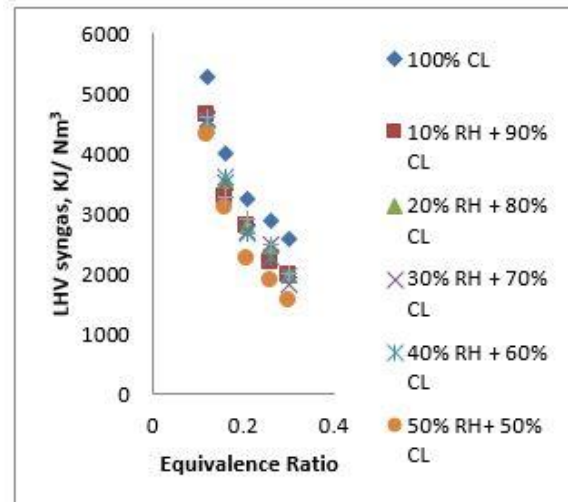


Figure-2: Lower heating value producer gas for Blends of CL and RH

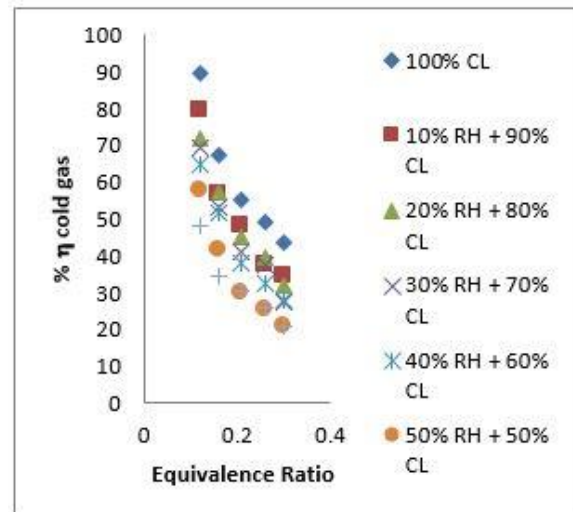


Figure-3: Variations in cold gas efficiencies of Gasifier for blends of CL and RH.

The variation in the percentage composition of CO, CO₂, H₂ and CH₄ obtained by gasification of chicken litter and with different blends of rice husk for different values of equivalence ratios is shown in Figure-4, 5, 6 and 7 respectively.

The variation in generation of CO, H₂ and CH₄ produced were found to decrease with increase in the equivalence ratio, signifies a decrease in the heating capacity and the flame length of the producer gas obtained, which is due to low carbon content and high moisture content of the mixtures used.

The productions of CO₂ in the producer gas obtained were found to increase with increase in the equivalence ratio and blend, due to increase in

percentage of ash production with increase in the mixture. The gas obtained has to be thoroughly conditioned before utilizing it for further processing.

