

Energy use of rice husk by combustion and gasification

P. García-Bacaicoa*, S. Serrano, E. Esperanza, C. Berruenco
Dept. of Chemical and Environmental Engineering. University of Zaragoza (Spain)
C.P.S., María de Luna 3, 50015, Zaragoza, Spain.
Fax: +34 (976) 761879; bacaicoa@posta.unizar.es

Around of 800000 ton/year of rough rice are produced in Spain and 100000 of these are produced in the region of Aragon. Rice husk means around 20 % of the rough rice produced and its on-site use in the rice processing industry (which needs energy in thermal and mechanical forms) could be an interesting alternative. On this basis a project financed by the Spanish Science and Technology Ministry is being carried out by this team. Two Spanish companies are also involved, one processing 20000 ton/year of rough rice and the other one operating several energy and/or waste management plants. In this study the possibilities of energy use of the rice husk by gasification and combustion are analysed.

Fluidised bed gasification and combustion experiments in a laboratory rig have been performed. Next downdraft gasification tests in a pilot plant will be performed.

Laboratory fluidised bed plant consists of a stainless steel fluidised bed reactor of 32 cm high and 4.8 cm in diameter, continuous biomass feeding system gas conditioning system consisting of a cyclon and two heat exchangers and several systems for products recovery and analysis.

Downdraft gasification plant has a processing capacity of around 50 kg/h of biomass and it consists of gasifier, biomass and air feeding systems, gas cleaning and cooling systems, and control and measuring devices.

Rice husk processed in the laboratory plant has been a blend of three rice varieties consisting of: Bay (50%), Lido (25%) and Thainato (25%). Its analysis showed the following results (dry basis):

Proximate: Fixed Carbon 17.56 %, Volatile matter 67.32 %, Ash 15.12 %
Ultimate: C 42.01 %, H 5.67 %, O 36.13 %, N 0.05 %
Heating value: 14977 kJ/kg

In fluidised bed gasification influence of temperature and equivalence ratio were analysed:

Temperature: 650 - 800 °C
Equivalence ratio: 0.15 - 0.3

Optimum conditions (from gas quality point of view) were reached at 750 °C and a value of equivalence ratio of 0.25. Gas composition at these conditions was: 4 % of H₂, 4 % of hydrocarbons (CH₄, C₂H₂, C₂H₄, C₂H₆), 16 % of CO₂, 19 % of CO and 57 % of N₂. High heating value was 3.5 - 5.5 MJNm⁻³ and gas produced was 1.4-1.8 Nm³/kg rice husk. Carbon conversion to gas was 65 – 85 % (in mass).

In fluidised bed combustion operating conditions were:

Temperature: 750 °C
Equivalence ratio: 1.1 - 1.4

In this paper these results and the ones obtained in downdraft gasification pilot plant will be detailed and analysed.

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