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Portable Biomass Gasifier Power Generation Using Non Edible Seed Cake

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Abstract

Non edible seeds are used most of the applications but the dehydration of seed cakes is too difficult. And the same time the seeds could not feed food as animal. Hence, to adopt various techniques it can be used for other applications. 1 ton crude oil yield from 3 tons of seeds and the remaining becomes seed cake. After oil extraction using screw press machine, seed cake still has 10 % to 15 % of oil. Hence this is a good combustible material with calorific value of approximately 600 Kcal/m^3 and the electrical output voltage 180 – 200 at the range of 3.00 -3.5 amps. This paper deals with the power generation from Jatropha seed cake using gasification technology.

Keywords: *Biomass Gasifier, Non Edible Sees, Jatropha Seed cake, Producer Gas, Thermal output, Electrical output*

1. Introduction

At present situation deficit of electric energy is around 12000 MW per day [1]. According to the Ministry of energy generation report indicates the deficit of electric energy is raised up to 8% during the year 1984 – 2013 [2], [3], [4]. 75% electrification rate and 288 million people lived in without electricity. And the same time the generation of fossil fuel is also decreased from 68% to 57% during the year of 2011 to 2035 [5], [6], [7]. Not only in India, had Tajikistan peoples also suffered insufficient of electric power [8], [9]. All over the world suffers due to insufficient of electric energy. If it continues in future our country has been divided majorly in to two groups there is an energy consumer and another one is electric energy unknowns. It creates a major problem and the younger generation suffers due to the insufficient of electric energy hence our ultimate growth down to the minimum. The availability of non edible seed cakes like Jatropha cruises is more in India. And the same time the yield of the cruises is higher production when compare to other country. Jatropha oils were used to various industrial applications such as chemical industry, soap manufacturing unit etc., after segregation of oil the seed cake thrown away because it cannot utilize. So that the usage of oil level also be reduced. The proposed research work is to overcome the issue and to give suitable solution to the effective utilization of non edible seed cakes. The biomass fuels not limiting to non- edible seed cakes i.e. Jatropha, Pungamia, Castor, and other biomass waste.

The non edible seeds not only used for oil extraction it can be used for many other applications some of the applications are shown below:

The property of non edible seed cakes and oils (Jatropha methyl ester, Jatropha oil, Pungamia, Castor, etc..,) such as diversity, biology, cultivation, tissue culture, genetic transformation, density, viscosity, acid value, saponification number, iodine value, ketene number, flash point, Kinematic viscosity, Cloud point and Pour point was analysed in detail within the range specified by the ASTM standards and it concludes1 kg Jatropha oil provide 2.50 kWh electricity through a Multi Functional Platform connected to the local grid [10], [11]. Mahua oil, Liquid Petroleum Gas and Diesel combination was studied and verified through the engine operation [12], [13].

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De-oiled seed cake of Karanja (SCK), an organic industrial waste obtained from Karanja biodiesel industries was mixed with cow dung in different proportions on mass basis. The results of methane (CH4) and carbon dioxide (CO_2) content in the biogas was found to be 73% and 17% [14].

The transesterification of unfiltered jatropha oil added with 3 % of KOH catalyst. Ethanol was added to oil by 30 per cent volume basis. The economic feasibility of prepared biodiesel was calculated by calculating the various economics of Jatropha up to Jatropha ethyl ester production [15]. Jatropha Carcus and Ricinus Communis oils from both feed stocks are suitable for the production of biodiesel [16].

It reviews the potentiality Pongamia pinata of the fuel as a source of biodiesel and its benefits in Bangladesh in the field of medical and energy [17]. Thevetia peruviana seeds vegetable oils results minimal pollutants from its emissions using fuel as engine and the role of Biodiesel meeting the pollution criteria [18]. The use of straight vegetable oil encounters problem due to its high viscosity, poor volatility and cold flow. It reduce the viscosity of oil by effectively utilization of waste heat from exhaust gases before fed it in to inlet and favourable properties compared to diesel [19].

The use of lipase as biotechnological solution to alkali and acid catalysis of transesterification it improves the system efficiency [20] and the use of Jatropha curcas with orange peeal and pungam oil cake feed in to biogas plant for bio- methanation power generations [21], [22]. The various characters of pongamia pinnata oil cake had been analysed with repeated experiments as per ASTM 6751-9B standard [23]. The production of Biogas from poultry waste and Jatropha de-oiled cake management made using Biogas power generation [24].

Objectives of the research is to: meet the energy demand in rural applications; increase the usage of gasification technology for Thermal/ Power Generation; increase the production of Jatropha Cruises; improve the effective utilization of Cruises; and increase the local employability.

2. Research Method

Based on the working it was segregated in to three steps

Step 1 Portable 2 kW biomass gasifier fabricated and erected

Step 2 Fuel preparation

Step 3 Verification of Thermal and Electrical Output

Step 1 Portable 2 kW biomass gasifier fabrication

This method proposed a portable (2 kW) Biomass Gasifier with thermal utility. Gasifier is used to convert carbonaceous materials in to CO and H by react the raw material at high temperature with a controlled amount of oxygen. The resulting gas mixture produced from the gasification process is called synthetic gas / Producer gas. It is a primary fuel. The fuel burned directly in to the gasifier and to generate thermal power. The generating output power is given to the furnace / heating element.