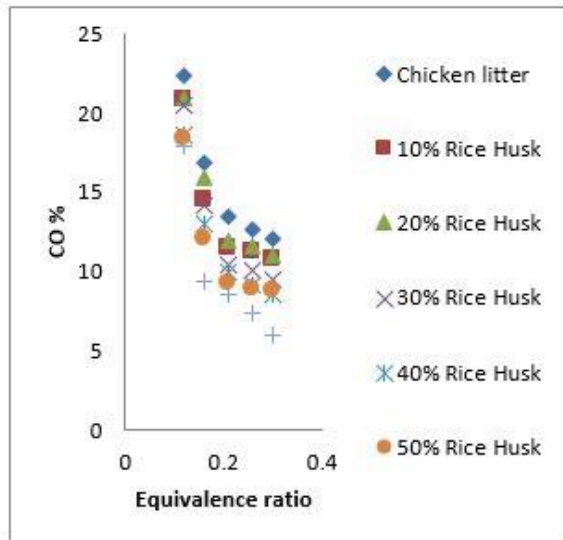


Figure-4: CO composition variation for blends of CL and RH

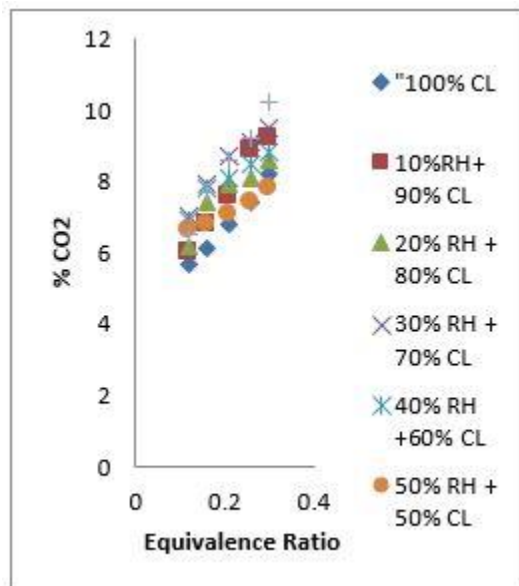


Figure-5: CO₂ composition variation for blends of CL and RH

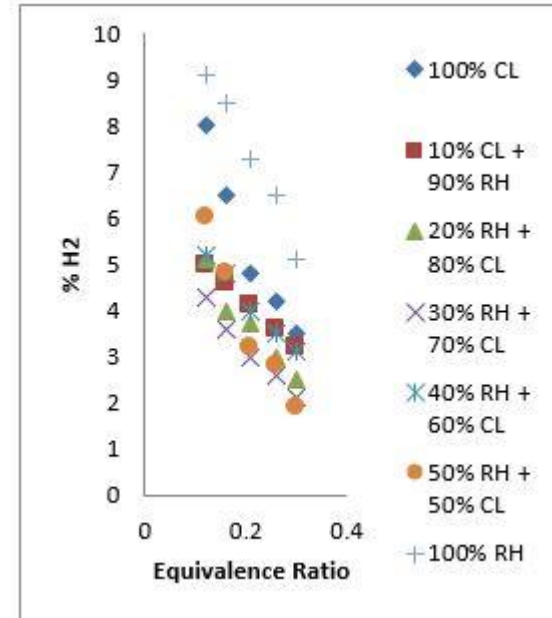


Figure-6: H₂ composition variation for blends of CL and RH

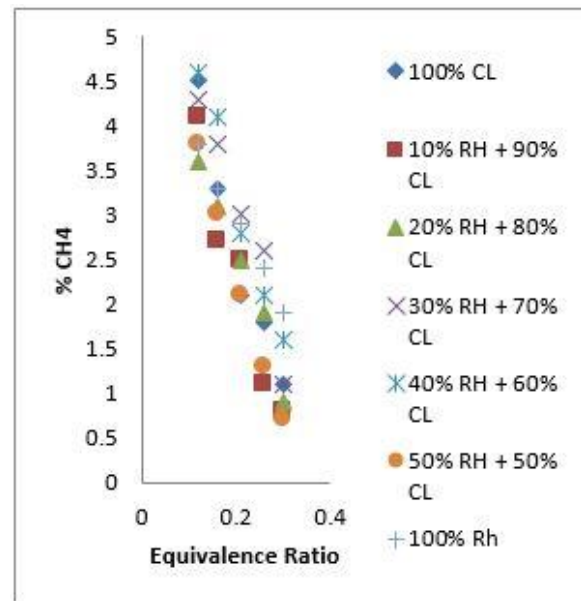


Figure-7: CH₄ composition variation for blends of CL and RH

Experimental Results for gasification of CL with SD

Chicken litter was available along the sawdust in mixture form at the poultry farm. The gasification of chicken litter with different blends of sawdust was undertaken. The fluidized bed Gasifier was tested for gasification of chicken litter with different blends of rice husk (90% CL + 10% SD, 80% CL + 20% SD, 70% CL + 30% SD, 60% CL +

40% SD, 50% CL + 50% SD). The cold gas efficiency and heating value of the producer gas calculated are plotted in the figure 8 and 9 respectively. The compositions (CO%, CO₂%, CH₄ % and H₂%) of the producer gas are plotted in the figure 10, 11, 12 & 13 respectively.

