International Journal For Technological Research In Engineering
Volume 4, Issue 4, December-2016 *ISSN (Online): 2347 - 4718*

PERFORMANCE ANALYSIS OF FBC BOILER EFFICIENCY USING RICE HUSK AND COAL AS FUEL IN RICE MILL

Munna Kumar[1], Anurag Kulshreshtha[2]
Mechanical Engineering Department, Scope College of Engineering, Bhopal, MP, INDIA.

Abstract: In view of energy and environmental problems associated with the use of fossil fuels (coal, petroleum and gas) in power generation, an increasing attention is being paid world-over by the scientists and technocrats for the utilization of renewable energy sources in power generation, metallurgical industries etc. There are various type of renewable energy sources such as solar, wind, hydropower, biomass energy etc. out of these renewable energy sources, biomass is more economically viable for almost all the continents in the world. Biomass is a carbonaceous material and provides both the thermal energy and reduction for oxides, where as other renewable energy sources can meet our thermal need only. Amongst all the solid fuel like coal etc. biomass is the purest fuel consisting of very lesser amount of ash materials. The power generation potential data for renewable energy sources in India clearly indicates that the biomass has potential to generate more than 17000 MW of electricity per year in India. However, the country is looking in exploitation of biomass in power generation. Till date, India has been capable to generate only 2000 MW (approx.) of electricity per year in spite of declaration of several incentives by the govt. of India. Hence, there is an urgent need to increase the utilization of biomass in power generation. The present project work is a positive step towards energy and environmental problems facing the world. The presently selected forestry biomass materials has no any commercial use and are underutilized. Presently, co-firing (coal + rice husk) has been proved to be more attractive and economically viable technique for power generation. In the present work, briquettes were prepared by mixing non-coking coal from WCL (Chhindwara ,MP) mines and the related biomass materials in different ratio (coal: rice husk) = (95:05, 90:10, 85:15, 80:20,75:25,70:30,65:35,60:40). The objectives have been to examine their energy values and power generation potential.The softening temperature results of the briquettes also indicated that the boiler could be safely operated up to about 1100 0C with studied (Coal + Biomass) briquette.
Keywords: Proximate Analysis, Ash fusion temperature, Electricity generation, Energycontent, Biomass like rice husk.

I. INTRODUCTION

India being a developing nation, sustainable development is more important. Energy is a basic requirement for economic development. Every sector of Indian economy – agriculture, industry, transport, commercial and domestic – needs inputs of energy. Energy is an important factor for anydeveloping country. Ever increasing consumption of fossil fuels and rapid depletion of known reserves are matters of serious concern in the country. This growing consumption of energy has also resultedthe dependency on fossil fuels such as coal, oil and gas. Rising prices of oil and gas and potential shortages in future lead to concerns about the security of energy supply needed to sustain our economic growth. Increased use of fossil fuels also causes environmental problems both locally and globally. Biomass has always been an important energy source for the country considering the benefits it offers. Biomass provides both, thermal energy as well as reduction for oxides. It is renewable, widely available, carbon-neutral and has the potential to provide significant employment in the rural areas. Biomass is also capable of providing firm energy. About 32% of the total primary energy use in the country is still derived from biomass. Ministry of New and Renewable Energy has realised the potential and role of biomass energy in the Indian context and hence has initiated a number of programmes for promotion of efficient technologies for its use in various sectors of the economy to ensure derivation of maximum benefits Biomass power generation in India is an industry that attracts investments of over Rs.600 crores every year, generating more than 5000 million units of electricity and yearly employment of more than 10 million man-days in the rural areas. For efficient utilization of biomass, bagasse based cogeneration in sugar mills and biomass power generation has been taken up under biomass power and cogeneration programme. Renewable energy sources are continuously replenished by natural processes. For example, solar energy, wind energy, bio-energy, bio fuels, hydropower etc., are some of the examples of renewable energy sources. In view of energy and environmental problems associated with the use of fossil fuels in power generation, scientist and technocrats, world over, are in search of the suitable substitute of fossil fuels for power generation. The various forms of renewable energy sources having a potential to be utilized in power generation are as follow:-

