Pine Needles and Agro Waste: A New Eco-Friendly Energy Resource

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Abstract

Global warming is one of the major issues of the present era. One of the best conducts to reduce such global environmental issue is sustainable use of available natural resources. This study emphasis on the usage of pine needles and agricultral waste to produce energy due to it's less polluting nature. Also in the lower himalayan regions, these are collected and removed from residential and nearby forest areas. The use of such waste pine needles also helps in controlling forest fires during summer season and maintaining ecological balance. In this study we have made an attempt to highlight the comparative study of briquettes produced from mixture of pine needle with rice husk and wheat residue.

Keywords: *Briquettes, Pine needles, Wheat residue, Rice husk, calorific value*

1. Introduction

In India the power demand is always higher than the power supply due to the industrialization and rapid population growth, the vast majority of the Himalayan Region comprises of pine trees. Uttarakhand is home of pine woods. Since carriage of pine needle isn't simple, henceforth on the off chance in the present study we only consider the carriage of pine needles from the pine woods which are close to residence or close to the street head than roughly 40% of the biomass can be transported.

Additionally in the late spring season, woodland fires are basic in these regions due to dry pine needles, basically pine tree have needle formed leaves which continue tumbling off trees from the center of March till the beginning of the downpours in July, are exceptionally inflammable. Indeed, even a half-consumed beedi indiscreetly tossed by a resident can cause fires that gut extensive backwoods regions.

These flames demolish the nearby nature, harming the ripe best layer of the dirt and decimating eating justification for steers. Also they affect the forest life of wild animals and sometimes the fire caused by these pine needles also affects the nearby villages.

Thus for maintaining ecology and to cope up with the demand of energy, pine needles can be utilised in form of briquettes for numerous domestic and industrial applications.

The aim of the present study is to determine the calorific value, ash content, moisture content, fixed carbon content and volatile matter of pine briquettes made with the mixture of rice husk and wheat residue.

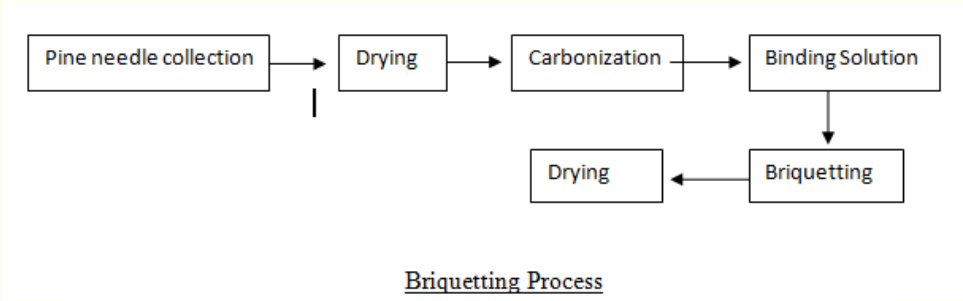
Ismaila et. al. shows the relationship between the total elemental hydrogen and carbon contents and high heating values (HHV's) of biomass briquettes and their results shows that, the HHV's of the biomass tried are not straightly identified with their all out hydrogen substance but rather, straightforwardly identified with their absolute carbon substance [1]. Efomah & Gbabo carried out investigations on the physical, proximate and ultimate analysis of rice husk briquette and they found the high volatile content and high heating value [2]. Romallosa investigated the quality examinations of biomass briquettes. They examined the parameters like mass thickness, warming worth, and dampness and demonstrate that nature of the three kinds of briquettes created utilizing waste paper, sawdust and carbonized rice husk, somewhat changed [3]. Pandey & Dhakal Concentrates the physico-chemical properties of pine needle in the planning of biomass briquettes. The outcome demonstrates the dampness substance and gaps present in briquette helps in productively consuming when contrasted with fuel wood and furthermore there is next to zero smoke after the underlying consuming [4]. Dhaundiyal & Gupta analyse the Pine Needles as a Substrate for Gasification [5]. Bisht et. Al. addresses the alternate uses of dry pine needles including vitality age, which would result in financial lift to the place. this is itself paid by vitality age[6]. Chauhan & Saini study encompasses the utilization of sustainable power sources in rural areas of Uttarakhand state. A modelling technique is enclosed, involving a definite arrangement of integrated resources entitled for rural electrification. Barriers and issues were discussed [7]. Singh et. al. Studies the bio-pretreatment of pine needles for sustainable energy. Experimentation was done for biomethanation of pine needle substrate delivered an aggregate biomethane [8]. Devi et. al. investigation shows the suitability and potential of pine needle for bigas production. [9]. Singh et.al. work reports a experimental analysis of performance of pine needle gasifier. The effect of gasifier responses are equivalence ratio(ER) and calorific value (CV). Analysis was done by setting Air flow rate, initial moisture content and biomass consumption rate. The result showed that for ER & CV, air flow rate is most influencing factor and then the initial moisture content and last is biomass consumption rate [10]. Bharti & Awasthi proposed the briquetting technology of pine needles. and showed that briquette using starch has high calorific value, low ash content and high volatile maater than biomass charcoal briquette sample using clay as a binder [11]. Ismail & Salam paper tells about the numerical recreation and test investigations of various working states of biomass gasification on the execution of updraft gasifier high temperature air gasification (HTAG). Villetta et al. work surveys impact of biomass dampness content, gasification identicalness proportion, weight varieties and oxygen enhancement on the nature of the delivered syngas specifically regarding lower warming worth and cold gas effectiveness.

