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Use of pine needle in energy generation application

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Abstract— The energy demand is growing and the conventional sources are limited. The world population is increasing day by day. so there is a need of sustainable development and for that energy and environment are two important factors. Most of our conventional systems are not environment friendly so there is a need of two way development where we can save environment and the environment saving cost should be paid by energy production. In this paper i am presenting the possibilities of energy production with Pine Needles (Biomass).

Keywords— Energy, Environment, Conventional Sources, Power, Pine Needle, Biomass

I. INTRODUCTION

The word energy demand is growing according to Energy Information Administration(EID) that the world energy demand will continue to increase at rapid rate until 2025.The majority of this increase due to increasing economic growth in Asia including India and China (USDOE,2005).The other reason for this is Industrialization & Economic growth.

In India the power demand is always higher than the power supply due to the industrialization and rapid population growth, most of the Himalayan Reason consisting these pine trees Uttarakhand is home to more than 340,000 hectares of pine forests. Since carriage of pine needle is not easy, hence if we consider the carriage of pine needles from the pine forests which are near to habitation or near the road head than approximately 40% of the biomass can be transported. Hence we can hope to get about 8.23 lakh tones every year and about 0.80 lakh tones pine needles is available in Van Panchayat and Civil Soyam Forest.Clubbed with stretches in western Nepal and Himachal Pradesh, pine forests cover about 1.5 million hectares. In the summer season, forest fires are common in these areas as pine needles, essentially needle shaped leaves which keep falling off trees from the middle of March till the onset of the rains in July, are highly inflammable. Even a half-burnt beedi carelessly thrown by a villager can cause fires that gut large forest areas. These fires destroy the local ecology, damaging the fertile top layer of the soil and destroying grazing grounds for cattle.

Due to the low density and low heating values no buddy use them as a result they always lying over the forest which causes forest fire and also damaged the growing capacity of land. If density of these pine needles increases (by chopping them or by bracketing them) they can be used as energy source. The material is then burnt with limited oxygen supply. This generates producer gas (a mixture of carbon monoxide, hydrogen and methane) which, after cleaning and cooling, is fed into a generator to produce electricity. The by product of this process is charcoal which can also be used as a replacement for wood and kerosene as cooking fuel. With the dual focus on the environment and energy engineering, where the pine needle would be used as a biomass for different thermal application.

Pine needles at present pose an environmental hazard as they are very flammable and cause large tracts of the forests to go up in flames each year. To use these needles as fuel for different energy generation application, which can be manufacture locally, would not only help our power issues in the world, but also help to remove an environmental danger.

II. MATERIAL AND METHODS

5 kg of pine needle sample was collected from uttarakhand hill region of India during May 2014. Sample was received in the form of long fibrous mass. It was chopped in order to get uniform representative sample. The material was kept in close poly bag to attain a uniform moisture level

In most of the combustion process biomass is gasified and the fuel gas is cleaned. Due to the combustion of pine needles Certain fundamental reaction will take place inside the gasifier. The main chemical reactions are:

Exothermic combustion reaction,

$$C + O_2 \longrightarrow CO_2 \qquad (1)$$

Endothermic Boudouard equilibrium process,

$$C + CO_2 \longrightarrow 2CO \qquad (2)$$

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Endothermic Heterogeneous water gas shift reaction,

$C + H_2O_{(g)} \longrightarrow 2CO$ (2)

Exothermic hydrogenation gasification,

$C + 2H_2 \longrightarrow 2CH_4$ (4)

TABLE I

FUEL ANALYSIS FOR PINE NEEDLES

S.N.	parameters	Available %
1	Ash	1.31
2	Carbon	52.60
3	Hydrogen	07.00
4	Oxygen	40.10

(As per the Biomass energy foundation)

Due to the availability of carbon content in pine needles this will be produce methane during combustion , so the methane with other gasses after cleaning can be used as fuel for electric generator in order to produce electricity. The by product of this combustion process ic char which can further use as a briquettes'

The two possibilities with pine needle are gasification and char although char is the by product from the gasification process

Char (biomass produced by pine needle carbonization) which can be further use as briquette by briquetting which is the process of converting low bulk density biomass into high density concentrated fuel briquetting. In this process we use modified kiln and briquetting mould.

Proximate analysis of material:

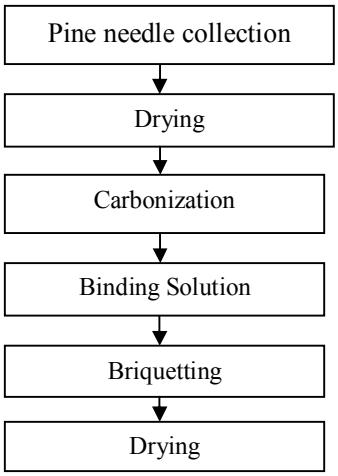
The moisture content ,ash, volatile material, and fixed carbon of the pine needles were determined by using standard method ASTM D-3173.The calorific values of pine needles and briquette sample was determined by using bomb calorimeter of model CC01/M3.

Material required: forest waste, binding materials, charcoal drum and briquetting mould /machine

Binding material: clay will used as a binding material

Sample	Char	Binding material
S1	1 kg	500g clay
S2	1kg	350g clay
S3	1kg	200g clay

The process can be defined as follow



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III.RESULT AND DISCUSSION

in this study, pine needle briquettes was prepared and physico chemical parameters were tested.it is cylindriacal in shape,weight about 185gm, and differs from other charcoal briquettes due to the vertical holes that run through it. The holes enable a flow of oxygen and controlled burning which creates a light blue flame.

