BIO BRIQUETTES AS ALTERNATE FUEL

M.Yugandhar[1], P.Dilip Kumar[2], B.Krishna Jayanth[3]

[1]*M.Tech student, mechanical department, SISTAM engineering college, Andhra Pradesh, India*

[2]*Assistant Professor, mechanical department,SISTAM engineering college, Andhra Pradesh, India*

[3]*Assistant Professor, mechanical department,SISTAM engineering college, Andhra Pradesh, India*

ABSTRACT

With the growth of population there is an enormous increase in the utilization of power which mainly depends on the fossil fuels i.e., coal. The utilization also doubled from the past. And also the municipal and solid wastage also increases which causes the problem of dumping. Hence in order to utilize the effective usage of the fossil fuels and also to solve the dumping problem we need to go for alternate sources of energy which was formed from the municipal and solid wastages. Hence the concept of Bio-Briquettes was introduced. Briquettes were prepared by saw dust, agriculture wastes, etc. In this paper we prepared briquettes with palm powder along with the coconut coir. Both are mixed in different ratios. Then they were analyzed for calorific value, proximate and ultimate analysis and also calculated the heat release rate.

***Key words:* Bio-Briquettes, calorific value, heat release rate, proximate analysis, and ultimate analysis.**

I.INTRODUCTION

The world's energy leader Christoph Frei, 2012, said that "As the population of the world continues to grow, the demand for energy is becoming critical". Energy is one of the major inputs for the economic development of any country. World energy consumption doubled between 1970 and 2000 and it is expected to double again between now and 2050. The world's energy supply is 81% reliant on fossil fuels (33.8% oil, 21.1% natural gas, 26.1% coal). So if we continue the usage of fossil fuels within a short span they became extinct in future. The extinct period of fossil fuels are given by Crude Oil is for 50 to 100 years, Natural Gas is for 60 to 70 years, Coal is for 200 years. Hence we need to go for alternate sources of energy like solar, wind, tidal, biomass etc. The briquettes are mainly prepared by using rice husk, ground nut shells, saw dust, paper, sugarcane wastes, saw dust, crop wastes, etc. Briquettes also made by mixing those wastes with coal, lignite, seaweeds, cotton stalks, textile wastes etc. As they are compressed and all the moisture is squeezed out hence emits less pollution. In this paper we used briquettes made from the palm powder and coconut coir in different ratio. Biomass briquettes are a biofuel substitute to coal and charcoal. Biomass briquetting is the densification (Kaliyan and Morey, 2008) of loose biomass material to produce compact solid composites of different sizes with the application of pressure. Briquetting of residues takes place with the application of pressure, heat and binding agent on the loose materials to produce the briquettes under compression. These compressed compounds contain various organic materials, including rice husk, bagasse, ground nut shells, municipal solid waste, and agricultural waste. Compared to coal,

a) They do not add any carbon to the atmosphere.
b) Briquettes provide higher calorific value per dollar than coal when used for firing industrial boilers.
c) They burn uniformly for a longer period of time
d) The heat lost upon burning decreases i.e. the heat energy released is utilized properly without any major loses.

II.LITERATURE REVIEW

a) T.U. Onuegbu et al.., 2011 Comparative studies of ignition time and water boiling test of coal and biomass briquettes blend. His work is aimed at comparing the ignition time and water boiling test of coal briquette blends with pennisetumpurpurem (elephant grass) and imperatacylindrica (spear grass). Proximate analyses and elemental compositions of the coal and biomass were determined.
b) PatomsokWilaipon 2008 Density Equation of Bio-Coal Briquettes and Quantity of Maize Cob in Phitsanulok, Thailand. In the experiments, maize cob was utilized as the major ingredient for producing biomass-coal briquettes. The maize cob was treated with sodium hydroxide solution before mixing with coal fine.
c) UGWU, K E; AGBO, K E 2011 Briquetting of Palm Kernel Shell. His work, briquettes were produced from Palm kernel shell. This was achieved by carbonizing the shell to get the charcoal followed by the pulverization of the charcoal. Starch was used as a binder. The briquettes were analyzed for their combustion characteristics. The results obtained showed that the Palm kernel shell briquettes had higher calorific value than the briquettes from charcoal and sawdust
d) O. A. Oyelaran et al.., 2015 Determination of the Bioenergy Potential of Melon Shell and Corn Cob Briquette. In his work, research were carried out on properties of bio coal briquettes produced from Okaba coal, melon shell and corn cob with a view to find out their effect on coal briquette. The research involves the production of briquettes from coal and the biomass at the following ratios of 100:0, 90:10, 80:20, 70:30, 60:40, 50:50, 40:60 and 0:100, coal to biomass, using cassava starch as binder and calcium hydroxide as desulphurizing agent. It was found that the burning rate and reduction in smoke emission revealed improvement with increase in biomass concentration.
e) WahidinNuriana et al.,, 2014 made briquettes from durian peel in cylindrical shape of 3.8 cm diameter,6.5 cm high and 100mesh grain size by carbonizing process and raised the fuel density and calorific value per volume.
f) Daham Shyamalee et al.,, 2015 prepared briquettes with binding agents like cow dung, wheat flour and paper pulp. These briquettes were tested for calorific value, compressive strength by varying percentage of binders and also calculated the minimum energy cost for production.

