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RESEARCH ARTICLE

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PROPOSAL TO REDUCE FUEL COST IN NAVAL TRANSPORT BY USING BIOMASS

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ABSTRACT: As observed biological wastes poses some characteristics which indicate that they are capable to attain calorific value up to a certain level which can be used as alternative fuels. As like jute sticks, cow dung dust, ground nut shells, jute caddies, wood, droppings of hen, dhanicha stick etc. can be used as raw materials to extract producer gas from them by proper technique to utilize the potential of these items.

The study will show that the one ton of any of these bio wastes can easily substitute oil which will be helpful to reduce the fuel cost as well. The process implies supply of producer gas from gasifier to engine to generate power in space of diesel engine to run naval transport like ships, jetty, and steamers by generating power, etc. This will result in utilization of green energy and cost effective operation.

Key words—Gasifier, Biomass, gas turbine, fuel.

INTRODUCTION

As per the high price rise of crude oil in global market the costs of all products and part products of crude oils has gone up to a high. Also there is a depletion of conventional energy sources from earth so it is very much required to generate power by any alternate source as like non-conventional energy source. The engines of the ships are mainly of three types as steam engines, diesel engine & gas turbine. As power generation through gas turbine is too costly so it cannot be used in all sorts of ships. Due to escalating price rise of crude oil in the international market the diesel cost also increased which also acts upon the fuel costs of the ships. Though steam energy generation is good enough to run a ship but it has some disadvantages which forces in implementation of diesel engines or gas turbines.

Disadvantages of current implementation: Steam causes high pollution, emits a large amount of exhaust gases also it requires a large amount of coal to generate power.

Diesel engines also have emission problems as well as fuel economy is quite expensive; contains particulate matters, high amount of sulphur content, toxic chemicals etc.

Gas turbines costs very high, requires longer start up, efficiency is less.

All these systems are depended on the convention energy sources while the sources are limited as well as costly to generate power

So if the power can be supplied in to the engine by some alternate like non-conventional energy sources then the environmental problems can also be avoided as due to pollutant wastes the water of sea get polluted and sometime poisonous too. Also the bio wastes after production of producer gas can be recycled again which will also reduce the waste disposal problems too.

THEORY

Biomass is easily available in all parts of the world is a biodegradable fraction of products, as well as waste and residues from agriculture, forestry, animal wastes, even biodegradable fraction of municipal waste too. Even animal manure, wood waste, sewage sludge and organic fraction can be used as biomass. Bio mass can be used mainly for three purposes like for heating, for electricity production and as bio fuels. If the biological wastes can be used in proper manner by using technology then they can be used as alternate source to generate power in large scale.

To use the biomass in different areas mainly in ships 1st of all briquetting achiness are required to solidify the bio-wastes and then by installing a gassifier heat can be generated inside the engine. It is not possible to store the producer gas from bio wastes in the tank as because ships are supposed to travel to a long distance so if the production of producer gas can be arranged inside the ships then it will be easy to run the ship smoothly. The bio-wastes can be recycled; the only difficulty is that biomass has to be stored in higher amount.

Sulpher content as well as nitrogen content of the bio fuels are very less but the nitrogen content is depended upon the type of bio mass used. To use the bio mass firstly pyrolysis has to be done followed by gasification, combustion then finally A/F mixture to supply in the engine.

Table -1: *Proximate analysis of biomass briquettes*

Emissions	Diesel	Bio-diesel
Carbon di-oxide	100	-78
Carbon monoxide	100	-41
NO_x	100	+5
Hydrocarbons	100	-80
SO_X	100	-100
Particulates	100	-55

Table - 2

Sl. No.	Biomass material	Calorific value (k.cal/kg)	Ash content (%)	Volatile matter (%)	Fixed carbon (%)	Moisture (%)
1.	Jute stick	4448.8	1.59	83.67	14.74	**9.35**
2.	Jute caddies	3923.4	9.71	81.28	9.01	**8.84**
3.	Dhaincha stick	4829.5	2.43	74.28	23.29	**9.62**
4.	Bagasse	3750.0	1.18	77.73	21.09	**9.62**
5.	Jute whole plant		9.44	67.08	23.48	**9.29**
6.	**Wood**	**4167.7**	**2.03**	**76.50**	**21.47**	**9.79**

ANALYSIS

Procedure

In general the engine room contains several engines for different purposes. In the diesel engines the fuel is burn inside propulsion engine which helps to turn the ship through the water. On the other hand for steam engines one or more boiler is required to produce high pressure steam to run the engine. A power generation from battery is required to start a diesel engine whereas for steam engines more pollution is offered; on the other hand for gas turbine air is used but the setup is costly. The diesel operation is like air intake first then followed by compression stroke, power stroke and exhaust stroke. Fuel efficiency is high of 4 stroke diesel engine, but the gas turbine offers highest efficiency. To utilize bio wastes to generate power we have to implement some techniques which can be achieved by application of Gassifier.

