A Review

Conversion of pine needle from threat to economic opportunity

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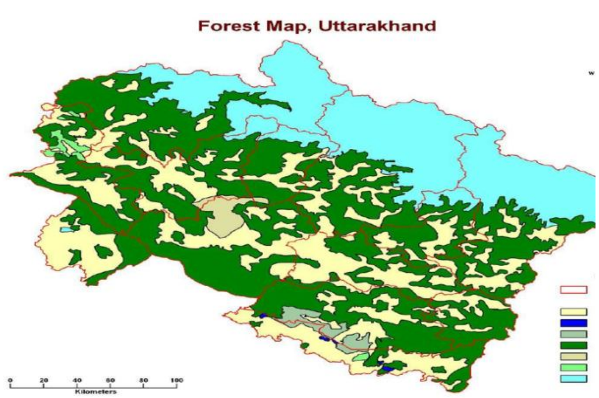
Abstract

This paper accounts for a methodology to address the management of forest bio residue i.e. pine needles and pine cones in Himalayan region of India .As we know that the population is increasing day by day and we don't have enough energy to meet the demand so in this case pine needles and pine cones can be used as a non conventional sources of energy .Pine needles are hazardous to environment as it causes forest fire and also damaged the growing capacity of land. This environment threat can converted into economic development of region by making alternate use of it. The biomass can be mix with some binding materials to form briquettes which are then use to generate power.

Keywords- Energy, Pine needle, Pine cones, Non -Conventional source, Population, Biomass, Power

Introduction



During the summer season dry and fallen pine leaves are burnt either accidently or intentionally by the villagers there by releasing large volumes of Green house gases into the atmosphere. Millions of tons of pine needles [47] in the outer Himalayan region fall every year on the forest floor which is ultimately turned to ashes causing great losses to the environment in the form of release of carbon dioxide, soil erosion, loss of soil fertility and damage to regeneration.

Due to the low density and low heating values nobody use them but if density of these pine needles increases (by chopping them or by bracketing them) they can be used as energy source.

One of the organizations named 'Avani' in Berinag village of Pithoragarh district is generating 9 kW of electricity from pine needles. Generating electricity from pine needles would have a ripple effect on the village economy. Villagers would collect pine needles and they would get paid for it. The forests would be cleared of pine needles thus reducing the chances of fire to a large extent.

Literature Survey

Chandel et al. (2010) the calorific values of various fuels are follows

TABLE 1

Fuel	Calorific value (approximate)
Natural gas	8600kcal/m3
Liquefied petroleum gas (LPG)	10,800 kcal/kg
Kerosene	10,300 kcal/kg
Diesel	10,700 kcal/kg
Biogas	5000 kcal/kg

The rural people are now shifting from fuel wood to LPG as government imposed banned on cutting of trees to carbon emission which leads to melting of Himalayan glaciers.

Muniz et al. (2014) estimates that pine needles were found to have ash content of 2.32% and gross calorific value of 20.30 MJ/kg. The calorific value increased by 45%, reaching 29.64 MJ/kg, after carbonization carried out at 600 ºC. This value is higher than that for charcoal made from eucalyptus (19.25 MJ/kg) and even coconut husks (23.55 MJ/kg), showing the high energy potential of these needles. Charcoal from pine needles has good energy potential due to the low ash content and a calorific value, which match those of the species that are commercially used as biomass.

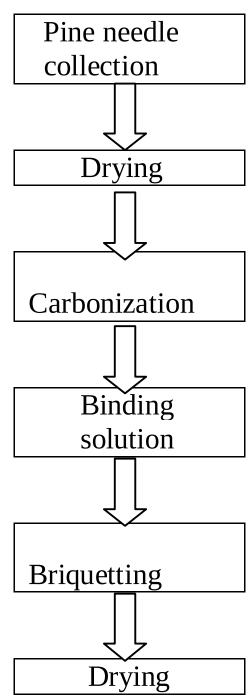
Bisht et al. (2014) the different process involved in gasification are Drying , Pyrolysis, Reduction and Oxidation.

TABLE 2

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

The whole process of making pine needles briquettes is follow



The pine needles briquettes bonded with less amount of clay are more efficient and have high calorific value , generate less smoke and ignition takes place properly.

Fateh et al. (2016) the combustion of the pine needles under air atmosphere in cone calorimeter which shows that carbon dioxide and water are the main emission during the experiment .**Quintiere (1992)** tells that even if a simple pine needle is a thin material during cone calorimeter experiments, the porous bed of pine needles behaves like a thermally thick material. Sixteen different gaseous variety have been simultaneously monitored during the process, but only, CH4, CO, CO2, and H2O are the main emissions.

