iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 2 **Issue:** XI **Month of publication:** November 2014

DOI:

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)

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,

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

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:

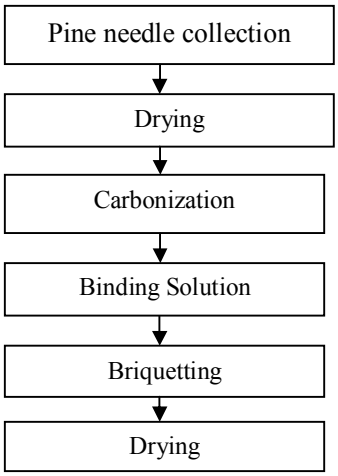
The moisture content ,ash, volatile material, and fixed carbon of the pine needles were determined by using standard method ASTM D-3173.The calorific values of pine needles and briquette sample was determined by using bomb calorimeter of model CC01/M3.

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



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.

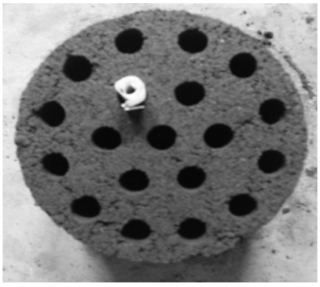


Fig1: Briquette sample with vertical holes

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

REFERENCES

[1] Mande Sanjay, Lata Kusum, "Preparation of charcoal briquettes from field and forest residues", Asia-Pacific forum for environment and development (APFED), 2004, 2-3
[2] Bamgboye Isaac Adeleke and sorghum
[3] rom Guinea corn (bi-color) Residue." Agricultural Engineering International: the CIGR Ejournal. Manuscript 1364 Volume (11), 2009. Accessed January 05, 2013. http://www.cigrjournal.org/index. php/Ejounral/article/viewFile/1364/1195
[4]
[5] [2]Font R., Conesa J.A., Molto J., Munoz M., "Kinetics of pyrolysis and combustion of pine needles and cones", J. Anal. Appl. Pyrolysis 85 (2009), 276–286
[6] [3]Sugumaran p., Seshadri s., "Biomass charcoal briquetting", Shri AMM Murugappa Chettiar Research Centre taramani, Channai-60011, 1-12
[7] [4]Access to Clean Energy, a glimpse of off grid projects in India, www.undp.org.in/sites/ default/files/reports_publication/ACE.pdf
[8] Accessed September 05, 2012. http://www.tungku. or.id/eng/?choose=detailnews&newsid=30&category= 11.
[9] Kim Hee-Joon, Lu Guo-Qing, Naruse Ichiro, Jianwei Yuan and Kazutomo Ohtake, "Modelling on combustion characteristics of biocoalbriquettes." Journal of Energy Resources and Technology 123 (2000): 27-31. Accessed December 20, 2012. doi: 10.1115/1.1347988.
[10] Pandey S. and Dhakal R.P., "Biomass Briquetting: Turning waste into Energy." (paper presented at First National Conference on Bioenergy, Nepal Academy of Science and Technology. Khumaltar, August 24-25, 2011).
[11] Sayakoummane Vongsayasana and Achara Ussawarujikulchai, ″Comparison of the Physical and Chemical Properties of Briquette and Wood Charcoal in Khammouane Province, Lao PDR". Environment and Natural Resources Journal. 7.1 (2009): 12-24.
[12] Shaw Mark, "Feedstock and Process Variables Influencing Biomass Densification", Agricultural and Bioresource Engineering, Master of Science, University of Saskatchewan, Canada, 2008. Accessed February 08, 2013.http://ecommons.usask.ca/ bitstream/handle/10388/etd-03092008115636/Thesis.
[13] MarkShaw.FinalR3.pdf.
[14] Singh R.M., M. Kamide and Toshihiko M., "Some chemical and physico-mechanical properties of Nepalese coal tested for biobriquettes." Journal of
[15] Nepal Chemical Society 15 (1996): 12-18. Accessed January 05, 2013. doi: 10.1016/S0140-6701(98)80124-0.
[16] Singh R.M., M. Toshihiko, M. Kamide, K. Taniguchi and K. Deguchi, "Biobriquettes-An alternative fuel for domestic and industrial applications." Nepal Journal of Science and Technology 3 (2001), 105-114.
[17] Strehler A., "Technologies of Wood Combustion." Ecological Engineering: (Supplement) 16 (2000), 25- 40. Accessed March 13, 2013. doi: 10.1016/S0925- 8574(00)00049-5.
[18] Sun Chen L., Zhang Ming Y., "Ignition of coal particles at high pressure in a thermo gravimetric analyzer." Combust Flame 1998; 115:267–74. Accessed December 25, 2012. doi: 10.1016/S0010- 2180(97)00350-7.
[19] [5]Quarterly magazine on biomass energy, published
[20] under the undp-gef biomass power project of ministry of new and renewable energy (MNRE), government of India. Published by winrock international India (WII), issue 2 – DEC 2009
[21] [6]Himalayan forest research institute, shimla, hfri.icfre.gov.in
[22] [7]P.D. Grover & S.K. Mishra, "biomass briquetting technology and practices", regional wood energy development programme in Asia gcp/ras/154/net, Field Document No.46, 1-43
[23] [8]Sugumaran P, Seshadri S, "Evaluation of selected biomass for charcoal production', journal of science & industrial research, Vol.68, August2009, 719-723
[24] [9]Kim H., kazuhiko and masayoshi S., "Bio-coal briquette as a technology for desulphurdizing and energy saving", In T. Yamada ed. Chapter34, 2001, 33-75
[25] [10]Onuegbu T.U., Ekpunobi U.E., Ogbu I.M., Ekeoma & Obumselu F.O., "comparative studies of ignition time and water boiling test of coal and biomass briquettes blend", IJRAS 7 (2), vol.17issue2, May2011, 153-159
[26] [11]Bogale Wondwossen, "preparation of charcoal using agricultural wastes", Ethip .J. Educ. & Sc., vol.5 no.1 September 2009, 82
[27] [12]ASTM standard E711-87, Standard test method for gross calorific value of refuse – derived fuel
[28] by the bomb calorimeter. Annual book of ASTM standard,11.04. ASTM International, http//www.astm.info/standard/E711.htm 2004
[29] [13]Eriksson, S. and M. Prior, "the Briquetting of Agriculture of Agricultural Wastes for Fuel", F.A.O. Publication, 1990.
[30] [14]Sotannde O.A., Oluyege A.O, Abah G.B., "Physical and combustion properties of charcoal briquettes from neem wood residues", Int. Agrophysics, 2010, 24, 189-194.
[31] Tosun I. Yildirim, ″Clean Fuel-Magnesia Bonded Coal Briquetting.″Fuel Processing Technology. 88.10 (2007): 977-981. Accessed January 25, 2013. doi: 10.1016/j.fuproc.2007.05.008.
[32] Wilaipon Patomsok, "Density Equation of Bio- Coal Briquette and Quality of Maize Cob in Thailand." American Journal of Applied Science 5(12), 2008.