Among two types of Gasifiers updraft gasifier& downdraft gasifier updraft gassifier can be used to generate powers in ships. A fixed bed of carbonaceous fuel is to be added with proper agent (like air) and it will flow in counter current configuration. The ash is then removed in dry condition and the temperature will go up to higher than ash fusion temperature. The efficiency of the produced gas is high as the temperature of the produced gas is relatively low compare to the combustion chamber. But the only problem is tar & methane production. Tar can be recycled to reactor by proper technique. There is a bed inside the gassifier where hot charcoal is formed and the gas is

passes through is. For some bio wastes like rice hulls air is to be forced to pass through the bed.

Gasification is a two-stage reaction consisting of oxidation and reduction processes. These processes occur under sub-stoichiometric conditions of air with biomass. The first part of sub-stoichiometric oxidation leads to the loss of volatiles from biomass and is exothermic; it results in peak temperatures of 1400 to 1500 K and generation of gaseous products like carbon monoxide, hydrogen in some proportions and carbon dioxide and water vapour which in turn are reduced in part to carbon monoxide and hydrogen by the hot bed of charcoal generated during the process of gasification. Reduction reaction is an endothermic reaction to generate combustible products like CO, H_2 and CH_4

$C+CO_2 \rightarrow 2\ CO$
$C+H_2O \rightarrow CO+H_2$
$C+2H_2 \rightarrow CH_4$

A proper set up is also required to recycle the tar. As the ship engine rooms are consists of large area then it is quite easy to set up a gasifier along with briquetting or pelleting machines where the bio wastes can be solidified and then can be used as fuel in the gassifier. Diesel firing is required to start the gasifier to run and then after certain time it will start running by its own to supply power to engine to move through water. This economical steam system capable of producing over 650 psig of superheated steam. The desired balance between power and heat will dictate the selection of the appropriate steam turbine technology (back pressure, extracting, or condensing)

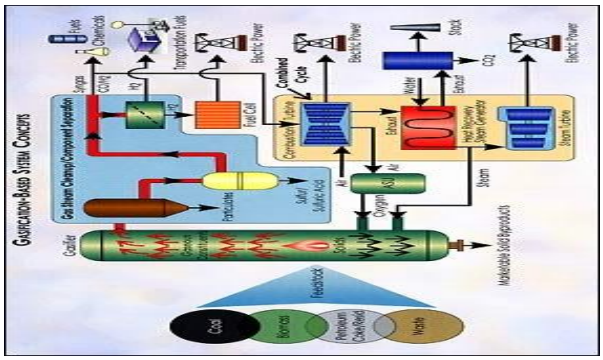


Fig. 1

Difficulties

At start up diesel firing is required

The waste materials have to be collected inside the ship to give input the bio masses in form of briquettes in the gassifier.

Due to inventory stock of bio wastes the weight of the engine might be increased

Calculation

Cost comparison:

Ground Nut Shells

Estimated calorific value of ground nut shells= 4625kcal/kg = 19.36 MJ / kg

Hence, 1 tonne of ground nut shells would produce about = 19000 MJ of energy (approx.)

So, [1 kwh = 3.6 MJ],

which gives 19000 / 3.6 = 5277.77 kWh: 5.28Mwh

5 tonne of ground nut shells per day would produce = 5.28 x 5 = 26.4MWh

Annually (350 days) , 5 x 350 tonne ground nut shells would produce 26.4 x 350 = 9240MWh

Wood Chips

Estimated calorific value of wood chips = 4785kcal/kg = 20.03 MJ / kg

Hence, 1 tonne of wood chips would produce about =20000 MJ of energy(approx.)

So, [1 kwh = 3.6 MJ],

which gives 20000 / 3.6 = 5555.55 kWh : 5.55Mwh

5 tonne of wood chips per day would produce = 5.55 x 5 = 27.5MWh

Annually (350 days) , 5 x 350 tonnewood chips would produce 27.5 x 350 = 9625MWh

Jute Caddies

Energetics of jute caddies for thermal application and power generation

Estimated calorific value of jute caddies= 3900kcal/kg = 16.33 MJ / kg

Hence, 1 tonne of jute caddies would produce about = 16000 MJ of energy (approx.)

So, [1 kwh = 3.6 MJ],

which gives 16000 / 3.6 = 4,444.44 kWh : 4.44 Mwh

5 tonne of jute caddies per day would produce = 4.44 x 5 = 22.2 MWh

Annually (350 days) , 5 x 350 tonne jute caddies would produce 22.2 x 350 = 6660 MWh

Briquettes of saw dust

Estimated calorific value of briquettes of saw dust= 4654kcal/kg = 19.48 MJ / kg

Hence, 1 tonne of briquettes of sawdust would produce about = 19000 MJ of energy (approx.)

So, [1 kwh = 3.6 MJ],

which gives 19000 / 3.6 = 5277.77 kWh : 5.28Mwh

5 tonne of briquettes of saw dust per day would produce

= 5.28 x 5 = 26.4 MWh

Annually (350 days) , 5 x 350 tonne briquettes of saw dust would produce 26.4 x 350 = 9240MWh

Briquettes of paper

Estimated calorific value of briquettes of paper= 4841kcal/kg = 20.23 MJ / kg

Hence, 1 tonne of briquettes of paper would produce about = 20000 MJ of energy (approx.)

