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Experimental Study of Cotton Stalk Pellet Renewable Energy Potential from Agricultural Residue Woody Biomass as an Alternate Fuel for fossil fuels to Internal Combustion Engines

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***Abstract*:-The gasification of biomass is potential source for renewable energy. In the most of the cases where the cost of petroleum product fuels are heavy the biomass based fuels can be used for gasification to provide a solution for the existing fuel crisis. To reduce Carbon dioxide emissions it will help a far extent. By using gasification process the gases such as CO2, NOx and SOx emissions cab decreased. The biomass gasification is purely echo friendly. India is agriculture based place that can produce tonnes of agriculture residues like Cotton stalks that can be utilized to meet the rural energy demand which also contributes to environmental protection. The study was undertaken to investigate the properties of cotton stalk fuel from the agricultural residues. The ultimate analysis of the cotton stalks on air dried basis in terms moisture content 6.84 %, ash content 3.28 %, fixed carbon 43.24 %, hydrogen 5.55 %, nitrogen 0.51 %, sulphur 0.46 %, oxygen 40.12 % and calorific value of cotton stalk biomass is 15200 KJ/Kg respectively.**

Key words: Gasification, Biomass, cotton stalk, ultimate analysis.

I. INTRODUCTION

These days Biomass plays vital role for energy production. Gasification is key tool for energy conversion. Gasification enables us to convert these biomass species into burning gases (producer gas). Progress and prosperity of nations depends mainly on energy. An availability and consumption level of energy is the best indicator of economic and social development. Utilization of yield buildups for vitality creation has been engendered as a substitute for petroleum products in industrialized nations. The accessible wellsprings of petroleum derivatives are restricted just as the developing familiarity with the negative natural outcomes coming about because of ozone depleting substance emanations have strengthened the significance of yield deposits as another vitality asset in created and creating nations. Trimming power, profitability and harvests developed in nation causes huge fluctuation in yield buildups age and their employments. Pathaket. Al. endeavored to survey the amount of recoverable biomass from cropland, prairie, woodland, roadsides, and agro-ranger service (Pathak et al., 2006). They evaluated complete accessible yield buildups in India as 523 mt/year and surplus as 127.3 Mt/year. They likewise reasoned that the surplus harvest buildups of cotton stalk, pigeon pea stalk, jute and mesta, groundnut shell, rapeseed and mustard, sunflower were 11.8, 9.0, 1.5, 5.0, 4.5, and 1.0 Mt/year, individually on yearly premise. The buildups of a large portion of the grain harvests and half of heartbeats are utilized for grub. Stalks of rapeseed, Coconut shell, mustard, pigeon pea, jute and mesta, and sun blossom are utilized as family fuel.

India has been an agrarian economy since much time as 70% of its GDP still originates from either farming or agro based industry (Singh, 1996). Any advancement of profits from this division is relies upon sufficient stockpile of essential contributions to this segment. Convenient and enough power supply is one such input. Rivalry among industry and urban relinquish the rural utilization of power step by step in our nation. Thus, there is a round the year lack of intensity in the farming division. Therefore, Urgent need has been emerges to deliver more power, so as to achieve the necessities of horticulture segment productively. An unpleasant estimation has putted rural and agro-modern buildups in tremendous amounts of around 350 million tones (mt) every year (Rao, 1996). It is additionally foreseen that the absolute dairy cattle decline produced is almost 250 mt for each year (Singh, 1996). Further, 50 mt of fuel wood and with related timberland misuse of around 5 mt created from almost 20% of the absolute land which is under woodland spread.

The complete accessibility of agrarian waste, vitality manors and agro-modern waste in the nation is set roughly 405 mt for each year (Rao, 1996). Set up of agriwaste based hostage power plants in agro-based businesses and little limit control age plants in country zones as decentralized power supply sources is the method for achieving utilization of such sources. Power need of a bunch of 30 to 40 close by towns can be happy with such power plants. The biomass like rice straw, saw-dust, cotton-seed, sugarcane-refuse, coir-essence,, nut - shells, sorghum, wheat-stalks and straw, stalks and husk, soybean stalks, maize stalks and cobs, bagasse, squander wood, , sunflower seeds, shells, pecan shells, structures and parts