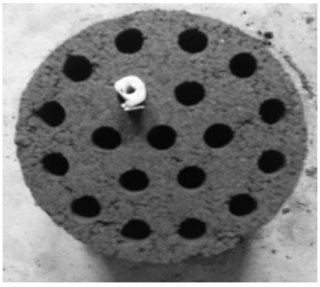

Fig1: Briquette sample with vertical holes

Fig2: Different briquette samples

Parameters	Pine Briquette
Appearance	Black color,Cylindrical Shape witht holes
composition	S1,S2,S3
Average diameter	6CM
Average height	3.4CM
Weight	185g

TABLE 2- PHYSICAL CHARACTERISTICS OF THE BRIQUETTE SAMPLES

The result of proximate analyses of the pine needle and biomass charcoal briquettes are shown in table3 from the result it is clearly shown that lesser the amount of clay higher the calorific values

Sample	S1	S2	S3
Moisture Content (%)	6.2	5.9	5.5
Ash Content (%)	32.6	29.3	26.2
Volatile matter(%)	50.7	55.4	60.1
Fixed Carbon(%)	10.5	9.4	8.29
Calorific Value (Kcal/Kg)”	4907	5745	6434

TABLE 3-THE RESULT OF PROXIMATE ANALYSIS OF BRIQUETTE SAMPLES

Ignition time: Each Briquette sample was ignited.the time required for the flame to ignite the briquette was recorded as the ignition time using stop watch.

Efficiency of the briquettes: thermal efficiency is the ratio of thermal power of the product gas producedto the thermal power of the input briquette biomass material supplied. In this briquettes selected for water boiler test it measures the time taken for each set of briquettes to boil an equal volume of water under similar conditiojn

IV. CONCLUSIONS

The result of this studies shown that the pine briquettes bonded with less amount of clay are more efficient and they also have the following properties: ignite properly, generate less smoke, high calorific value

This technology has greater potential and can be used for future

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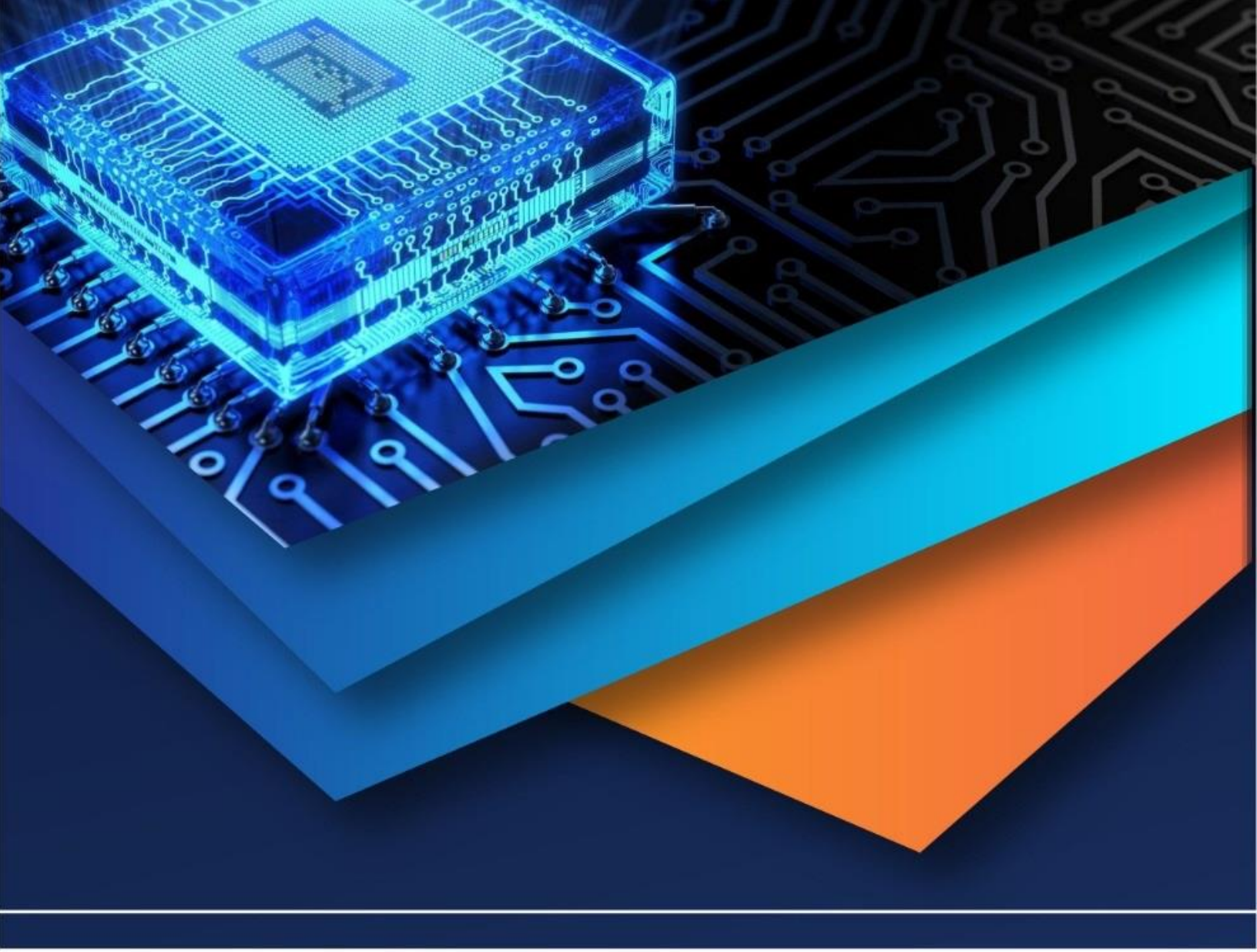

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