Almendros et al.(2015) the characterization of the pine cone shell shows that it can be used as the biosorbent of nickel and than as inlet material in thermo chemical process .The effect of nickel in the process shows that the nickel does not form volatile compounds at operational conditions due to its emission in ash-char fraction .The result demonstrated that Pyrolysis ,combustion or gasification is a suitable way for disposal this heavy metal contaminated biomass ,ignoring loss of valuable process energy and compounds and preventing nickel from releasing to the environment.

Font et al. (2009) studied kinetics for pine cone shell and pine needles under different conditions in TG and TG-MS. Dynamic runs performed out at constant heating rate and others runs are carried out at isothermal regime . Kinetic values were calculated by integration of the differential equations and minimizing the squared differences between the experimental and calculated values. The kinetic study was done to correlating dynamic and isothermal runs with same set of parameters.

Regueira et al. (2001) calorific values of forest waste biomass were measured by static bomb calorimeter. The results based on **Hubbard et al. (1956)** shows that the calorific values are exceeding 20 000 kJ/ kg for pine needles which shows that they can be used as alternative fuels. The electric energy which is obtained from xyloenergy is considered as a clean and high-quality energy. These forest waste biomass s a fuels results in twofold benefit i.e. and economic benefit and ecological benefit as removal of forest residue reduces the risk of forest fires.

Moreno et al. (2012) Combustion is the most commonly used method for extracting biomass materials energy. This is usually measured in terms of HHV or LHV. The determination of the HV is very expensive since it requires the use of specialized equipment. However, the HHV and LHV can be measured using models based on the results of relatively simple analyses, e.g., proximal, elemental, structural physical or chemical analysis. The most used analysis to develop models for determination of HV of biomass materials is elemental analysis.

Safi et al. (2013) thermal degradation analysis has been done by using a thermo gravimetric analyzer under oxidizing atmosphere at different heating rates. The result shows four distinct degradation zones. The second, third and fourth zone shows the fast degradations and gave highest values of activation energy. **Agrawal and Sivasubramanian (1987)** method was used to determine the kinetic parameters of pine needles.

Joshi et al. (2015) the author had discuss various methodologies to address the management of the forest bio residue and it also deals with the complete innovation cycle. Methodology so generated in this study traveled through the passage of inductive, deductive and positivistic approaches which finally ended with a basic but a need based invention for the communities.

Conclusion

This review paper conclude that the pine needle is a great source of energy and can be used as a alternate fuel to generate electricity due to its good calorific value. The pine needle can be converted into briquettes mixing them with binding materials. By using different binding materials we can compare the calorific value of pine needle briquettes by which we can determine the most efficient binding material for making pine needle briquettes. This source of energy leads to economic development and ecological benefit.

References

[1] Chandel, S.S., Aggarwal, R.K., 2008. Performance evaluation of a passive solar building in Western Himalayas. Renewable Energy 33, 2166–2173.
[2] W. Hubbard, D. Scott, G. Waddington, in: F.D. Rossini (Ed.), Experimental Thermochemistry, Interscience, New York, 1956, p. 5.
[3] L. NuÂnÄez-Regueira, J. ProupõÂn CastinÄeiras, J.A. Rodrõ Âguez AnÄon, Bioresour. Technol. 57 (1996) 283.
[4] Uttarakhand Renewable Energy Development Agency Department of Renewable Energy, Govt. of Uttarakhand, UREDA online at http://ureda.uk.gov.in/pages/display/142-pine-needle-based-project
[5] Biomass energy Foundation report on Proximate Analysis online at www.woodgas.com/proximate.htm, Biomass energy foundation
[6] R. Font, A. Marcilla, E. Verdu´ , J. Devesa, J. Anal. Appl. Pyrol. 21 (1991) 249.
[7] P.L. Walker, F. Rusinko, L.G. Austin, Adv. Catal. 9 (1959) 133.
[8] Personal communications, Kumar Kabra: Owner, Suyas udyog private limited, Kiccha, Uttarakhand; 2014.
[9] Callejón-Ferre AJ, López-Martínez JA. Briquettes of plant remains from the greenhouses of Almería (Spain). Span J Agric Res 2009;7:525–34.
[10] J. Quintiere, A Semi-quantitative Model for the Burning Rate of Solid Materials NISTIR 4840, National Institute of Standards and Technology, Gaithersburg, MD, 1992.
[11]C.DiBlasi, Modeling chemical and physical processes of wood and biomass pyrolysis,Prog.EnergyCombust.Sci.34(2008)47–90. [
[12]C.Branca,C.DiBlasi,Global intrinsic kinetics of woodoxidation, Fuel83 (2004)81–87.