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and coconut husk can be productively used in power age (Grover, 1996).
33% of essential vitality sources are contributed by Biomass in India. Biomass energizes are prevalently utilized in residential for cooking and water warming, just as by ordinary and craftsman businesses. All out biomass vitality sources wood powers contribute 56 percent (Sinha et. al, 1994). Since most biomass isn't executed available, estimation of biomass utilization remains exceptionally factor (Ravindranath and Hall, 1995; Joshi et. al., 1992). Supply-side estimation (Ravindranath and Hall, 1995) of biomass vitality are accounted for as: fuel wood for family unit area 218.5 million tons (dry), crop buildup 96 million tons (gauge for 1985), and dairy cattle excrement cake-37 million tons. The agriwaste, aside from being a transfer duty, clearly represents a genuine natural risk which thusly endangers biology and human wellbeing the same, on the grounds that by and by, a portion of the agri deposits are being disposed of at the fields and consumed in-situ, which results in ecological contamination and furthermore influences the quality and ripeness of soil. On the off chance that these squanders are utilized for creating electric power it might help control the earth related issues. In any case, this requires a detailed gathering process and monetary change activity too.

1.1 Introduction to Alternate Fuels:

An elective fuel characterized as material, substance, or oil, which can give vitality to inner ignition motors. Elective fuel wellspring of vitality, which is utilized in IC motors. This exploration has discovered appropriateness of biomass fuel, which utilized in IC motor and which inexhaustible.

1.2 Some types of alternate fuels

Biomass
Bio diesel
Bio fuel
Bio alcohol (methanol, ethanol, butanol)
Bio gas
Battery and fuel cells
Hydrogen
Vegetable oil

1.3 Biomass

The term biomass defines a broad category of compounds characterised by an organic matrix and produced by living organisms (vegetable or animal). In general biomass directly or indirectly originates from the process of photosynthesis and thus constitutes an important renewable energy source derived from the Sun. However, fossil fuels (coal, oil and natural gas), though they were formed in past eras starting from organic vegetable and animal matter, and their derivatives (such as plastics) are not considered biomass. The following materials are instead included in the definition:

• Woody and herbaceous species deriving from agricultural crops and forestry;
• Agricultural and forestry residues (straw, brushwood, barks, etc.);
• Agro-industrial residues (rice husk, olive residues, bagasse, etc.);
• Livestock residues (animal manure, etc.);
• Organic fraction of municipal solid waste, also called humid fraction3.

As one can see, most of these species has vegetable origin and also concerning livestock residues, it must be noted that vegetables are the basic element of animal feeding.

1.4 Petrol

It is the most important and most powers utilized for vehicle. Oil is a fluid with a solid dissolvable request is its common state. Gas is delivered from oil built up the thick raw petroleum because of the impacts of warmth, weight and time on natural issue beneath the surface.

1.5 Diesel

It is utilized a fluid fuel in diesel motors, and it is a blend of hydrocarbons by refining of unrefined petroleum be gotten. The normal for diesel fuel is thickness, ceten number, instability, cold conduct, thickness, and Sulfur content. It is thick and slick.

1.6 Ethanol

Ethanol is an alternative energy source. Ethanol is an alcohol, which made from fermenting corn or similar biomass material. Ethanol can have used in three ways as transportation fuel.

II. LITERATURE SURVEY

[1]Distinctive 13 new formulae have been produced for assessing the calorific estimations of 20 diverse biomass tests from their proximate investigations information. So as to acquire these formulae, 20 biomass tests from various sorts were investigated to decide calorific qualities and proximate examinations. The deliberate net warming estimations of the biomass tests fluctuated somewhere in the range of 15.41 and 19.52 MJ/kg. All connections were created by methods for least squares relapse examinations. Relapse coefficients of the connections extend from 0.829 to 0.898. Standard deviations of the warming qualities decided from 13 distinct relationships are somewhere in the range of 0.4419 and 0.5280.

[2]Consistently a huge number of huge amounts of rural squanders are produced which are either annihilated or consumed wastefully in free structure causing air contamination. These squanders can be reused and can give a sustainable wellspring of vitality by changing over biomass squander into high thickness - fuel briquettes without expansion of any cover. This reused fuel is advantageous for the earth as it monitors normal assets. For this the biomass briquetting is the primary sustainable power source asset. In this paper the crude material including rice husk, espresso husk, saw dust, ground nutshell and cotton stalks and so on were densified into briquettes at high temperature and weight utilizing various advances. We talk about the different points of interest, factors that influencing the biomass briquetting and correlation among coal and biomass briquetting. The subtleties of the examination were featured in this paper.

