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CONTROL OF FOREST FIRE IN TIMBER FORESTS AREA THROUGH BIOLOGICAL AND TECHNICAL APPROACHES

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ABSTRACT

Pine trees cover large portions of the region and are considered as a hazard to cultivation and agriculture as well as the environment. This is because during the summer season, dry pine needles fall from the trees and cover the forest floor. Not only is this detrimental to cultivation, and the growth of grass needed as fodder for livestock, this is a serious cause of uncontrolled frequent forest fires during the dry months. The fires damaged the fertile top layer of the soil and left a layer of pine needle litter that prevented rain water from being absorbed by the soil and contributed to early depletion of the groundwater cycle and stopped grass growth, thus depriving livestock of important food. So, the question of what to do with these pine needles is an important one for forest and livestock. The focus of this study is to research alternate uses of these dry pine needles, including energy generation, which would result in an economic boost to the region. It would also greatly reduce the risk of forest fires, and therefore be of value from an environmental point of view.

Keywords: Pine needles, Forest fire, Economy, Environment, Forest Floor

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 and 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 are 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 byproduct 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.

MATERIALS AND METHODS

Pine needle sample of about 5kg was collected from Smahani mountainous area of Azad Kashmir for the duration of April 2019. The sample was collected in polythene bags so that their moisture level remained unchanged. The sample was in needle form and hewed it to get constant level in each sample

Types of Biomass

The Biomass is an organic material which is derived from the trees, algae and crops. All those plants which are capable of photosynthesis can produce the biomass. These plants included water living and land-living plants. The Biomass is an organic matter in which the chemical energy is stored from the sunlight and hence considers as a major source of energy.

There are two basic types of biomass including plant derived and animal derived biomass. The woody & non woody biomasses are the two types of plant deriver biomass. Woody biomass comprises all the trees & tree residues et. Non woody biomass includes the aquatic plants, agricultural plants and marine plants.

The characters of animal derived biomass are not yet fully studied. It considered as the municipal solid waste, sludge animal derived biomass. The animal derived biomass is not used for the purpose of gasification.

Characteristics of the Biomass

The performance of biomass in gasification and combustion processes is determined by its specific properties. Related to thermal conversion, the most important characters of biomass are as follows:

The Moistness

Quantity of water present in biomass is called as Moisture content or Moistness of the biomass. The moisture in biomass have effect on the value of biomass. Different biomass has different value of moisture as 10% in cereals and 50-70% in the forest residues.

Content of the Ash

The chemical breakdown of biomass due to different processes results in production of a solid deposit. When this process occurs by the combustion in air then this solid residue is called ‘ash’. Ash content effects on b management cost and the processing costs of overall energy conversion cost. At the point when accessible vitality of the fuel is decreased proportionately while subject to the extent of the cinder content. A thermochemical-transformation process in which the substance organization of the fiery remains can display a noteworthy operational issue which is especially precise for the burning procedures though, the cinder can respond to shape a 'slag', which is a fluid stage framed at raised temperatures that can lessen plant throughput and result in an expanded working expense.

A. The Volatile matter and a fixed carbon content

The Volatile matter (VM) is described as a gaseous matter which driven off from the matter. It also includes the water content which evaporates form biomass. The fixed carbon content (FC) is that mass which left after the releases of volatile matters apart from ash and the water contents. These two factors are the most important to examine the chemical energy stored in two forms like the fixed carbon and volatiles.

B. The Calorific value

The CV of a material is an expression of the energy content or the value of heat released when burnt in air. This value is usually measured in relations of the energy content per unit mass.

This value is expressed in two forms. These two forms are gross caloric value (GCV) or the higher heating value (HHV) & the net caloric value (NCV) or lower the

heating value (LHV). The higher warming worth is that the all out vitality substance is discharged when the fuel is copied in air including the idle warmth limited in the water vapor and in this manner, it speaks to the most extreme measure of vitality possibly recoverable from a given biomass source. While in commonsense terms, the inert warmth limited in the water vapor can't be utilized proficiently and, in this way, the lower warming worth is a proper incentive to use for the vitality accessible for the resulting use.

C. The Bulk Density

Significant character of a biomass material is their mass thickness or the volume both as created and as-hence prepared. The as-delivered mass thickness is most significant in connection to the vehicle and away costs. The Density of the prepared item that impacts the measuring of the materials dealing with framework, a fuel stockpiling necessity and how the material is probably going to carry on during the resulting canteen concoction or natural handling as a fuel or feedstock. The Bulk thickness is fundamentally an extraneous property that relies upon way of the material-taking care of. The Chemistry of Gasification Process

a) Ventilation

The biomass fuel generally contains the moisture in range of 10 % and 35 %. The moisture content is converted to steam upon heating the biomass around 100°C.

b) The Pyrolysis

When the biomass in dry form is heated it undergoes the process of pyrolysis. The Pyrolysis refers thermal breakdown of biomass in the nonappearance of O_2. It also crumbles into gasses, liquid gas & solid charcoal.

c) The Oxidation

In the oxidation zone, the air is introduced in reactor. About 700 to 1400°C temperature is required for the process of oxidation. In this process the solid carbon fuel reacts with O2 in the presence of air and CO_2 and heat releases.