2. Materials

- Pine needles were collected from hilly regions of Uttarakhand India.
- Rice husk is obtained from the rice mill and then is converted in powder form using electric grinder.
- Wheat residue is obtained from farming grounds of Uttarakhand and is converted to powder form using electric grinder.

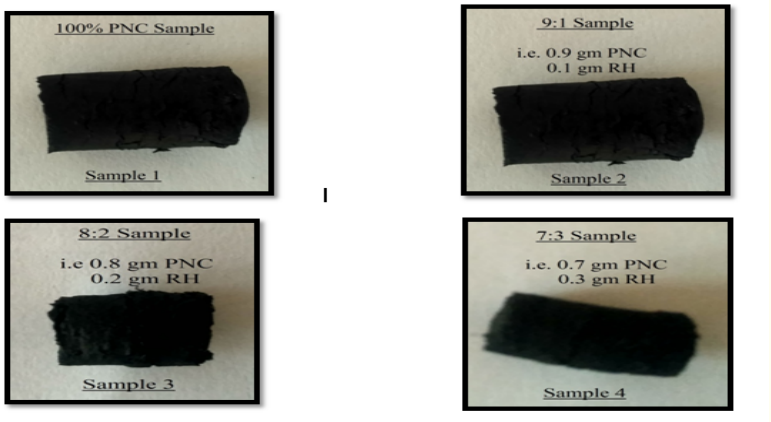
3. Methodology

Pine needles collected from hilly region are converted to briquettes using rice husk and wheat residue as a binder.



Briquetting Process

9 briquette sample of 1g are produced in different ratio of binder.



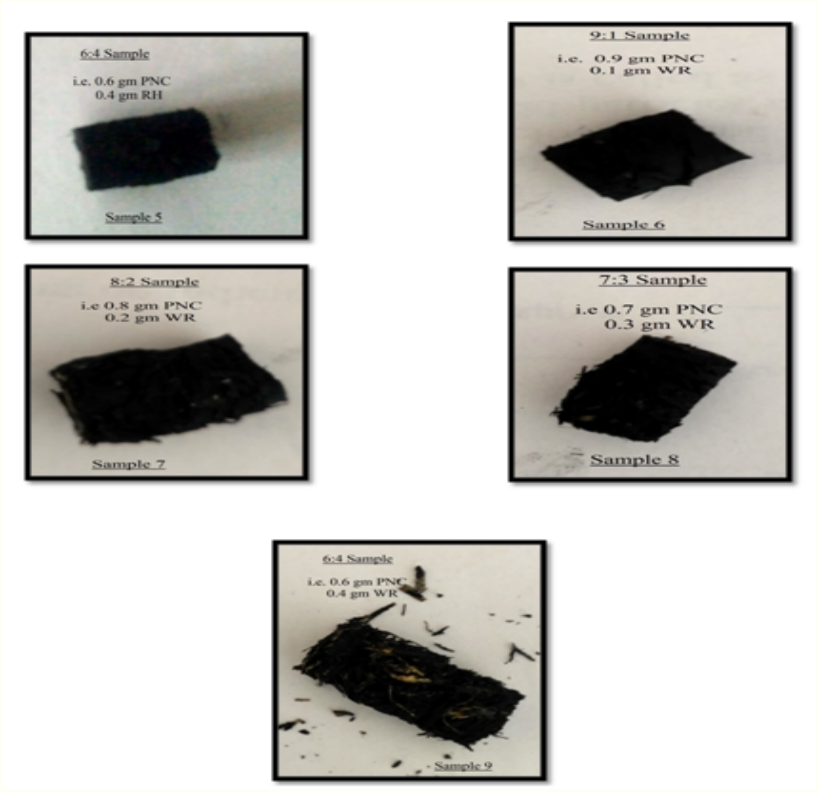
Various tests on samples are conducted to determine the calorific value, ash content, volatile matter and fixed carbon content.

Calorific Value – It is determined by burning sample in Bomb Calorimeter.

