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Bio Gas as a Fuel for Internal Combustion Engine

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ABSTRACT:
Bio gas as a fuel is a developing enthusiasm for interior burning (IC) motor. A percentage of the drivers and individuals trust that as the interest of fuel is expanding step by step there must be some other renewable fuel source that satisfy the interest of fuel for future era, for over accompany the fuel emergencies, bio gas is the a standout amongst the most proficient and conservative fuel for IC motor. The purpose for this is that it is a renewable wellspring of vitality and we can create bio gas by natural waste just we don't spend additional cash for developing natural waste as we develop some plant for bio energizes, the bio gas likewise help in over accompany the waste transfer issue, after generation of bio gas we can utilize waste as compost in our ranches so with delivering bio gas we likewise over accompany different issues additionally like measures to enhance neighborhood air quality and the requirement for clean transport powers in urban areas. The point of this paper is to exhibit the potential part of bio gas as a fuel for IC engine. Biogas is delivered from the procedure of anaerobic absorption of wet natural waste, for example, dairy cattle and pig slurries, nourishment squanders and developed wet biomass. To be utilized as a vehicle fuel biogas must be moved up to no less than 85% to 95% methane by volume and it can then be utilized as a part of vehicles initially altered to work on characteristic gas. Biogas energized, vehicles can decrease CO_2 discharges by (75-200)% contrasted and fossil powers. The fluid excrement left untreated in ranches creates methane emanations, which are 21 times more intense as a nursery gas than CO_2 so for utilizing all the fertilizer for delivering biogas help in lessening fossil outflows from smoldering diesel and petrol and decreasing methane discharge from waste composts.
Presently days the fuel for future is the standout amongst the most faulty point, if the regular source are decrease then what is the new fuel on which our vehicle run? For this situation the reasoning for exchange fuel must be the need. For adding to a substitute fuel for inside ignition (I.C.) engine. I thing bio gas is the best interchange fuel in light of the fact that it is renewable and Eco-accommodating fuel in our inclination we can produce bio gas simple than some other fuel. What's more, time taken for producing bio gas is less as contrast with other fuel.

KEYWORDS: Biogas, fuel, air pollution, Eco-friendly

1. INTRODUCTION:

The biogas is a non-fossil gas. It is produced from cow dung, sewage, landfills or food industry waste, waste manures. With those material numerous and abundant origins, the potential of the European biogas production is so large that it could replace 12 to 20 % of the natural gas consumption. This renewable biogas energy is already used for lamping in village, heat and electricity production, but the best use of this clean energy should be the production of biogas as vehicle fuel. Biogas is used just like as natural gas because it is a renewable source. The fossil resources like oil, gas, and coal are not unlimited. But the hole human kind is depend upon it, if one day all these resources end what happen what is the new fuel on which we depend? And the environmental problem caused by the waste and the waste water are increasing day by day to over come with all these problem biogas is the solution because the waste (like animal dungs, human sewage or

agricultural residues) and waste water can be used for the production of biogas there is no need to use fresh water for biogas production and any kind of organic waste can be used for biogas production. The use of biogas as a clean fuel answers to current various concerns dealing with economics, ecology and energetic:
Search for renewable energies while the fossil deposits are draining day by day,
Reduction of the energetic dependence (their are some countries who do not have their own mines and oil refinery they buy fuel from other countries, country like these condition can reduce fuel dependence by the use of biogas),
- Limitation of the atmospheric pollution linked to the gas emissions (we human can survive in a define condition limit in term of pollution if the limit cross then human survival is in danger),
- Decrease of the smell and noise annoyances,
- Reduction of the green house effects.
Biogas fuels usually cause low pollution to the environment and because they come from Renewable resource of energy, they have a great potential for future use. This vehicle fuel is the best way to upgrade waste and control the problem of air pollution and fuel dependence.

