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Application of Biomass Gasifier for Agricultural Electrification in Developing Countries as India

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Abstract: Recently our world is facing energy crisis problem due to lack of fossil fuels like diesel, petrol etc. The available fossil fuels will supply energy up to maximum 25 years. So world is trying to find out another alternative which are available at least cost, easily available and energy obtained from new one is equivalent to that of fossil fuel. Also fossil fuel has a lot of pollution related problem. So the fuel which we are going to use to run the gasifier has a less pollution problem as compared to fossil fuel. So wood gasifier is a miracle which overcome all problems related with fossil fuel like limited energy storage, pollution effects etc. In simple words wood gasifier is producing producer gas which is equivalent to energy production using diesel and having calorific value in between 8000 to 10000 KJ/K. Gasifier consist of reactor, cyclone filter, wet scrubber, cotton filter, blower, blower to engine intake manifold gas carrying pipe. Hence we are going to use agro-waste as a fuel like ground-nut shells, rice husk, corns, cobs, baggage etc. which in turns run the pump of 3 to 5 HP which is affordable at least price to common farmer.

Keywords:Fossil fuel, wood gasifier, rice husk, baggage, irrigation.

I. INTRODUCTION

In earlier days India face lots of problem related to lack of energy or electricity. Electricity demand is greater as compare to production. Our farmer suicide because of lack of electricity. Diesel prices touch to the sky and this expenditure is not affording by common former. So we will be developing a wood gasifier which runs the irrigation pump. This wood gasifier search in 1789 some scientists work on it but all of them are fail due storage of methane. It is use only in running application no one can store methane because it is explosive gas. In time of Second World War, gasifier fitted on vehicle and all vehicles, ships are run on wood gasifier.

Mr. Shrinivasan works on irrigation pump which run on wood gasifier but they face problem related to production and the price of wood gasifier made by Shrinivasan is so high in that time which is not affordable to a common farmer. Government not aware about this type of non-conventional energy in that time and they not show their interest in Shrinivasan’s product. The gasifier made by Shrinivasan is run only with diesel as a fuel we are trying to run a wood gasifier with petrol as fuel for better efficiency. But now day’s government support this type of project and also provide subsidies on energy saving product. We are trying to use a MOF (metal organic frame material) or we will use it on future to save the methane. By using this we can use wood gasifier for all applications by few changes in construction. We are trying to develop a wood gasifier and pump setup in near about cost of 25,000/- by which a 2HP pump set runs efficiently. Gasification still requires research to fulfil all energy demand and to reduce its cost.

II. BIOMASS

All Biomass is a biological material derived from living, or recently living organisms. In the context of biomass for energy this is often used to mean plant based material, but biomass can equally apply to both animal and vegetable derived material.

2.1 Properties of Biomass

The properties of biomass which influencing gasification process and the design of gasification equipment are as follows:

1. Bulk density of fuel.
2. Energy density of fuel.
3. Proximate analysis.
   - Volatile content
   - Fixed carbon content
   - Ash content
4. Moisture control
5. Size and form of biomass

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2.1.1 Bulk density:
Hopper of gasifier is the important part which houses the biomass material. The substantially big size hopper is to be provided to ensure certain minimum period of uninterrupted operation. The size of the hopper for a given period is a function of bulk density of the biomass. Lighter the biomass material, need provision of bigger hopper.

2.1.2 Energy Density
Energy content essential means its calorific value determined by the adiabatic constant volume bomb calorimeter. The energy that can be actually available from the fuel is less than the heating value by an amount to the equal to the latent heat of the formed moisture. Higher heating value of any biomass material depends upon its ultimate analysis. It's also depends on the moisture content and ash content of material depends upon its ultimate analysis.

2.1.3 Proximate analysis
The proximate analysis composition of biomass material is determined through the thermal gravimetric analysis in which the material is subjected to controlled heating rates in well define atmosphere.

2.1.4 Volatile material
The volatile material is released during the process is a mixture of a water and condensable light and heavy hydrocarbons called as oil and tar. If the fuel gas is to be used in internal combustion engine, in condensable content are required to be reduced to minimum. The volatile content of the biomass material is important from the point of view of gasification process, since it is this part of biomass which passes to the oxidation zone and helps in maintaining the required temperature.