Moisture Content – for this test sample is taken in a crucible and placed in an oven at 105ºC for 1 hrs. The decrease in weight of sample represents the moisture content of a sample.

Volatile Matter – for this sample is taken in a closed crucible and placed in a muffle furnace at 905ºC for 7 mins. The reduction in weight represents volatile matter in a sample.

Ash content – for this sample is taken in a crucible and placed in muffle furnace at 730ºC for 7 hrs. Now the change in weight shows the ash content in that sample.



Fixed Carbon - It can be calculated by the equation.

%Fixed Carbon= 100 – (%Volatile Matter + %Moisture Content + %Ash Content

4. Results and Discussion

Pine Needles Charcoal (PNC) -From the experiments done at the Bomb calorimeter, the calorific value of the Pine Needle charcoal is about 19.11 MJ/kg and after adding different binders in it, its calorific value becomes high. Proximate analysis shows that it has 16.8% of Volatile matter, 6.1% Ash content, 6.5% Moisture content and rest is the Fixed Carbon.

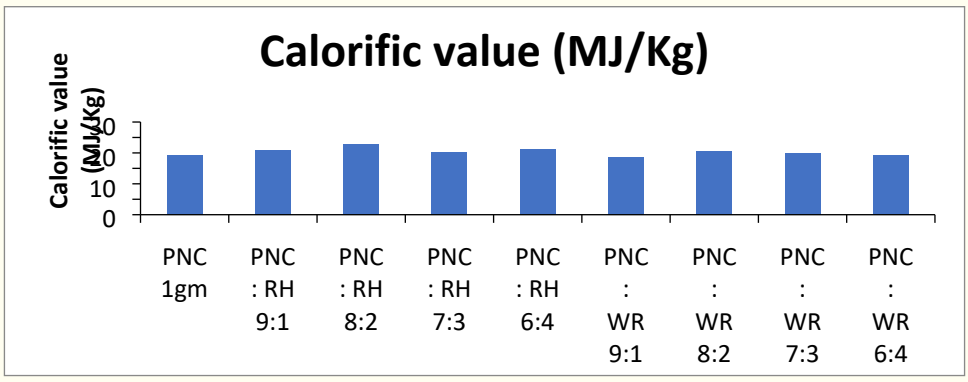


Fig. 1: Comparison of Calorific value of vaious samples

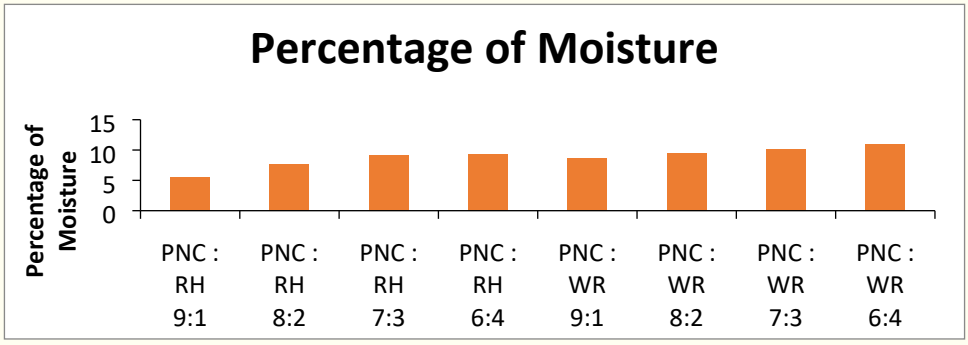


Fig. 2: Comparison of Moisture percentage of vaious samples

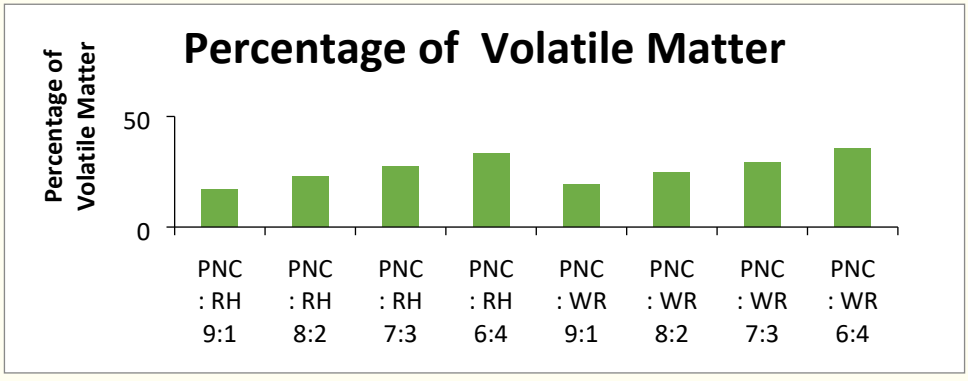


Fig. 3: Comparison of Volatile matter percentage of vaious samples

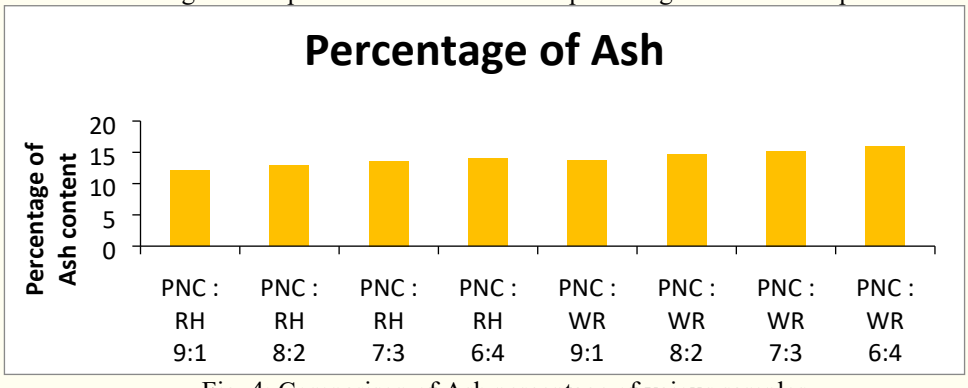


Fig. 4: Comparison of Ash percentage of vaious samples

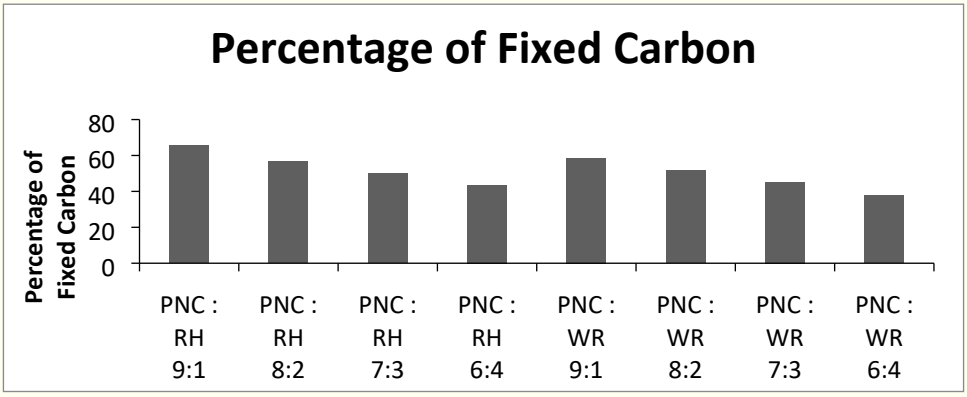


Fig. 5: Comparison of Fixed carbon percentage of vaious samples

Results shows that

- From fig. 1 the calorific value of Pine needles is 4568.2 cal/ gm (19.11 MJ/Kg) but when Pine needle charcoal 80% by weight is mixed with 20 % by weight of Rice husk, then it gives a maximum calorific value of 22.83 MJ/Kg.
