Analysis and Comparison of Biomass Pellets with Various Fuels

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Abstract— The demand for bioenergy systems in small scale industry is increasing at faster rate due to its lower investment cost The use of renewable energy sources is becoming increasingly necessary, if we are to achieve the changes required to address the impacts of global warming.. Pellets are bio fuels made from compressed organic matter or biomass. Pellets can be made from any one of five general categories of biomass: industrial waste and co-products, food waste, agricultural residues, energy crops, and virgin lumber In this paper a research is made on performance of pellets as an alternative fuel , and using that fuel for various burning purposes, and hence analysis and comparison of pellets with various fuel is done so as to calculate an efficiency of the pellets .as per the practical performance pellets have wide applications. These pellet fuels can be an effective alternative for LPG, PNG, and diesel fuels. Hence comparison between these fuels is done.

Key words: Biomass Pellets, Fuels

I. INTRODUCTION

Biomass is one of the most promising renewable energy resources on earth which is used in the form of solid, liquid and gaseous fuels. The demand for bioenergy systems in small scale industry is increasing at faster rate due to its lower investment cost. Currently bioenergy is the second largest commercial renewable energy source. Current total biomass energy usage ranges around 12% of world total primary energy consumption, mainly in traditional applications like cooking in developing nations like India. Also the usage of wood for heating purposes is increasing day-today. Normal domestic wood-burning appliances include fireplaces,pellet stoves and burners, central heating furnaces and boilers for wood logs and wood pellets.

II. OBJECTIVE

By using Biomass pellet, We are using pellets as the substitute for oil and gases. Our aim is to replace Oil/Gas by using Biomass pellet as fuel with low cost as compared to fuels such as kerosene, L.P.G, natural gas, wood, Coal. Main objective of our project is to reduce greenhouse gas emission through creation by introduction of biomass pellets, and also carbon emission is very less as compared to other fuels.

III. PELLETS

Pellet fuels are bio fuel made from compressed organic matter or biomass. Pellets can be made from any one of five general categories of biomass: industrial waste and co-products, food waste, agricultural residues, energy crops, and virgin lumber.

Pellets are categorized by their heating value, moisture and ash content, and dimensions. They can be used as fuels for power generation, commercial or residential heating, and cooking.

Fig. 1:

The wood is cut into small particles by grinding process and is dried. It may then be processed with readily available equipment to make wood pellets. These processed wood pellets have comparatively high calorific value, easy transportation and storage and can be utilized for heat and power. Pellet plants can be built at a wide range of sizes. Smaller plants require less feed. Larger plants will generally offer good economy of scale, but may also face greater costs for feed brought in from a larger growing area.

In the production of fuel pellets and briquettes, the feedstock has to be milled, pulped and undergoes steam before being transformed into a denser product. It is in either refined powder form or crop residue that has been put under high pressure so as to be formed into small cylinders like structures of different sizes. At a given pressure, in its phase of production and reduced humidity, the energy density of the wood pellet obtained is about almost double that of the wood. Hence reduction of size is an important treatment of biomass for energy conversion. Reduction of size of the particle increases the total surface area, pore size of the material and the number of contact points for inter-particle bonding in the compaction process. A number of properties are commonly known to affect the success of pelleting, including calorific value, moisture content of the material, bulk density, particle size, fiber strength of the material, lubricating characteristics of the material, and natural binders. Utilization of wood and crop residues as an energy source will serve to reduce consumption of fossil fuels, thereby reducing the emission of greenhouse gases to the environment. Ideal in providing fuel for heating devices, the wood pellet it is pure, non-pollutant, and neutral in carbon dioxide (CO2) emissions. In other words, it doesn't contribute to the destabilization of the ambient, as whatever carbon dioxide emissions occur from its combustion they are counterbalanced by equivalent amounts of (CO2) that have been absorbed from the plant during its life, process of photosynthesis, it burns completely, without producing smoke, leaving minimum residue of ash, always less than 1%, which can be used as a precious fertilizer for the garden too.

A. Features of Pellets:

- Cost Effective
- Sustainable and Eco-friendly
- Efficient.
- Safe.
- Less smoke produce Easily available
- Convenient pack size.

B. Data Analysis:

The correlation of the calorific value of the biomass and its elementary components is usually determined by ultimate analysis which requires very expensive investment such as laboratory equipment and highly skilled and trained analysts. The proximate analysis on the other hand requires simple standard laboratory equipment and a normally skilled scientist or engineer can run the experiment. But it is limited to ash content and volatile material content in the biomass. Hence for the correlation of calorific value and elemental components it is better to use Statistical analysis. The best available statistical process for this project is Regression analysis.