2.1.5 Fixed carbon content
Presence of fixed carbon is important from the point of view of reduction. It will be appropriate to mention here that the biomass material not containing any fixed carbon can be classified only by pyrolysis.

2.1.6 Ash content
The non – combustible material present in a biomass material constitute ash. The gasifier should be designed in such way that there is a continuous provision of ash disposer. For this grate design size and configuration is extremely important for successful gasification.

III. BASIC CHEMISTRY IN GASIFIER

Gasification in its simplest definition is the conversion of Solid Carbonaceous fuel into combustible gas (main by CO & H2) by partial combustion i.e. combustion in the presence of limited air. In wood gasifier there are four zones in reactor name as drying, pyrolysis, oxidation and reduction respectively.

TABLE I: VOLATILITY OF MATERIAL

Sr. no	**Volatility**		
	Name	**Cetane or Octane No.**	**Calorific valuein MJ/Kg**
1	Diesel	40-55	43.8
2	Petrol	82	47.3
3	Methane	120	55.5
4	Wood, Rice husk	-	16
5	baggage	-	43

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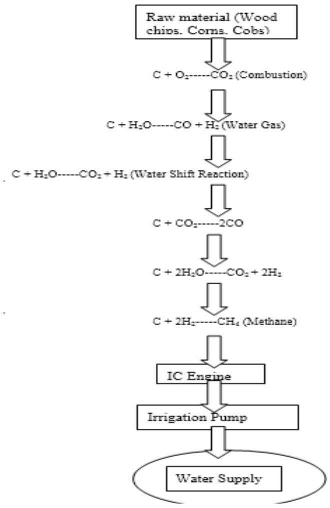
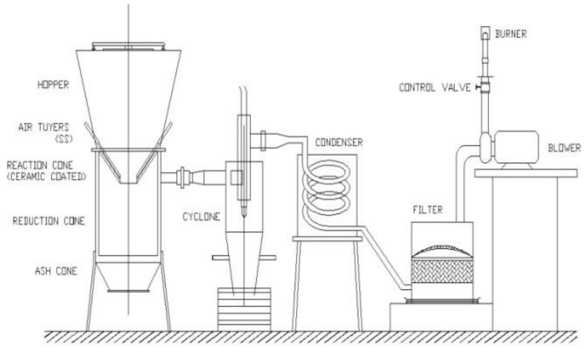
Set up Process-



IV. EXPERIMENTAL WORK OF WOOD GASIFIER

All components of wood gasifier are shown as on below layout. We will try various types of fuels like cobs, corn, baggage, rice husk, briquettes. First of all fuel feed in hopper and close all chamber. This wood gasifier work on partial combustion.

Layout



Then fuel pass to reduction chamber in which it passes four zones as follows:

1) Drying: in drying free moisture and cell bound water are removed from the biomass by evaporation. These process ideally take place at a temperature of up to 160^0c using waste heat from the conversion process.
2) Pyrolysis: where volatile gases are released from the dry biomass at temperature ranging up to about 700^0c, these gases are non-condensable vapour and the residuum from this process is activated carbon.
3) Oxidation and Reduction: In oxidation process electrons are release from materials and reduction is reverse of oxidation. In reduction where activated carbon react with water vapour and carbon dioxide to form combustible gases such as hydrogen and carbon monoxide. The reduction process is carried out in the temperature ranging up to about 1100^0c.

At the end of reactor these gases passes through charcoal grate, in which carbon dioxide react with coal to form CO gas which is known as producer gas. The producer gas then free to move in cyclone filter. In which vortex flow is created due to vortex high density particles will settle down and clean gas sucked by blower and passed to next step of cooling. In cooling zone we are going to use cooling coils in combination with wet scrubber. After that there is filtering stage in which the gas so produced is pass through the fuel which is previously used. Before sucking this gas by blower, it is passed through core pad which acts as a cotton filter in order to remove dust particle to enhance clean producer gas then it is sucked by blower (metal blade, 2880 RPM, 0.5 HP). It is an adventures task to store the methane as till the date no one has any component to store methane. So we are going to use MOF (metal organic framework) which has capability to store it easily. Such stored methane can be used anywhere in applications like cooking, running vehicle etc.