2. COMPOSITION OF BIOGAS:

As we all know that biogas is produce by anaerobic digestion (i.e. digestion in the absence of oxygen) of organic material, the organic material is broken down in several steps by different types of microorganisms. The end product of anaerobic digestion is gas which containing mainly methane and carbon dioxide and some other gases are also in it, it is reffered to as biogas; and a slurry or solid fraction left after use of row material is referred to as digestate.The gas is typically composed of 50-70% Methane, 30-40% Carbon dioxide, 1-10% Hydrogen, 1-3% Nitrogen, 0.1% Oxygen and Carbon monoxide and trace of Hydrogen sulphide. The composition of biogas is depend upon the nature of material like Cow dung, Cow pea, vegetable and fruits type waste and Cassava peeling. It was found that caw pea produced maximum methane about 60% to 80% and cassava peeling and vegetable and fruits type waste produce minimum methane about 45% to 60%. If we compare biogas, landfill gas, natural gas then it is clear the composition of different gas present in it(tab.1).

Tab.1. Composition of biogas, landfill gas and natural gas

Parameter	Biogas	Landfill gas	Natural gas (danish)	Natural gas (dutch)
Methane (vol-%)	60-70	35-65	89	81
Other hydro carbon (vol-%)	0	0	9.4	3.5
Hydrogen(vol-%)	0	0-3	0	_
Carbon dioxide(vol-%)	30-40	15-50	0.67	1
Nitrogen (vol-%)	~0.2	5-40	0.28	14
Oxygen (vol-%)	0	0-5	0	0
Hydrogen sulphide (ppm)	0-4000	0-100	2.9	_
Ammonia (ppm)	~100	~5	0	_
Lower heating value (kWh/Nm^3)	6.5	4.4	11.0	8.8

Tab. 2. Selected standard requirements for grid injection or for utilization as vehicle fuel

Compound	Unit	France		Germany		Sweden	Switzerland		Austria	Netherlands
		L gas	H gas	L gas grid	H gas grid		Lim. inject	Unlim. inject		
Higher wobbe index	MN/Nm^3	48.48-46.8	48.24-56.52	37.8-46.8	46.1-56.5	95-99			47.7-56.5	43.46-44.41
Methane content	Vol-%					95-99	>50	>96		>80
Carbon dioxide	Vol-%	<2		<6			<6		<26	
oxygen	Vol-%			<3			<0.5		<0.56	
	ppm V	<100								
	Mol%									
Hydrogen	Vol-%	<6		<6			<5		<46	<12
$CO_2+O_2+N_2$	Vol-%					<5				
Water dew point	ºC	<-5		<t[4]		<t[5]-5			<-8[7]	-10[8]
Relative humidity	ρ						<60%			
Sulpher	mg/Nm^3	<100[2]-<75[3]		<30		<23	<30		<5	<45

To increase the quality of the raw biogas, the gas is usually cleaned off, unwanted substances such as carbon dioxide, hydrogen sulphide, oxygen, nitrogen, water vapor and particulates are removed. The main reason for doing this is to fulfill the requirement of IC engine that engine require these gas free fuel except oxygen and to prevent corrosion and mechanical wear of the equipment in which the biogas is filled. The main difference between biogas and natural gas relates to the carbon dioxide content. The carbon dioxide(CO_2) is the main components of biogas, while natural gas contains very low amount of CO_2. When we compare biogas with natural gas the level of hydro carbon in natural gas is much more than biogas (tab.1) but after the purification of biogas the level of hydro carbon is comparably equal and the calorific value of both the gas is comparably near by each other it is just about to use biogas as fuel as we use natural gas. Several countries have defined standards for injection of upgraded biogas or for utilization as vehicle fuel (Tab. 2). France, Germany and Switzerland have two levels of requirements for the upgraded biogas with different restrictions applied for the injection of low and high quality gas. Sweden has one standard that has been defined for biogas utilized as vehicle fuel.

3. CLEANING OF BIOGAS:

As we all know that apart from methane and carbon dioxide the biogas is also containing water vapor, oxygen, nitrogen, hydrogen sulphide, ammonia and particles. The amount of all these gases and particles depend on the composition of substrate or row material used for producing biogas. All these gases and particles causes various problems such as in inappropriate burning,corrosion,wear(mechanical) to the system provided.

Now various Methods used to Remove all these gases stated above are as follows;

3.1 REMOVAL OF CARBON DIOXIDE (CO_2):

The various techniques and methods used for removal of carbon dioxide are as follows.