WIND ENERGY
SOLAR ENERGY
HYDRO POWER
GEOTHERMAL ENERGY
NUCLEAR ENERGY
BIOMASS AND BIO-ENERGY

Experimental Analysis

In the present project work, types of Rice husk procured from the Dawat Rice Mill, Satlapur, (M.P.) . These biomass (Rice husk) materials were air-dried in cross ventilator room for around one days. When the moisture contains of these air-dried rice husk waste sample came in equilibrium with that of the air Coal sample for making the blend was collected from Western coalfield limited,M.P. These materials were than processed for the determination their proximate analysis and Energy values.

PROXIMATE ANALYSIS

Proximate Analysis consist of moisture, ash, volatile matter, and fixed carbon contents determination were carried out on samples ground to -72 mess size by standard method. The details of these analysis are as follows;

CALORIFIC VALUE DETERMINATION

The calorific values of these rice husk waste (-72 mesh size) were measured by using an Oxygen bomb calorimeter (BIS, 1970, shown in Fig.3.3); 1 gm. of briquetted sample was taken in a nicron crucible. A thread was placed over the sample in the crucible to facilitate in the ignition. Both the electrodes of the calorimeter were connected bya nicrom fuse wire. Oxygen gas was filled in the bomb at a pressure of around 25 to 30 atm. The water (2 lit.) taken in the bucket was continually starred to homogeneous the temperature. The sample was ignited by switching on the current through the fussed wire and the rise in temperature of water was automatically recorded. The following formula was used to determine the energy value of the sample.

Gross calorific value (GCV) = {(2500 × ΔT) / (Initial wt. of simple) ─ (heat released by cotton thread + Heat released by fused wire)}

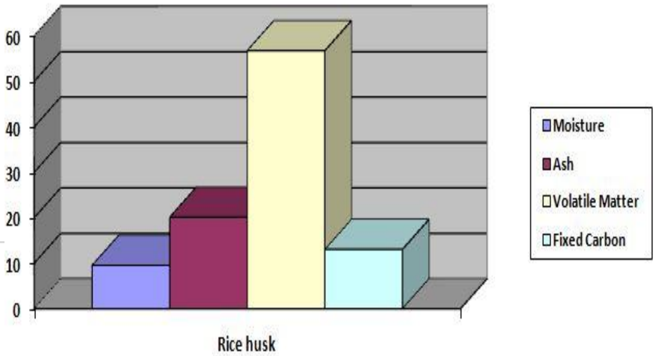
II. ASH FUSION TEMPERATURE DETERMINATION

The ash fusion Temperature, softening Temperature, Hemispherical temperature and Flow temperature) of all the ash samples, obtained from the presently selected husk waste and coal-biomass(husk waste) (in ratio) mixed sample were determined by using Leitz Heating Microscope (LEICA shown in Fig.1) in Material Science Centre of the Institute. The appearance of ash samples at IDT, ST, HT and FT are shown in Fig.2.

III. RESULTS AND DISCUSSION

Table 1: Proximate Analysis of rice husk waste

Component	Proximate Analysis (Wt. %, air-dried basis)				Gross Calorific Value (Kcal/ kg, Dried Basis)
	Moisture	Ash	Volatile Matter	Fixed Carbon	
Rice husk	9.38	5.53	39.1	45.99	3415



Ratio (Coal: Rice Husk)	Proximate Analysis (Wt. %, Air Dried Basis)				Calorific value (Kcal/ kg, Dried Basis)
	Moisture	Ash	Volatile Matter	Fixed Carbon	
95:05	3	36	36	25	3146
90:10	4	36	33	27	2980
85:15	4	37	39	20	3482
80:20	6	35	41	18	3454

Table 2: Coal: Rice husk Biomass

IV. CALCULATIONS

Total Energy Contents and Power Generation Structure Rice husk

Component	Calorific Value (kcal/t, dry basis)	Biomass Production (t/day, dry basis)	Energy Value (kcal/ha)
Rice husk	3237×10^3	23.80	77040.6×10^3