The heating value (6453 to 3626.6KJ/ N m³) and the cold gas efficiency (79.16% to 20.96%) of the producer gas obtained were found to decrease with increase in the equivalence ratio (0.16 to 0.3) and also with the increase in the blend composition. It signifies that blending the chicken litter with rice husk decreases the heating capacity of the producer, because the heating value rice husk get heated up faster and that heat is absorbed by the chicken litter for further processing. Of these blends 40% saw dust and 60% chicken litter were found to give better result in comparison with other blends.

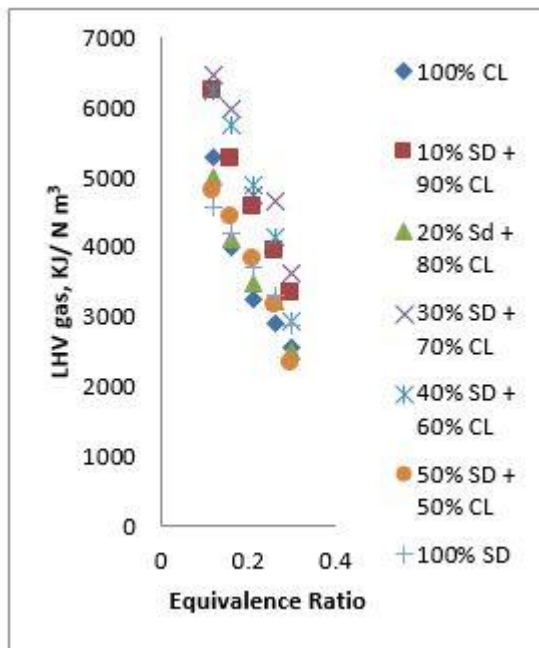
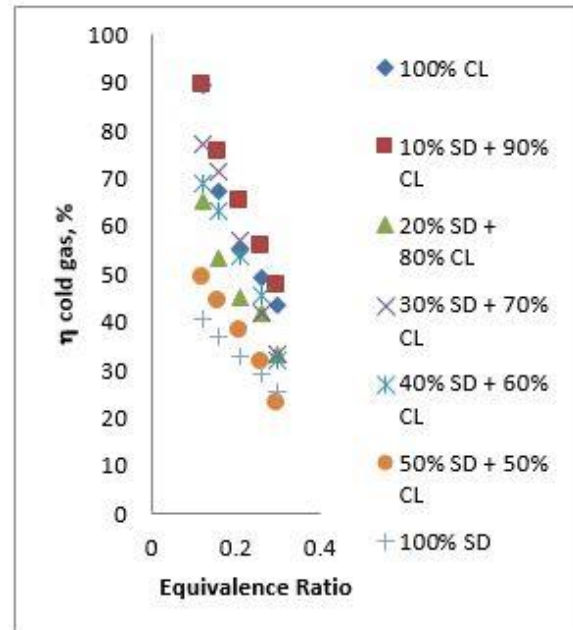


Figure-8: Variations in lower heating value of producer gas for various blends of CL and SD.



9: Variations in cold gas efficiency of producer gas for various blends of CL and SD.

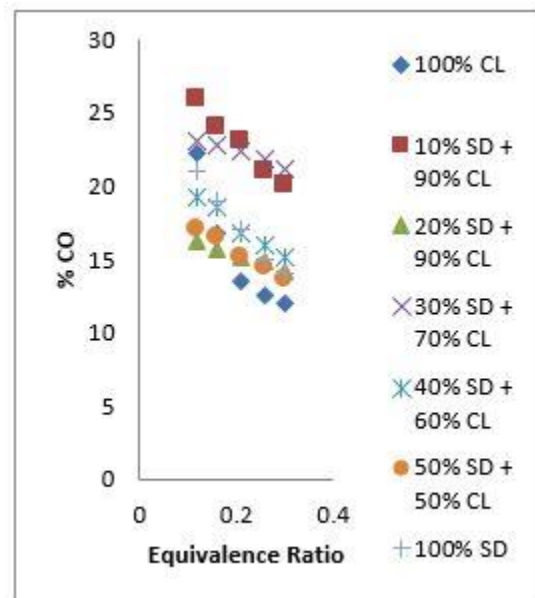


Figure-10: Variation of CO% for various blends of CL and SD.