C. Regression Analysis:

Regression Analysis is a statistical tool for analyzing the variables when the focus is on the determination of the relationship between the dependent variable and the independent variables. More specifically, it depicts the typical value of the independent variable which has the more influence on the dependent variable with its change. The estimation target which is a function of independent variables called Regression function, which can be described by a probability distribution.

Regression analysis is widely used for prediction and forecasting. It is also used to determine the relationships between the dependent variable and independent variables. There are many techniques have been developed in Regression analysis of which Linear Regression analysis and Nonlinear regression analysis are vital for the current analysis.

D. Multiple Regression Analysis:

Regression analysis dealing with the equations either linear or nonlinear with variables more than two is called as multiple regression analysis. It allows us to control the several other factors that simultaneously affect the dependent variable. Multiple regression models can accommodate many explanatory variables that can be which are often mislead in simple regression analysis. It is generally used to predict the better model equation for dependent variable. Since the biomass consists of multiple (elemental components) independent variables and calorific value as dependent variable, multiple regression analysis is used to find the better correlation. Hence a linear and nonlinear multiple regression analysis gives the better estimation of correlation between the calorific value of biomass and its elemental components.

IV. COMPARISION OF DIFFERENT FUELS WITH PELLETS

A. Pellets and LPG:

Calorific value of pellets = 4200 kcal/kg
Calorific value of LPG =11900 kcal/kg
Cost of pellets/kg = 14/-
Cost of LPG/kg = 74/-
Equivalent pellet consumption:- It is the amount of pellet required to burn to generate equal amount heat as produced by burning 1 kg of LPG.
Equivalent pellet consumption = Cv of LPG
Cv of pellets
Equivalent pellet consumption = 2.833
Cost of pellet to generate equal amount of heat as produced by 1kg of LPG = 2.833×14
40 Rs
Saving (Rs) = 74.40 = 34Rs
%saving (approx) = 34/74 = 46%
2. Pellets and PNG:-
c.v of pellets = 4200 kj/kg
c.v of PNG = 9000 kj/kg
cost of pellets/kg = 14/-
cost of PNG = 50/-
Equivalent pellet consumption = C.v of PNG/C.v Of pellets
9000/4200
Equivalent pellet consumption = 2.1428
Cost of pellets to generate equal amount of heat as produced by 1kg of PNG = 2.1428×1
= 30 Rs
Saving in Rs = 50-30
= 20 RS
% saving (approx) = 20/50 = 40%
3. Pellets and diesel:-
c.v of pellets = 4200 kj/kg
c.v of diesel = 10000 kj/kg litre
cost of pellets = 14 Rs
cost of diesel = 64 Rs
Equivalent pellet consumption:- c.v of diesel/c.v of pellets
= 10000/4200
= 2.38
Cost of pellets to generate equal amount of heat as produced by 1 litre of diesel = 2.38×14
= 34 Rs
Saving in Rs = 64-34
= 30
percent saving (approx) = 30/64
= 46.87%

V. FEATURES AND BENEFITS OF PELLETS BURNER

- Energy-efficient
- High thermal efficiency
- Stable and reliable performance
- Low carbon and pro-environment
- Low investment and running cost
- Labor Saving
- Hot water utilization

Advantage:

1) The energy density of the wood pellet obtained is about almost double that of the wood. Hence reduction of size is an important treatment of biomass for energy conversion.
2) Reduction of size of the particle increases the total surface area, pore size of the material and the number of contact points for inter-particle bonding in the compaction process.
3) A number of properties are commonly known to affect the success of pelleting, including calorific value, moisture content of the material, bulk density, particle size, fiber strength of the material, lubricating characteristics of the material, and natural binders.
4) Utilization of wood and crop residues as an energy source will serve to reduce consumption of fossil fuels, thereby reducing the emission of greenhouse gases to the environment.

5) Ideal in providing fuel for heating devices, the wood pellet it is pure, non-pollutant, and neutral in carbon dioxide (CO2) emissions. In other words, it doesn't contribute to the destabilization of the ambient, as whatever carbon dioxide emissions occur from its combustion they are counterbalanced by equivalent amounts of (CO2) that have been absorbed from the plant during its life, process of photosynthesis, it burns completely, without producing smoke, leaving minimum residue of ash, always less than 1%, which can be used as a precious fertilizer for the garden too.

VI. FUTURE SCOPE

In future, we can use in household works & in industries in large scale. We can use it in furnace for melting the metal in industry. It is use in boiler work on biomass fuel with maximum efficiency. It can be used for preparing meals in large amount.

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