Carbon fuel + oxygen → Carbon dioxide+ 393800 kJ/kg

d) The Reduction

Under high temperatures & reducing conditions, CO2, CH4 and H2 formed under different reactions. In the process of burning, the biomass convert in gaseous form and the fuel gas become pure. IN gasifier reactor, due to the burning of needles many important reactions take place. These reactions are described as:

Exothermic Reaction

$C + CO_2 \rightarrow 2CO$

Endothermic Equilibrium process

$H_2O + C \rightarrow H_2 + CO_2$

Endothermic heterogeneous water gas shift reaction

$H_2O + CO_2 \rightarrow H_2 + CO_2$

Exothermic hydrogenation gasification

$2H_2 + C \rightarrow H_4 + 7500$ KJ/kg mole

Table 1: Fuel investigation of pine needles collected from the study area.

Sr. No.	Constituents	Percentage
1	Carbon	50.20
2	Oxygen	39.00
3	Ash	02.41
4	Hydrogen	08.00

Due to the available content of carbon in pine needles, methane gas is produces during the burning of pine needles. This methane gas is used for producing the electricity through electric generators. The byproduct of this process is Char which is

further used as a fire brick. Char and process of gasification are two prospects with needles of pine plant. During the process of gasification, char is produced as residue.

The char is the biomass of pine needles produced during the carbonization process which is used in the process of briquetting as a block. In this process high density fuel is formed from the low bulk density biomass. briquetting mould and Modified kiln are used during this process.

Proximate analysis of pinus leaf needles

ASTM D-3173 is an ordinary technique which is used to determine the fixed carbon content, Moisture content, Volatile matter & ash content of pine needles. Bomb calorimeter is used to check the Calorific values of needles of pine plant briquette sample. CC01/M3 model of bomb colorimeter is used for this purpose.

Table 2: Proximate analysis

Sr. No.	Parameter	Percentage
1	Moisture content	50.20
2	VM content	39.00
3	Ash	02.41
4	Carbon	08.00

The Binding Material

Pine needles, Clay, Samples that are made up of iron, Water, Gloves and Plastic Pot were required for the experiment. Clay was required as a binding material.

Table 3: Different models of bricks

Model	Char Content	The Binding Material
M1	1 Kg	600 g
M2	0,9 Kg	450 g
M3	0,85 Kg	300 g

The procedure of binding is as follow;

The gathering of Pine needles

↓

The Drying

↓

The Carbonization

↓

The Binding Solution

↓

The Briquetting

↓

The Drying

RESULTS

This research paper indicated that pine needles have a tremendous energy. Proper utilization of these pine needles will greatly help to meet the energy shortage and prevent forest fires in the particular region. And this will surely raise living standard of people by giving job in these fire briquetting plants. This also leads to save our forest and our ecosystem from forest fires. These briquettes that are obtained from dry pine needles can be also used for heating purpose. So, this is a technique to get dual energy from single biomass.

Fig. 1: Different briquette samples

In this study, pine needle briquettes were prepared. It is cylindrical in shape, weight about 98gm. For the research purpose, three briquette model samples were made by using dry pine needles and clay (as a binding material). Firstly, three model samples were named as M1, M2 and M3 and then the result of proximate analysis of briquette samples was in a way that the moisture content (%) of M1=4.2, M2=3.9 and M3=3.3, the Ash content (%) of M1=28.2, M2= 26.3 and M3=24.2, the Volatile matter (%) of M1=46.7, M2=51.4, and M3=56.1, the fixed carbon (%) of M1=5.5, M2=6.4, and M3=4.29, Lastly the Calorific value of M1=2507, M2=3545 and M3=4434.

Table 4: Physical characteristics of the Briquettes samples

Parameters	Fine briquettes
Appearance	Black and light brown color, cylindrical shape
Composition	M1, M2, M3
Average diameter	4CM
Average height	2.1CM
Weight	98gm

Table 5: Result of Proximate Study of the Brick Models.

Sample	M1	M2	M3
Moisture content(%)	4.2	3.9	3.3
Ash content(%)	28.2	26.3	24.2
Volatile matter(%)	46.7	51.4	56.1
Fixed carbon(%)	5.5	6.4	4.29
Calorific value(Kcal/Kg)	2507	3545	4434

The Table 5 indicated that higher calorific value of a model shows that it has small amount of clay. There are large amount of pine needles present on the forest floor having *Pinus roxburgi* plants. The pine needles are helpful in producing the electricity as well as it can subsidize to the National Grid System. Usage of pine needles for the different purposes makes the environment save and also makes the forest save from fire as these needles contribute more in the forest fire. The pine needles are helpful to meet the energy requirement of the region or country. Some other useful impacts are as follows:

Beneficial aspects of Pine needles

As the pine needles are frequently available in the forest areas, an initial investment is required for this purpose. The reimbursement period for such arrangements is very low because of the high rates of process of fire briquetting.