Figure 1 show that the schematic diagram of Biomass gasifier.

The biomass fuels are stored in the fuel bunker and feed it in to the furnace through the hopper and the conveyor. The fuel is fired with the help of air nozzle and the forced draft fan is switch on to absorb producer gas. Depending upon the application, the producer gas is fed in to the furnace or the generator (Power Generation).

Proposed design

Figure 1. Fabricated and Erected 2 kW Gasifier

Step 2: Fuel preparation:

The main fuel from the proposed system is Jatropha seed cake, primarily the Jatropha seed cake was collected from the oil mills. And dry it in to the atmospheric temperature or the dryer at the level of moisture content maintained as 5 %, 10 %, 15 % and 20 %.

Figure 2. Drying process of Jatropha seed cake

Based on the operation of the Biomass gasifierit is working in three zones they are Pyrolysis, Oxidation, and Reduction.

1. Pyrolysis: The dried Jatropha seed cake enters the “Pyrolysis” zone. The fuel is partially burnt with the existing air/ external air. And the producer gas can be produced. The produced gas goes to the application either Thermal / Electrical applications.
2. Oxidation: The outputs from the above zone, react with the remaining char in the absence of oxygen at a temperature of around 800-900 °C.
3. Reduction: In the reduction zone, char that has been made it through the combustion zone from the pyrolysis zone is reacted with the CO_2 and H_2O from the previous steps. The producer gas exits the reactor typically in the range of 300-400°C.

Step 3: Verification of Thermal and Electrical output.

The thermal output and electrical output of the Jatropha seed cake was discussed.

Initially the fabricated model was tested for thermal output after that it enhanced to generate electric power. Initially the engine was ignite with the help of petrol (100 ml) and to feed the producer gas to the engine it operates continuously Four (4 Hours) hours per day in a week.

3. Results and Discussion

3.1 Thermal Output for the Proposed System

The figure 3 shows that the range of temperature 365^{0}C to 650^{0}C the thermal output of the system was present in the range of 650 to 700. From this concludes the non edible seed cake (Jatropha seed cake) can able to utilize for thermal applications. i.e. heating, boiling etc.,

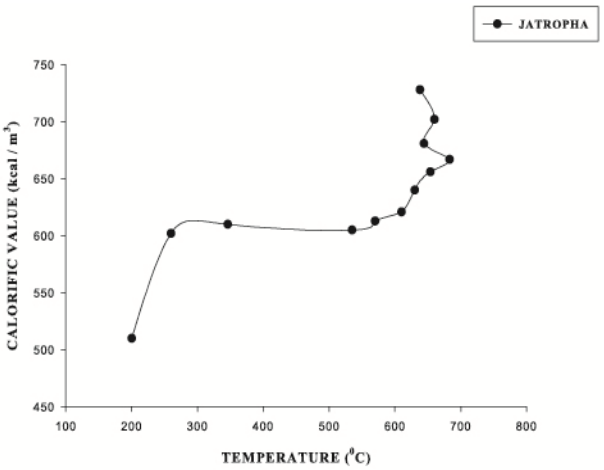

Figure 3. Calorific value vs Temperature

3.2. Electrical Output

Figure – 4 shows that the VI Characteristics of Biomass Gasifier power generation using Jatropha seed cakes. The output power varied depending up on the moisture and the level of temperature.

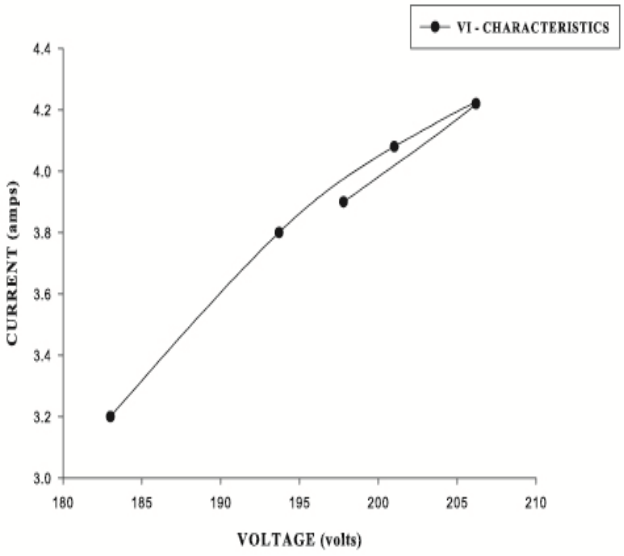

Figure 4 – VI Characteristics

4. Conclusion

Non edible oils are used as an alternate fuel for engine. The seed cakes were disposed and it creates harm to the environment because it cannot be used for animal feeding and the

disposals through dehydration methods are difficult. From this work we conclude that the Non edible seed cakes (Jatropha seed cake) can be used in thermal and electrical applications such as water heating, power generation, etc.,

We had fabricated and erected a portable 2 kW Gasifier model to reprocess the seed cakes and produced 740 kcal/m^3 thermal energy which could be used to produce electrical power in the range of voltage 180 - 200 and current 3.5 - 4. The fabricated model was implemented in Periyar R & D Centre for Solar and Bio Energies under the Department of Mechanical Engineering in Periyar Maniammai University, Vallam, Thanjavur. In future it extends to analysis other kind of non edible seed cakes and to standardize the Gasifier unit depending up on the seed cakes.

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