Energy Calculation:

On even dried basis, total energy from one day

77040.6×10^3kcal

It is assumed that conversion efficiency of wood fuelled thermal generators = 26 % and mechanical efficiency of the power plant = 85 %.
Energy value of the total functional biomass obtained in one day at 26% conversionefficiency of thermalpower plant = $77040.6 \times 10^3 \times 0.26$
20030.55×10^3 kcal
$20030.55 \times 10^3 \times 4.186 \div 3600$
23291.08 kWh/Day

Power generation at 85 % mechanical efficiency
23291.08×0.85
19797.42 kWh/Day

V. CONCLUSION

In the present work a biomass Rice husk were selected. Experiments to determine the proximate analysis, calorific values and ash fusion temperature was done on each of the components of the selected Biomass materials were performed. Estimation was done to analyze how much power can be generated. The following are the different conclusions drawn from the present work:

- A Biomass (Rice husk) showed almost the similar proximate analysis results for their components.
- Mixed ratio of a biomass with coal (in four different ratio) also showed the same proximate analysis results, the ash contents being more when 95% coal mixing with 5% biomass and volatile matter is more when 80% coal mixing with 20% biomass.
- Amongst the a biomass ,has the highest energy value compared a Rice husk.
- Amongst the four different ratio, ratio 80:20 gives the highest energy value compared to 95:05, 90:10, 85:15.
- Calculation results have established that nearly 17% waste(Total production is 140 tonne per day waste quantity is 23.8tonne per day) 19797.42 kWh per day from Rice husk biomass materials.
- The ash fusion temperature of all the biomass materials are coming within permissible limit of boiler operation, this would avoid clinker formation in the boiler.

This study could be positive in the exploitation of biomass materials for power generation.

REFERENCES

[1]. Angelis-Dimakis A., Biberacher M. and Dominguez J., Methods and tools to evaluate the availability of renewable energy sources Renewable and Sustainable Energy Reviews, 15 (2011): pp. 1182-1200
[2]. Boudri J.C., Hordijk L., Kroeze C. and Amann M., The potential contribution of renewable energy in air pollution abatement in China and India, Energy Policy, 30 (2002): pp. 409–424
[3]. Demirbas A., Potential applications of renewable energy sources, biomass combustion problems in boiler power systems and combustion related environmental issues, Progress in Energy and Combustion Science, 31 (2005): pp. 171–192
[4]. Goldemberg J. and Teixeira Coelho S., Renewable energy—traditional biomass vs. modern biomass, Energy Policy, 32 (2004): pp. 711–714
[5]. International Energy Agency (IEA): www.iea.org/Textbase/techno/essentials.htm
[6]. http://www.ireda.gov.in
[7]. Kumar M. and Patel S.K., Energy Values and Estimation of Power Generation Potentials of Some Non-woody Biomass Species, Energy Sources, Part A: Recovery, Utilization and Environmental Effects, 30:8, (2008): pp. 765 – 773
[8]. Kumar A., Kumar K. and Kaushik N., Renewable energy in India: Current status and future potentials-Renewable and Sustainable Energy Reviews, 14 (2010): pp. 2434–2442
[9]. Ministry of New & Renewable Energy (MNRE): http://mnre.gov.in/prog- biomasspower.htm
[10]. Mukunda H.S., Dasappa S., Paul P. J., Rajan N.K.S. and Shrinivasa U., Gasifiers and combustors for biomass technology and field studies, Energy for Sustainable Development.1 (1994): pp. 27-38
[11]. Pillai I.R. and Banerjee R., Renewable energy in India: Status and potential, Energy, 34 (2009): pp. 970–980
[12]. Ravindranath N.H., Balachandra P., Dasappa S. and RaoUsha K., Bioenergy technologies for carbon abatement, Biomass and Bioenergy, 30 (2006): pp. 826–837
[13]. Regueira L.N., Anon J. A. R., Castineiras J. P., Diz A. V. and Santovena N. M., Determination of calorific values of forest waste biomass by static bomb calorimetry, ThermochimicaActa, 371 (2001): pp. 23-31.