1808-1812. Accessed October 02, 2012. doi: 10.3844/ajassp.2008.1808.1811.

[33] Zhang, D.K., Wall, T.F., Harris, D.J., Smith, I.W., Chen, J., and Stanmore, B.R., "Experimental studies of ignition behaviour and combustion reactivity of pulverized fuel particles" Fuel, 71 (Nov), p1239, 1992. Accessed December 25, 2012. doi: 10.1016/0016-2361(92)90049.

[34] Bamgboye Isaac Adeleke and Bolufawi Joseph Senewo, "Physical Characteristics of Briquettes from Guinea corn (sorghum bi-color) Residue." Agricultural Engineering International: the CIGR Ejournal. Manuscript 1364 Volume (11), 2009. Accessed January 05, 2013. http://www.cigrjournal.org/index. php/Ejounral/article/viewFile/1364/1195

[35] Chen Yong, Mori Shigeikatsu, Pan Wei-Ping,. "Estimating the combustibility of various coals by TG-DTA." Energy Fuels 1995; 9:71–4. Accessed December 25, 2012. doi: 10.1021/ef00049a011.

[36] Demirbas Ayhan, "Combustion characteristics of different biomass fuels." Progress in Energy Combustion Science, 2004; 30:219-30. Accessed January 05, 2013. doi: 10.1016/j.pecs.2003.10.004.

[37] Dionco-Adetayo A. Erlinda, "Utilization of wood wastes in Nigeria: A feasibility overview." Technovation, 21 (2001): 55-66. Accessed February 22, 2013. doi: 10.1016/S0166-4972(00)00003-1.

[38] Eriksson S. and M. Prior, "The Briquetting of Agricultural Wastes for Fuel." FAO Environment and Energy Paper11 (1990), FAO, Rome. Accessed January 05, 2013. http://www.fao.org/docrep/t0275e/ t0275e00.HTM

[39] Food and Agriculture Organization (FAO), "Simple technologies for charcoal making." FAO (1987). Rome,

[40] Italy. Accessed January 05, 2013. http://www.fao.org/docrep/x5328e/x5328e00.htm.

[41] Food and Agriculture Organization (FAO). "Industrial charcoal making." FAO (1985). Rome, Italy. Accessed January 05, 2013. http://www.fao.org/docrep/x5555e/ x5555e00.htm.

[42] FORPRIDECOM, "Wood Charcoal." FORPRIDECOM Technical Note. Forest Products Research Industries and Development Commission. Manila, Philippines. 1979.

[43] Grover P.D. and Mishra S.K., "Biomass Briquetting: Technology and Practices." RWEDP Field Document no. 46, Food and Agricultural Organization of the United Nations, Bangkok, 1996. Accessed March 25, 2013.http://www.ces.iisc.ernet.in/energy/HC270799/R WEDP/fd46.html.