So, [1 kwh = 3.6 MJ],

Which gives 20000 / 3.6 = 5555.56 kWh : 5.56Mwh

5 tonne of briquettes of paper per day would produce

= 5.56 x 5 = 27.5MWh

Annually (350 days) , 5 x 350 tonne briquettes of paper would produce 27.5 x 350 = 9625MWh

Briquettes

Bagasse

Estimated calorific value of bagasse= 4380kcal/kg = 18.33MJ / kg

Hence, 1 tonne of bagasse would produce about = 18000 MJ of energy (approx.)

So, [1 kwh = 3.6 MJ],

which gives 18000 / 3.6 = 5000kWh : 5.0Mwh

5 tonne of bagasse per day would produce = 5 x 5 = 25MWh

Annually (350 days) , 5 x 350 tonnebagasse would produce 25 x 350 = 8750MWh

Diesel

The calorific value of diesel is 45 MJ/kg

Thus 1 ton of diesel would produce 45000 MJ of energy

[1 kwh = 3.6 MJ],

which gives 45000 / 3.6 = 12,500 kWh = 12.50MWh

5 tonne of diesel per day would produce

12.50 x 5 = 62.5 MWh

Annually (350 days), 5 x 350 tonne diesel would produce 62.5 x 350 = 21875 MWh

The calorific value of diesel 10748.06 Kcal/kg

1 lit of diesel be equivalent to 4500/10748 kg: 0.41 kg of jute caddies

Steam

For production of steam in gas turbine atleast 2.2 pence is required to produce 1 KWh energy.

1 pence= 100 GBP & 100 GBP= 11000 INR (approx.)

1 ton = 1163 Kwh

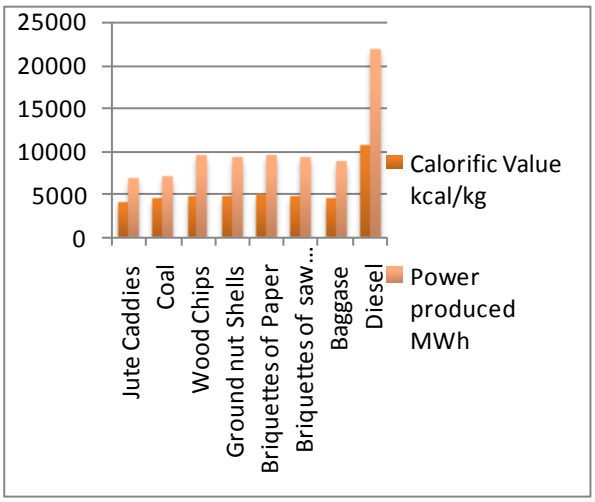
So 5 ton= 5812 Kwh

& it costs nearly 6 Crore 40 lakhs approx.

So it is highly beneficial to use bio wastes through gassifierin space of gas turbine as the set-up is less costly compare to gas turbine set up and the wastescould be recycled. But multiple Gasifiersare required for the large ships where though a channel all the produced gas will have to be supplied in to the engine.

Comparison

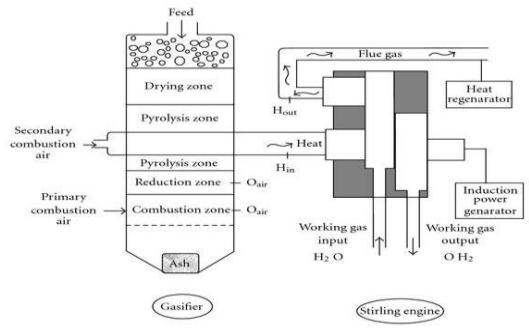
Graph 1



The cost of 5 ton of diesel = 5 * 1162 lit = 5810 lit;
It costs 2, 90,500 (approx.)
Whereas 5 ton of jute caddies cost = 5x500= 2500/-
Refinery Transfer Price (RTP) for BS-III Diesel
(Price Paid by the Oil Marketing Companies to Refineries) r/Liter50/-

On the other hand the production cost of 1 kg of producer gas through jute stick is RS. 5 / kg and the dust particles which precipitates after the combustion can again be used by making pallets of them and re use them though there be some loss of energy but the raw material will have to be inserted less in the next input. Assume that 2% of the unburnt materials remained there. Also a recycling of tar is required so some economic invest is required in that area too. Gassifier set up cost: The approximate cost of gasifier for thermal application is Rs. 30000 per KW. As a whole it is very cheap even 10 gassifier are installed inside the engine room of a ship too.

Fig:3



CONCLUSION

The fuel cost might be reduced a lot through this process. Though the set up cost is high and also setting up sensor inside is tough but it will serve in long run. The thermal efficiency is very high due to updraft gasifier. This study may require more research and implementation. The results may vary from the proposed costs. The speed of the ship is not depended upon the type of fuel used

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