3.1.1 ADSORPTION TECHNIQUE:

To separate carbon dioxide from biogas techniques includes are based on absorption on solid surface.
The techniques includes are;
PSA-Pressure Swing Adsorption
TSA-Temperature Swing Adsorption
VSA-Vacuum Swing Adsorption
ASU-Air Separation Units
Talking about the pressure swing absorption, it is a process which involves separation of gases from a mixture under pressure taking into account the similarities and molecular characteristics of the material that meet the requirement include zeolites,activated carbon,carbon molecular sieves.The use of carbon molecular sieves is characterized by high effectiveness low setup and technological costs,as well as simplicity of operation.
TSA deals with the difference in bed's absorption capacity against temperature.The lower the temperature ,the greater the absorption capacity of absorbent of given component.When absorbent become fully saturated ,the bead is regenerated.It involves increasing temperature which causes the component absorbed on the bed to be released again.
Another technique of carbon dioxide separation from biogas is adsorption on an activated bed, followed by its regeneration which involves passing neutral gas through it.Each of those techniques has its advantages and disadvantages.In order to improve their effectiveness and reduce the disadvantages,their complementary combinations are used.

3.1.2 ABSORPTION TECHNIQUES:

cheap and effective techniques of impurity removal from biogas have been being looked for all the time.So far,the sorption techniques may be regarded as those having the above characteristics.

3.1.3 CARBON DIOXIDE ABSORPTION, USING AMINO ALCOHOLS:

In this type of technique basically we use to pass the biogas through a solution of water in which carbon dioxide dissolved in better way and at the same time methane does not react with the absorbent. Also biogas pressure effects the effectiveness of the carbon dioxide or we can say that $CO_{2's}$ effectiveness is dependent on biogas pressure.
Another method involved a chemical combination of we can say binding of carbon dioxide. Since the reaction is reversible,the adsorbent can be recovered again. The use of methanol amine to remove carbon dioxide provides an example of reversible absorption. An irreversible chemical reaction is also used to remove carbon dioxide from biogas.e.g.-absorption of carbon dioxide in lime milk.
Now the Amines used in carbon dioxide separation from biogas includes:
-**MEA**-monoethanolamine
-**DEA**-diethanolamine
-a mixture of glycol and monomethylamine
-**TEA**-triethanolamine
-**DGA**-diglycolamine
-**DIPA**-diisopropanolamoine
-**MDEA**-methyldiethanolamine
-amine mixtures
The general schematic of the reaction is as follows;
$RNH_2 + CO_2 \rightarrow RNHCOO^- + H^+$

The resulting carbamate can be decomposed by temperature.
The characteristics of selected amine alcohols are shown in Table3.

Table-3.**COMPARISON OF PHYSICAL PROPERTIES OF AMINE ALCOHOLS:**

Property	MEA	DEA	TEA	MDEA	DIPA	DGA
Molar mass	61.09	105.14	149.19	119.17	133.19	105.14
Specific gravity	1.0179	1.0919	1.1259	1.0418	0.9890	1.0550
Boiling point	171		360	247.2	248.7	221
Freezing point	10.5	28	21.2	-21	42	-9.5
Heat of vaporization	355	288	230	223	184.5	219.1
Water solubility %	100	96.4	100	100	87	100

Monoethanolamine is commonly used to remove carbon dioxide and hydrogen sulfide from biogas.However,its large amounts are lost during hydroren sulfide removal.Acid gas absorption involves passing a mixture of gases through amine stream in which acid gases are “caught up” by alkaline particles of the amine.This technique is applied at a normal temp. If a amine solution is to be regenerated,it should be boiled for 5 minutes at 105ºC.As a result,the bound particles of carbon dioxide are released and the solution reused. A mixture of glycol and monoethanolamine was used to remove carbon dioxide and dry it at the same time.The system is effective because of economical power consumption.The biogas can be dehydrated to 5% moisture.
Diethanolamine was used for many years to purify gases from carbon dioxide and sulfur substances onan industrial scale as early as the $1930_{s.}$ As organic monoethanolamine and diethanolamine.
Diglycolamine is a primary amine and thus the separation of gases from a mixture follows the procedure for MEA.
Other amine alcohols,such as diisopropanolamine(DIPA) and methyldiethanolamine(MDEA),are selective amines used to separate sulfer compounds mainly in the treatment of natural gas.If an effective removal of carbon dioxide is required,a mixture of the amines mentioned aboved is used.