III.BRIQUETTE PREPARATION METHODS

3.1 Powder Preparation

The palm branches, coconut coir, are collected and dried for 2-3 days to remove the moisture content in them. After that by using the paper machine the palm branches are chopped into fine powder. Powder from all the raw materials are collected and then dried for 3-4 days. They are mixed in the different ratios. From this mixture of Palm powder and coconut coir the briquettes were made in the ratio of 50:50, 80:20 with and without binder.

3.2 Binder Material Preparation

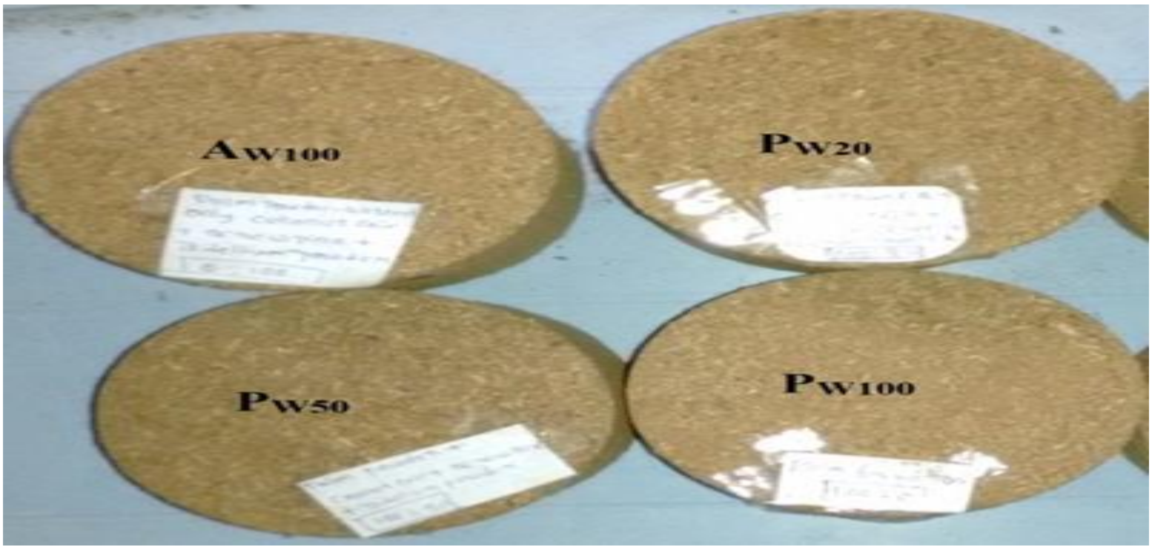
The binder material is used for strengthening of the briquettes. In this project I prepared binder by Maida and boiled starch. First the Maida flour is taken and it is mixed in boiling water, stirred well until it becomes paste. The starch comes after rice preparation is boiled until it gets glue. Then both Maida and starch are mixed properly to avoid formation of lumps. This mixed is settled until it gets cold. The paste is mixed with Palm powder in proper ratios.