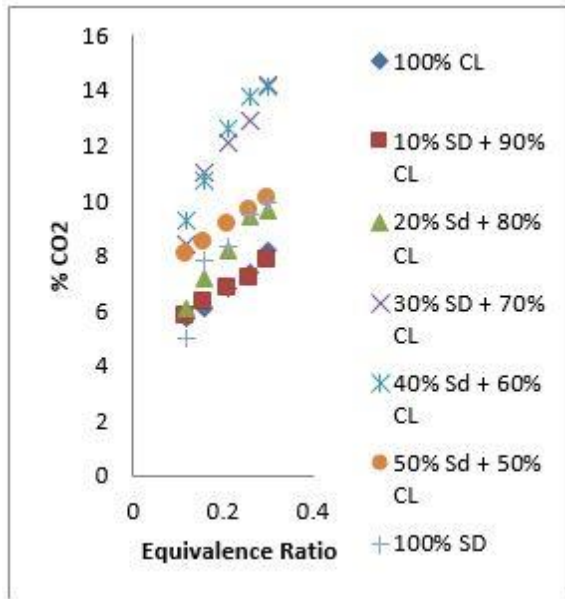


Figure-11: Variation of CO2 % for various blends of CL and SD

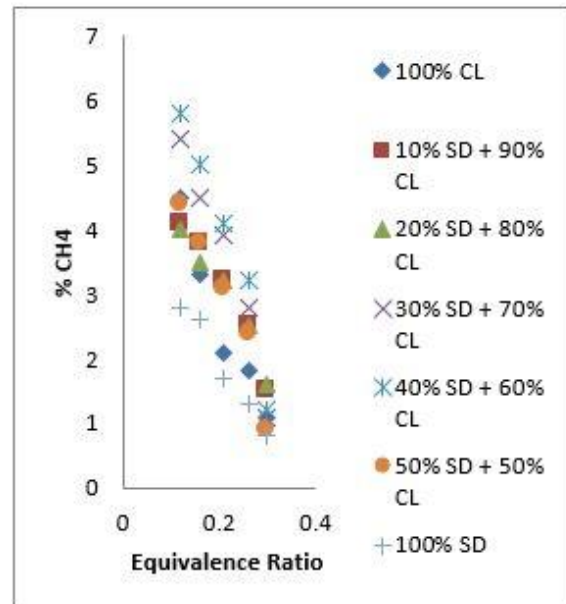


Figure-13: Variations of CH4 for various blends of CL and SD

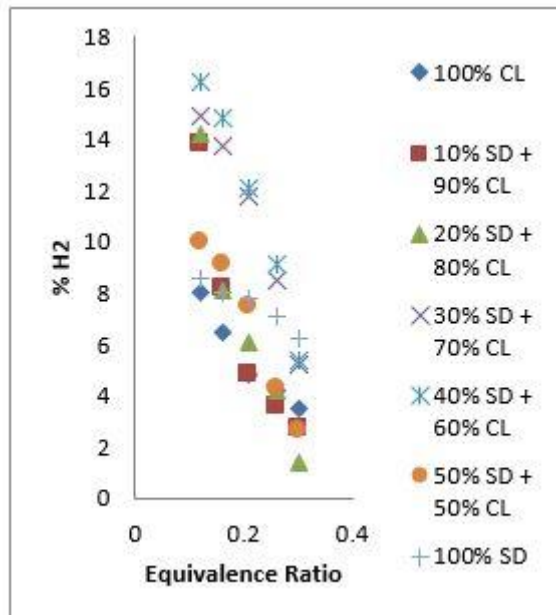


Figure 12: Variation of H2 % for various blends of CL and SD

Conclusion

The gasification of chicken litter, saw dust and rice husk was done individually, but no research work was found to be conducted in mixture state. In this regard, the gasification of blend of chicken litter with rice husk and blend of chicken litter with saw dust was done for various equivalence ratios was conducted. The heating value, cold gas efficiency and percentage of CO for producer gas obtained for blends of 30% RH and 70% CL was found to give better results in comparison with other blends and the heating value, cold gas efficiency and percentage of CO for producer gas obtained for blends of 40% SD and 60% CL was found to give better results in comparison with other blends.

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