3.1.4. ADSORTPION TECHNIQUES IN THE SOLUTION OF INORGANIC BASES:

Organic compounds are not the only ones employed to remove carbon dioxide from biogas.In some cases sodium calcium hydroxide and potassium are sufficient.Sometimes the hydrogen carbonates are used.The process necessitates the formation of basic medium in the solution.The dissolved carcon dioxide reacts with water as follows:

$\mathbf{CO_2+H_2O}\rightarrow H_2CO_3$

Carbon dioxide forms a hydrogen carbonate ion on the basic medium

$H_2CO_3+OH\rightarrow HCO_3+H_2O$

Carbon Dioxide is removed from biogas in the form of hydrogen carbonates.
The process involves passing raw gas at a lowered temperature through a column containing potassium hydroxide which makes carbomn dioxide present in the biogas react and form potassium hydrogen carbon-

ate.The resulting sedimenr is then regenerated.An hydroxide into the purifying column.The technique produces biogas with an 80-85% methane concentration.

An application of arsenic trioxide to carbon dioxide is also an interesting suggestion.Its Stoichiometric amounts in sodium hydroxide and potassium carbonate markedly increase the sorption and desorption coefficients in carbon dioxide.Such a solution does noty only cause a considerable decrease in heat during regeneration,but also produces gas of much higher purity than that resulting from a normal but carboin di oxide removal with potassium carbonate.

$$6CO_2+2K_3AsO_3+3H_2O \rightarrow 6KHCO_3+ As_2O_3$$

This reaction is completely reversed.

3.1.5 TECHNIQUES FOR LEACHING CARBON DIOXIDE FROM BIOGAS WITH WATER:

The main advantage of this technique include the simplicity of operation,low operating costs and possibilities for carrying out the process at low gas flow.Apart from carbon dioxide,water is capable of removing other impurities,such as hydrogen sulfide,ammonia,hydrogen phosphide,chloronated hydrocarbon and other.Biogas is introduced,at the bottom of the column while water absorbing the impurities is introduced at the top, sprinkling the column.Gases,accept the methane,from a strong 'complex' reacting with water which is broken down by decreasing pressure.In time,the columns overgrow which reduces their efficiency and therefore occational use of disinfactent is recommended.Various technologies are suggested.The difference lie in the use of scrubber of differnt parameters of gas pressure,water flow or water purity.

3.2 REMOVAL OF WATER VAPOUR:

When biogas leaving the digester, it contain water vapour which are harm full for pipe line and burning of biogas and it also cause engine running. Water can be removed by cooling, compression, absorption or adsorption. By increasing the pressure or decreasing the temperature, water vapour will condensate from the biogas and can thereby be removed. Cooling can be simply achieved by burying the gas line equipped with a condensate trap in the soil or passing the coiled gas line through ice box. Water can also be removed by adsorption using e.g. SiO2, activated carbon or molecular sieves. These materials are usually regenerated by e.g heating or a decrease in pressure. Other technologies for water removal are absorption in glycol solutions or the use of hygroscopic salts.

3.3 REMOVAL OF AMMONIA:

Ammonia is formed during the degradation of proteins. The amounts that are present in the gas are dependent upon the substrate composition and the pH in the digester. Ammonia is usually separated when the gas is dried or when it is upgraded. A separate cleaning step is therefore usually not necessary.

3.4 REMOVAL OF OXYGEN AND NITROGEN:

Oxygen is not normally present in biogas since it should be consumed by the facultative
aerobic microorganisms in the digester. However, if there is air present in the digester nitrogen will still be present in the gas when leaving the digester. Oxygen and nitrogen can be present in landfill gas if the gas is collected using an under pressure. These gases can be removed by adsorption with activated carbon, molecular sieves or membranes. They can also to some extent be removed in desulphurisation processes or in some of the biogas upgrading processes. Both compounds are difficult (i.e. expensive) to remove hence, their presence should be avoided unless the biogas is used for CHPs or boilers

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