Metal-Organic Framework (MOF)

As a cleaner, cheaper and more globally evenly distributed fuel, natural gas has considerable environmental, economic advantage over petroleum as a source of energy for the transportation sector. Despite these benefits, its low volumetric

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energy density at ambient temperature and pressure presents substantial challenges, particularly for light-duty vehicles with little space available for on-bored fuel storage. Adsorbed gas systems have the potential to store high densities of methane within a porous material at ambient temperature and moderate pressures. Although active carbons, zeolites, and metal organic frameworks have been investigated extensively for methane storage. Here we use a reversible phase transition in metal-organic framework (MOF) to maximize the deliverable capacity of methane while also providing internal heat management during absorption and desorption. In particular the flexible compounds Fe (bdp) and C (bdp) are shown to undergone structural phase transition in response to specific methane pressures, resulting in absorption and desorption isotherms that feature a sharp step. Such behaviour enables greater storage capacities than have been achieved for classical adsorbents, while also reducing the amount of heat released during absorption and the impact of cooling during desorption. The pressure and energy associated with the phase transition can be turned either chemically or by application of mechanical pressure.

V. FUTURE SCOPE

As per our testing and result we will predict gasifier kit price along with irrigation pump. We will approach it to Government of India for providing subsidies on gasifier kit for agricultural purpose. Also by using our gasifier farmer will use agro-waste to run the pump which in turn saves the electricity and fossil fuel too. We research on various type of fuel for gasifier and use this gasifier to run a boiler.

REFERENCES

[1]. Prof. S. U. Chaudhari et. al. "Performance of biomass gasifier using wood", RKDF College Of Engg. Bhopal(M.P.) India (2012)
[2]. H.Lafontaine et. al. "Construction of simple wood gas generator for fueling IC engine in petroleum emergency", Federal Emergency Management Agency, Washington DC-20472 (1989)
[3]. U. SHRINIVASAN et.al "Wood gas generators for small power (5 hp) requirements" Department of Mechanical Engineering. Department of Aerospace Engineering, Indian Institute of Science, Bangalore 560 012, India.(1983)
[4]. A.K. Rajvanshi "Development and operational experience with topless gasifier running 3.75 hp diesel pump set", Nimbkar Agricultural Research Institute, PO Box 23, P haltan 415523, Maharashtra, India(1989)
[5]. Paulo Job Brenneisen et. Al. "Performance of diesel cycle engine operating on duel fuel mode with gasification gas" Postgraduate Program in Energy in Agriculture, UNIOESTE - Western Paraná State University, Cascavel - Paraná, Brazil. October, 2012
[6]. Sunil.K.Amrutkar, Satyshree Ghodke, KN Patil"Solar flat plate collector analysis"IOSR Journal ofEngg., 2012 ,Vol. 2 Issue 2, Feb.2012, pp.207-213
[7]. TERI Energy Data Directory and Yearbook (TEDDY) 2002/03, The Energy and Resources Institute, New Delhi, 2003.
[8]. Biomass Gasification-based Power Stations, internal report, NETPRO Renewable Energy (India) Ltd., Bangalore, January 2004
[9]. Ashden Awards, 2009. Case study summary Saran Renewable Energy, India.www.ashdenawards.org/files/pdfs/saran_full.pdf
[10]. Babu, S. P., 2005. Observations on the Current Status of Biomass Gasification. IEA Bio-energy Task 33: Thermal gasification of biomass. Paris: IEA
[11]. Kartha, S., Leach, G. and Rajan, S., 2005. Advancing bio-energy for sustainable development: Guideline for policymakers and investors. Energy Sector Management Assistance Programme, World Bank Report, 300/05.
[12]. S. Dasappa, P. J. Paul, N. K. S. Rajan, H. S. Mukunda, G. Sridhar, H.V. Sridhar, Biomass gasification technology – a route to meet energy needs, Current Science, Vol. 87, No. 7, 2004, pp – 908-916.
[13]. Dasappa, S., Sridhar, H. V., Sridhar, G., Paul, P. J. and Mukunda, H. S., Biomass gasification – a substitute to fossil fuel for heat application. Biomass Bioenergy, 2003, 23, 637–649
[14]. N.H. Ravindranath, H.I. Somshekar, S. Dasappa and C.N. Jayasheela Reddy, Sustainable Biomass Power for Rural India: Case Study of Biomass Gasifier for Village Electrification, Current Science vol 87, No 7, 2004.