Table 3.1 Briquette Ratio and Composition

BRIQUETTE MATERIAL RATIO	COMPOSITION
50:50 P_{W100}	Palm powder, coconut coir mixture with binder
50:50 P_{W50}	Palm powder, coconut coir mixture without binder
80:20 P_{W20}	Palm powder, coconut coir mixture with binder
80:20 A_{W100}	Palm powder, coconut coir mixture without binder

IV.EXPERIMENTAL SETUP AND BRIQUETTE PREPARATION

Many techniques are used for preparing briquettes such as screw press, ramming, hydraulic pressing(C. Supann et al.,, 2008), peterson press (Daham Shyamalee et al.,, 2015). For making briquettes I made my own set up using iron channels of 10cm (4 inches) width and hydraulic jack of 100 tonn is used for compressing the powder. Two iron channels of 46 cm (18 inches), 61 cm (24 inches) are welded to another two iron channels of 127 cm (50 inches) long to form a shape of alpabet "A". The mould used is of cylindrical in shape having dimensions of 15 cm (nearly 6 inches) diameter, 30.5 cm (12inches) height. The interior of die is very smooth.
Now fill the mould with powder in proper ratio completely and is placed above the hydraulic jack and a supporting rod is placed on it as shown in figure. Compress the powder by jack up to its maximum power of 100 tones and kept it for 12hrs. Then take it out from the mould. Now we get briquettes and carried out for required analysis.



V.**RESULTS AND DISCUSSION**

The prepared briquettes are carried out for proximate and combustion analysis. The experimental procedure and results are discussed below.

Proximate analysis reveals the quality and precise composition of a coal sample. This analysis examines four factors: moisture, volatile compounds, ash content and fixed carbon.Proximate and ultimate analyses of the coal, sawdust and bio coal briquettes were conducted in accordance with American Society of Testing and Materials (ASTM) D3173, D3175 and D3174 standards. The calorific value was determined using Ballistic Bomb Calorimeter.

Table 5.1 Proximate values of each briquette

Briquette Type	Moisture Content	Volatile Matter	Ash Content	Fixed Carbon	Experimental Calorific Value (KJ/KG)
P_{w100}	3.5	75.6	8.2	12.7	22329
P_{w50}	3.6	80.5	6.5	9.4	19894
P_{w20}	4.96	73.5	11.5	10.04	19118
A_{100}	5.16	66.9	8.5	19.44	20215

5.1Combustion Analysis

Combustion is the ability of a substance to burn or ignite, causing fire or combustion. In the Combustion Analysis we find out the ignition time, maximum temperature, and time for acquiring maximum temperature, burning rate and burning time.

5.1.1Ignition time

Each briquette sample was ignited at the base in a drought free corner by adding 2ml of kerosene. The time required for the flame to ignite the briquette was recorded as the ignition time using stop watch.

Table 5.2 Ignition time for each briquette

Briquette Type	Ignition Time (Sec)
P_{W100}	60
P_{W50}	44
P_{W20}	52
A_{100}	64

5.1.2Total burning time

It is the total time taken for complete conversion of briquettes to ash form.

Table 5.3 Total Burning Time for Each Briquette

Briquette Type	Total Burning Time (Min)
P_{W100}	26
P_{W50}	20
P_{W20}	24
A_{100}	20

5.1.3Burning rate

The burning rate is the rate at which the briquette will burn. It gives the specific fuel consumption of briquette. It is calculated by the formulae

$$\text{Burning rate} = \frac{MASS\ OF\ BRIQUETTE\ CONSUMED\ (G)}{TOTAL\ TIME\ TAKEN\ (MIN)}$$

Table 5.4 Burning Rate for Each Briquette

Briquette Type	Burning Rate(g/min)
P_{W100}	3.3
P_{W50}	2.9
P_{W20}	2.5
A_{100}	3.0

5.1.3Maximum temperature

It is the highest temperature attained by the briquettes while burning.

Table 5.5 Maximum Temperature for Each Briquette

Briquette Type	Maximum Temperature (^{0}c)
P_{w100}	240
P_{w50}	256
P_{w20}	230
A_{100}	250

5.14Time for maximum temperature

It is the time taken for attaining maximum temperature.

Table 5.6 Times for Attaining Maximum Temperature for Each Briquette

Briquette Type	Time To Maximum Temperature (Sec)
P_{W100}	580
P_{W50}	800
P_{W20}	698
A_{100}	342

VI.BOILER EFFICIENCY BY INDIRECT METHOD

In order to calculate the boiler efficiency, all the losses that occur in the boiler must be established. The efficiency can be arrived at, by subtracting the heat loss fractions from 100.