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[3]The potential offered by biomass to decrease ozone harming substance generation is currently being all the more generally perceived. The vitality in biomass might be acknowledged either by direct ignition use, or by updating into increasingly profitable and useable items, for example, gas, fuel oil and higher worth items for use in the concoction business or for clean control age. Up till now, gasification work has focused on woody biomass yet as of late wellsprings of different biomass with huge vitality generation potential have been recognized, in particular hazelnut shells. Accordingly, a pilot scale downdraft gasifier is utilized to research gasification capability of hazelnut shells. A full mass equalization is accounted for including the tar creation rate just as the arrangement of the delivered gas as an element of feed rate. Furthermore, the impact of feed rate on the CV/sythesis of the item gas and the related varieties of gasifier zone temperatures are resolved with temperatures recorded all through the principle zones of the gasifier and furthermore at the gasifier outlet and gas cleaning zones.

III. METHODOLOGY

3.1 Analysis of Coal

There are two techniques: extreme investigation and proximate examination. A definitive investigation decides all coal part components, strong or vaporous and the proximate examination discourage mines just the fixed carbon, unpredictable issue, dampness and powder rates. A definitive examination is resolved in an appropriately prepared lab by a talented scientific expert, while proxi- mate investigation can be resolved with a straightforward mechanical assembly. It might be noticed that proximate has no association with "inexact".

3.2 Ultimate Analysis:

The ultimate analysis indicates the various elemental chemical constituents such as Carbon, Hydrogen, Oxygen, Sulphur, etc. It is useful in determining the quantity of air required for com- bustion and the volume and composition of the combustion gases. The mainobjective of the work is to find the calorific values of biomass samples using ultimate analysis.

3.3 Proximate Analysis

Proximate analysis was carried out for characterizes the moisture content, volatile matter, ash content and fixed carbon. Proximate analysis of the fuel defines its volatility and burning properties. ASTM standard (ASTM, 1983) recommended for coal, sparky fuels, etc., which meets the demand of the biomass material largely, was used for these analysis.

3.4 Moisture Content

Dampness substance of a large portion of the biomass relies upon the kind of fuel, its source and treatment before it is utilized for gasification. Dampness substance assume significant job in the ignition procedure. The dampness content beneath 15 percent by weight is attractive for issue free and conservative activity of gasifier. Fuel dampness content (FMC) of cotton stalk was dictated by drying the known load of test in tourist oven at 105 oC for 24 hours while keeping the ground test in petridish till consistent weight.

3.5 Volatile Matter

Unstable issue and intrinsically bound water in the fuel were surrendered in pyrolysis zone framing a vapor comprising of water, tar, oils, and gases. Fuels with high unpredictable issue substance produce more tar. Unstable issues in the fuel decide the structure of gasifier for expulsion of tar. Unstable matter of cotton stalk biomass is the item, restrictive of dampness, radiated by a material as a gas or vapor when strong biomass is warmed out of contact with air under institutionalized conditions that may fluctuate as indicated by the idea of the material.

3.6 Ash Content

Mineral content of fuel which remains in oxidized form after combustion of fuel is called ash. In practice, ash also contains some unburned fuel. Powder substance and fiery remains creation have sway on smooth running of gasifier. Liquefying of cinders in reactor causes slagging and clinker arrangement. On the off chance that no measure is taken, slagging or clinker arrangement prompts unnecessary tar development or complete hindering of reactor.

3.7 Fixed Carbon

The fixed carbon speaks to the non-unpredictable flammable part of the fuel. The measure of fixed carbon present gives an unpleasant sign of the charcoal yield. Additionally, a higher fixed carbon material is commonly more qualified for gasification then a lower fixed carbon material. Subsequent to deciding fuel dampness content (d.b.), unpredictable issue (d.b.) and fuel powder content (d.b.).

Calorific value of biomass

Calorific value is the amount of heat generated by unit mass of the fuel on its complete combustion. It very well may be accounted for in two different ways, specifically HHV (higher warming worth), and LHV (lower warming worth). Calorific estimation of biomass feed stalk is resolved for its appropriateness of gasification and gasifier effectiveness.

Bomb calorimeter was utilized to decide the calorific estimation of cotton stalk biomass. One gm test of the air dried ground test was taken in the cauldron. The circuit wire was appended over the cathodes of the bomb.

3.8 Calorific value of biomass

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IV. TESTING OF BIOMASS SAMPLES:

Cotton stalk biomass sample has been taken to check the elemental composition at IICT (Indian Institute Of Chemical Technology). These samples have been

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analyzed by different analysis techniques for their characteristic study before experimentation in a gasifier.