- Moisture content in a coal reduces its calorific value and its capability to burn. Moisture content generally increases with decreasing coal rank. From fig. 2, it can be seen that as the ratio of binders increases from 10% to 40%, the moisture content in the sample increases.
- From fig. 3, it is cleared that as he percentage of binders in the sample increases from 10% to 40% by weight, the amount of volatile matter in the sample increases.
- From fig. 4, it is clear that when the mixing ratio of Pine Needle charcoal and binders decreases from (9:1) to (6:4), there is a simultaneous increase in the Ash content.
- From fig. 5, it is clear that when the mixting ratio of Pine Needle charcoal and binders decreases from (9:1) to (6:1), there is a decrease in the percentage of Fixed Carbon.

Conclusion

The study has been carried out to find out the chemical properties (such as calorific value, volatile matter content, moisture content, ash content and fixed carbon) of Pine Needle briquette using different binders. The various conclusions that can be made by study are:

- Pine Needle is a good source of fuel from which we can derive a vast amount of thermal energy. Due to its vast availability it can also be used for generating electricity.
- Pine Needle charcoal can be used for making briquettes due to its better calorific value, less moisture and less ash content. From the above experimental investigation it is concluded that when Pine Needle charcoal is mixed with binders then its calorific value becomes high than that of Pine Needle charcoal.
- Pine Needle charcoal samples have a good range of volatile matter content (16% to 36%) for its better combustion.

- The calorific value is maximum i.e, 226.83 MJ/Kg, when 80% by weight of PNC is mixed with 20% Rice husk.
- Rice Husk samples have a maximum value of fixed carbon content.
- Wheat Residue samples have a maximum value of Ash content

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