Social (Common)

There are lack of jobs in the forest areas or neighboring areas. This industry usually works in the forest areas of associated areas providing the job opportunities for native peoples.

During the hot summer days, the fire burns the forest floor and also effects on the vegetation. The pine needles are highly inflammable and act as a fire load in the forest areas. The fire damage the top layer of soil and also effects on the grazing areas of forest. The native people of forest areas collect the pine needles and use them for different purposes and hence the forest is protected from the fire.

Effects of fire on Wildlife

The wild life includes the flora and fauna present in the forest area. The fire has adverse effect on the flora and fauna. Different plants which have no ability to tolerate fire or those plants which are not fire resistant are affected most from the fire. The fire also destroys the grass vegetation. In some cases, the fire is responsible for the extension of different plant species. It has negative impacts on the fauna also. Summer is the breading season for many birds. The fire effects on the breading phenomena of many birds and animals.

Impact of fire on Human Beings

The Control fire is generally used by native people to promote the growth of many grass species, but sometime this control fire turns into the crown fire and damage the forest area. The native people use special permission to gather timber from the forest area to repair their houses. The dry pine needles of pine plant can be used by the villagers for different purposes including food cooking, packing, lightening up etc.

DISCUSSION

This study is done to investigate the consequence of fire on *Pinus roxburghi* in Samahni Azad Kashmir. This thesis offerings the basic information about the effects of fire, causes and mitigation measures to control the forest fire. This research was done in those areas which are rich in plants of *Pinus roxburghii*. The time as well as fire have an effect on the flora.

Currently, Canada and USA are those countries which conduct research work on broad level to investigate the effect of forest fire. (Arno 1976; Romme 1982; Romme and Despain 1989; Baker 1989a, b). It can also be determined from the study that the fire has an adverse effect on the vegetation as well as on human life. The outcome is

more prominent if the suggested burning is applied year after year. The frequency of Fire has negative impacts on the flora of that area and also destroys the land. Also, effects on the fertile layer of soil. There is reduction in forest tops and controlling measures was noted in the study area as a whole with or without fire action, while there was an upturn of un-forested communities such as shrub lands and treed shrub lands. The unreadily destruction of forest especially pine trees are a great threat for human being and for other wild life. If this rate of deforestation is non-stop than it is difficult to survive. Now it is our duty that we protect forests by fire and by other hazards (Foster 1983; Arno and Gruell 1983).

A large area of the forest is covered by the pine trees and the forest floor is covered by the pine needles. These pine needles are a big threat to the cultivation & agriculture as well as for the environment. During the hot days of summer seasons, these pine needles fall from the plants on the forest floor. They can reduce the growth rate of grasses which act as fodder for the animals. These pine needles are highly inflammable and results in fire events due to many reasons. The fire can destroy a large forest area and also burn the crown of plants. The fire has negative impacts on the environment as it increases the amount of carbon dioxide in the atmosphere. IT also destroy the canopy layer and responsible for the soil erosion. The main aim of this research is to investigate the alternate uses of these dry pine needles. It also includes the energy generation, which would result in an economic boost of the areas. The use of pine needles for different purposes reduces the risk of fire events (Clark, 1990).

The population of the world is increasing day by day. The energy generation is less and the demand is more. The sources of energy generation are also limited. So there is need of maintainable 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 progress where we can save environment and the environment saving cost should be paid by energy production. In this Research paper, we presented the possibilities of energy production with pine needles (Biomass).

CONCLUSION

All the study and research show that there is a wide range of uses of pine needles if these are properly used. In forest areas or those areas which are rich in pine needles can produce the energy by needle bricks. The energy which is produced from this technique contribute the most to clean the environment and forest areas. There are many challenges in the amplification of this technique but the forecasts for this technology are very good. There are several features that are linked to pine needles-process of briquetting that must be dispensed within a well-organized way on a public level. This also includes the security matters, the waste organization, the load management and plant operation mode. In the conclusion, this type of technology will prove a social, the economic and environment friendly development. The research work shows that the pine needles have massive power if these pine needles are properly used. There is a wide availability of the pine needles in the Himalayan region and these needles are used for the power generation through the process of gasification. The power generation from the pine needles also leads to the environment development. The use of pine needles has two benefits. On one hand it is used for energy generation and on the other hand the forest floor is cleaned from the pine needles which decreases the risk of fire. The projections for this technology are very good & challenges in operation are also very high. The gasification process of the pine needles is related with many features which must be dealt in a good manner on local level. These features include safety issue, load management, waste management & mode of plant operation. At conclusion, we concluded that this technology will provide an economic, social & environment friendly development.

SUGGESTIONS

1. The main impact of fire is due to man. If there is awareness inthe different societies about bad impact of fire, we can save by this big loss.
2. Switching to a more use of wood is reduced and alternativesource is find for fuel.
3. By collecting dry pine needles to make fire briquettes that areused in heating process.

4. By saving the forests by timber mafia, which are main sourceof deforestation.
5. Inspire useful bats, birds & insects for natural pest control.

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