4.1 Biomass sample:

Cotton Stalks

4.2 TESTING PROCEDURE

4.2.1 Determination of Moisture

This describes the method of proximate analysis of solid fuel samples. Description of air oxygen – ventilated drying oven in which a constant and uniform temperature of 108(+/-) 2 deg can be maintained.

4.2.2 Determination of Ash:

Description of muffle furnace: capable of giving substantially uniform zone of 500 deg in 30 minutes from cold, of being raised to 815(+/-)10 deg in a further 30 to 60 minutes and maintaining this temperature up to the end of the run up period. The furnace should also be capable of being raised to 50(+/-) 10 deg if necessary. The ventilation shall be such as to given sufficient air.

4.2.3 Determination of Carbon &Hydrogen:

Furnace – the combustion device is heated by two furnaces, the lengths of which are given below for a continuation tube 80 cm in length. These are constructed by winding nichrome wire of diameter 25 mm and wall thickness of 1 mm. Furnace No-1: 35 cm in length to heat the boat and its contents and platinum gauge to a atmosphere of 800 to 900 deg C. Furnace No-2: 2-23 cm in length, to heat the copper gauge, lead chromate, red lead and silver gauge to a temperature gradient from 555 deg C to 250 deg C along the remaining 14 cm such that in the last 9 cm of length temperature is in the range of 350-250 deg C.

4.2.4 Determination of Nitrogen

A 50 ml conical flask for digesting the sample material distillation of flask of 500 ml for distillation. A deliver tub e, a condenser and a receiver of 250 ml conical flask are the apparatus.

4.2.5 Determination of Sulphur by Bomb method:

A high pressure bomb, preferably of the three piece Bertha lot type with separate cup, cap and uniform nut. The cup and cap are maintained from rolled bar of an austenitic chromium-nickle molybdenum steel or of rolled aluminium bronze with 0.5% proof stress of not less than 2.0 kg/cm2. This ensures that the bomb will be capable of
a) Burning totally one gram of strong or fluid fuel utilizing an underlying oxygen. Weight of 30 environment and b) Withstanding, with a sufficient wellbeing factor that will not be made of sort austenitic steel as that utilized for the cup and top. This is essential to counteract harm because of seizing of strings. Aluminum bronze is given as a choice to low molybdenum (free cutting) austenitic steel and whenever utilized, might be plated to improve the completion.

4.2.6 Calorific value of cotton stalk biomass

Calorific estimation of the cotton stalk biomass was resolved with the assistance of bomb calorimeter. The aftereffects of what could be compared to the calorimeter ascend in temperature, redress factors for the nichrome wire and string just as calorific estimation of the biomass is given. It can delighted that vitality likeness the bomb calorimeter was observed to be 398.26 cal/°C. The temperature ascend for consuming of the 1.02 g biomass test was seen as 1.75 °C in the bomb calorimeter. Calorific estimation of the biomass was acquired subsequent to utilizing the revision factor of nichrome wire and cotton string as 3827 cal/g. The calorific estimation of cotton stalk was found as 15.2 MJ/kg demonstrated great attributes for gasification on the grounds that higher warmth produced during ignition prompts high temperature in response zone. The aftereffects of calorific estimation of cotton stalk in the present examination were as per the outcomes exhibited by Dubey and Gangil (2009) as LHV and HHV of cotton stick 16 and 17.40 MJ/kg. Vyas and Singh (2007).

V. RESULTS

Ultimate Analysis of Biomass Sample on air dried basis.

Sr.No	Elements	% Weight
1	Moisture	6.84
2	Ash	3.28
3	Carbon	43.24
4	Hydrogen	5.55
5	Nitrogen	0.51
6	Sulphur	0.46
7	Oxygen	40.12
8	Calorific Value	15.2 MJ/Kg

The ultimate analysis of the cotton stalks on air dried basis in terms moisture content, hydrogen, carbon, nitrogen, sulphur, oxygen have been experimentally found.

VI. CONCLUSIONS

The results from this study have shown that characterization of the physical and chemical properties of cotton stalk agricultural residues to be used as feedstock for energy conversion process in open core downdraft. The ultimate analysis of cotton stalk biomass in terms of moisture content, fixed carbon, ash, hydrogen, nitrogen, sulphur and oxygen were found as 6.84 %, 43.24 %, 3.28 %, 0.51 %, 0.46 %, and 40.12 % (d.b) respectively. The calorific value of cotton stalk biomass was obtained as 15200 KJ/Kg. The cotton stalk residues can be considered as an alternative for the woody biomass.

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