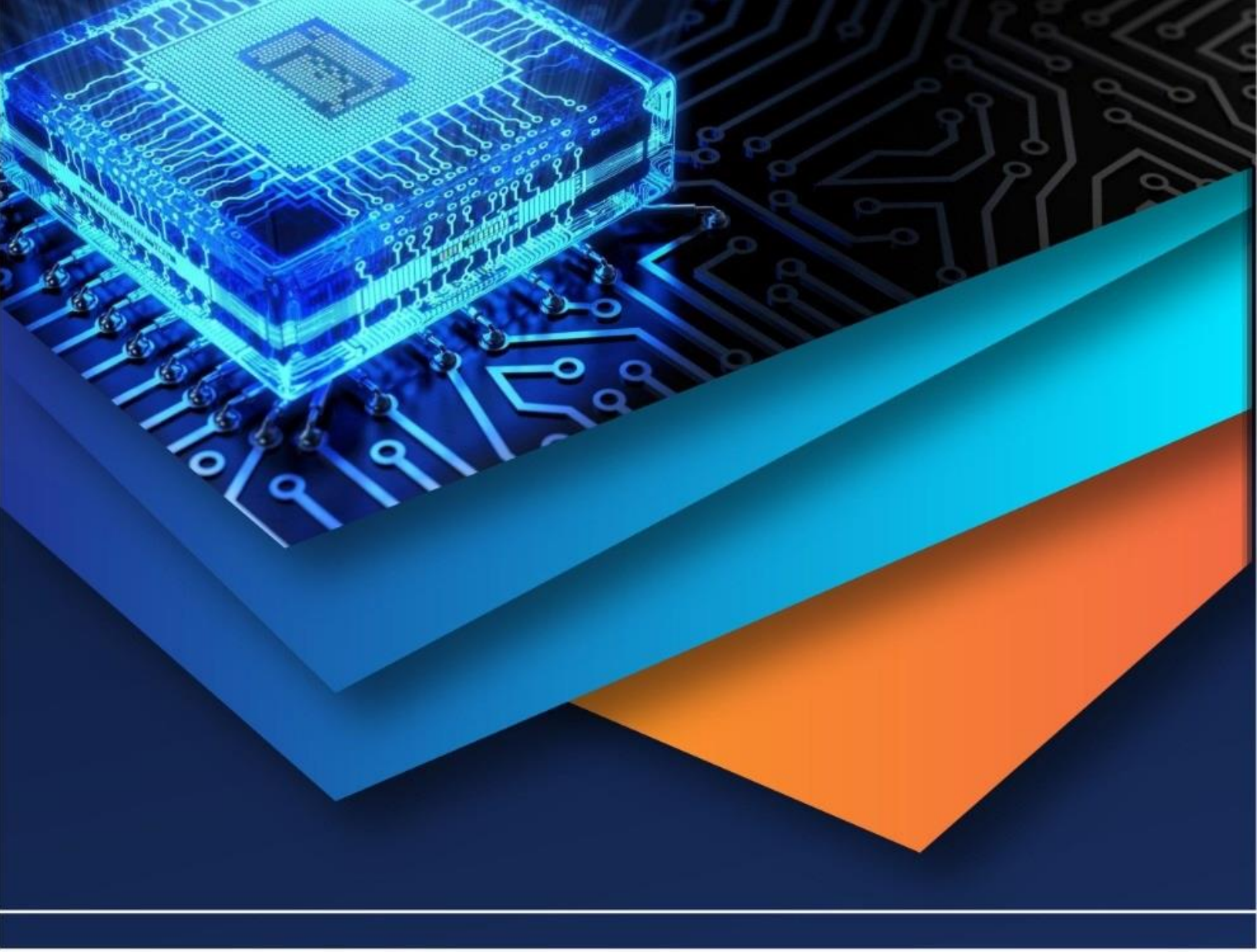
[44] Grover P.D., Mishra, S.K. and Clancy J.S., "Development of an Appropriate Biomass Briquetting Technology Suitable for Production and Use in Developing Countries." Energy for Sustainable Development. (1994): 45-48. Accessed September 05, 2012. http://purl.utwente.nl/publications/22483.

[45] Higman Chris and Burgt van der Maarten, "Gasification." Elsevier Science (2003). 200 Wheeler Road. Burlington. Page 67-70.

[46] Hindi S. Z. Sherif, "Contribution of Parent Wood to the Final Properties of the Carbonaceous Skeleton via Pyrolysis". International Journal of Science and Engineering Investigation. Vol. 1. 8 (2012): 9-12.

[47] Kaliyan Nalladurai and Morey R. Vance, "Constitutive Model for Densification of Corn Stover and Switchgrass." Biosystems Engineering. 104.1 (2009): 47-63. Accessed March 09, 2013. doi: 10.1016/j.biosystemseng.2009.05.006.

[48] Karve Priyadarshini, H.Y. Mahajan and A.D. Karve, "A Biomass Charring system for Rural Areas." In: Biomass Residues for Fuel. A Publication of Glow the Asia Regional Cookstove Program Vol. 24. June, 2001.



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