The following losses are applicable to liquid, gas and solid fired boiler

L1- Loss due to dry flue gas (sensible heat)

L2- Loss due to hydrogen in fuel (H2)

L3- Loss due to moisture in fuel (H2O)

L4- Loss due to moisture in air (H2O)

L5- Loss due to carbon monoxide (CO)

L6- Loss due to surface radiation, convection and other unaccounted*.

*Losses which are insignificant and are difficult to measure.

The following losses are applicable to solid fuel fired boiler in addition to above

L7- Unburnt losses in fly ash (Carbon)

L8- Unburnt losses in bottom ash (Carbon)

$$\text{Boiler Efficiency} = 100 - (L_1+L_2+L_3+L_4+L_5+L_6+L_7+L_8)$$

By calculating each loses the boiler efficiencies we get are tabulated below

Table 6.1 Boiler Efficiency

Briquette Type	Boiler Efficiency (%)
P_{W100}	78. 70758
P_{W50}	74. 26641
P_{W20}	77.12264
A_{100}	72.30156

VII.CONCLUSION

From the above calculations we can conclude that the briquette P_{w100} has the highest calorific value, burning rate, boiler efficiency and hence that mixture of palm and coconut coir is best suitable for industrial applications along with the coal or separately as the calorific value of coal is 25634 Kj/Kg.

REFERENCES

[1.] O. A. Oyelaran, Y. Y. Tudunwada April 2015 Determination of the Bioenergy Potential of Melon Shell and Corn Cob Briquette. Iranica Journal of Energy and Environment.

[2.] Kimiko Yamada , AtsuyukiSorimachi , Qingyue Wang , Jing Yi , Shuqun Cheng, Yanrong Zhou b, Kazuhiko Sakamoto July 2008 Abatement Of Indoor Air Pollution Achieved With Coal–Biomass Household Briquettes. Atmospheric Environment. Elsevier.

[3.] Chin Yee Sing and M. Shiraz Aris, 2013. A Study of Biomass Fuel Briquettes from Oil Palm Mill Residues. Asian Journal of Scientific Research.

[4.] CHU Mo, ZHU Shifeng, YI Yanyan,DENG Yunpeng, 2012 Characteristics of Pyrolysis Products of Bori Lignite Briquette. Elsevier International Conference on Future Energy, Environment, and Materials.

[5.] Ch. A. I. Raju, U.Praveena, M. Satya, K. RamyaJyothi, Prof. S. Sarveswara Rao, March 2014. Studies on Development of Fuel Briquettes using Biodegradable Waste Materials Journal of Bioprocessing and Chemical Engineering (Science Q).

[6.] UGWU, K E; AGBO, K E National Centre for Energy Research and Development, University of Nigeria, Nsukka Sept, 2011 Briquetting of Palm Kernel Shell. Journal of Applied Science Environmental Management.

[7.] T.U. Onuegbu, I.M. Ogbu, and C. EjikemeNov-2011. Comparative Analyses Of Densities And Calorific Values Of Wood And Briquettes Samples Prepared At Moderate Pressure And Ambient Temperature. International Journal of Plant, Animal and Environmental Sciences.

[8.] T.U. Onuegbu1, U.E. Ekpunobi, I.M. Ogbu, M.O. Ekeoma& F.O. ObumseluMay 2011 Comparative Studies Of Ignition Time And Water Boiling Test Of Coal And Biomass Briquettes Blend International Journal Of Recent Research And Applied Studies.

[9.] PatomsokWilaipon 2008 Density Equation of Bio-Coal Briquettes and Quantity Of Maize Cob In Phitsanulok, Thailand. American Journal of Applied Sciences.

[10.] Arinola B. Ajayi, Justina I. Osumune 2013 Design of Sawdust Briquette Machine. Innovative Systems Design and Engineering.

[11.] IkelleIssieIkelle and OgahSule Philip Ivoms2014 Determination of the Heating Ability of Coal and Corn Cob Briquettes. IOSR Journal of Applied Chemistry.

[12.] Raphael IddphonceMkini, ZuwenaBakari March 2015. Effect Of Moisture Content On Combustion And Friability Characteristics Of Biomass Waste Briquettes Made By Small Scale Producers In Tanzania. International Journal of Engineering Research and Reviews.

[13.] NayaraVilelaAvelar, Ana Augusta PassosRezendea, Angelica de Cassia Oliveira Carneiro, Claudio Mudadu Silva January 2016. Evaluation Of Briquettes Made From Textile Industry Solid Waste Elsevier Renewable Energy.