



SNS COLLEGE OF TECHNOLOGY

Vazhiampalayam, Coimbatore-35

(An Autonomous Institution)

Accredited by NAAC with A++ grade 3rd cycle, Accredited by NBA
Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai



Types of fuels- CNG, LPG; Power alcohol, Biodiesel





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- Introduction to natural gas
- Composition of natural gas
- Compressed Natural Gas
- Liquefied Petroleum Gas





INTRODUCTION

Gaseous Fuel Natural Gas

- Natural gas is found above the oil in oil wells
- It is also called Marsh gas
- It consists of methane and other saturated hydrocarbons.

The average composition of natural gas is as follows

Constituents	Percentage
Methane	88.5
Ethane	5.5
Propane	4
Butane	1.5
Pentane	0.5



Gaseous fuel

- Its calorific value varies from 12,000 - 14,000 kcal/m³
- If natural gas contains lower hydrocarbons like methane and ethane, it is called lean or dry gas
- If the natural gas contains higher hydrocarbons like propane, butane along with methane it is called rich or wet gas

Uses

1. It is used as a domestic and industrial fuel
2. It is used as a raw material for the manufacture of carbon black and hydrogen
3. It is also used for the generation of electricity by using it in fuel cells



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- When the natural gas is compressed, it is called Compressed Natural Gas (CNG)
 - The primary component present in CNG is methane
 - It is mainly derived from natural gas
 - The natural gas can either be stored in a tank of a vehicle as compressed natural gas (CNG) at 3,000 or 3,600 psi or as liquified natural gas (LNG) at typically 20-150 psi.



Composition

The average composition of CNG is as follows

Constituents	Percentage
Methane	88.5
Ethane	5.5
Propane	3.7
Butane	1.8
Pentane	0.5



Properties

- CNG is the cheapest, cleanest and least environmentally impacting alternative fuel.



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- Vehicles powered by CNG produce less carbon monoxide and hydrocarbon (HC) emission
 - It is less expensive than petrol and diesel
 - The ignition temperature of CNG is about 550°C
 - CNG requires more air for ignition.

Uses

CNG is used to run an automobile vehicle just like LPG



Advantages of CNG over LPG

- CNG produces less pollutants than LPG
- CNG is cheaper and cleaner than LPG
- The octane rating of CNG is high, hence the thermal efficiency is more
- It does not evolve sulphur and nitrogen gases
- It mixes very easily with air than the other gaseous fuels
- Noise level is much less than diesel
- CNG vehicle limit 40% less of nitrogen oxide, 90% less of hydrocarbons, 25% less of CO₂





- LPG is obtained as a by-product during fractional distillation of crude petroleum oil or by cracking of heavy oil
- It consists of propane and butane
- It can be readily liquefied under pressure, so it can be economically stored and transported in cylinders.

Composition

The average composition of LPG is as follows.

Constituents	Percentage
n- Butane	38.5
Iso butane	37
Propane	24.5



- The calorific value of LPG is about 25,000 kcal/m³
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Uses

- It is used as a domestic and industrial fuel
- It is also used as a motor fuel

Advantages LPG over other gaseous fuels

- LPG consists of hydrocarbons, so it burns cleanly without leaving any residue
- The LPG (hydrocarbons) has higher calorific value than the other gaseous fuels containing H₂ or CO
- The calorific value is 7 times higher than coal gas and 3 times higher than natural gas.



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- LPG is characterized by high thermal efficiency and heating rate.
 - It is easy to manipulate
 - Comparatively it is less of health hazard, even in case of leakage
 - Needs little care for maintenance
 - It is free from CO, so it is less hazardous

Disadvantage of LPG over other gaseous fuels

- Due to its faint odour, leakage cannot be easily detected
- Its octane value is low
- Handling must be done under high pressure
- LPG is suitable only for the engines working under high compression ratio



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Types of fuels- CNG, LPG; Power alcohol, Biodiesel





- When ethyl alcohol is blended with petrol at concentration of 5-10%, it is called power alcohol
- In other words absolute alcohol (100% ethyl alcohol) is also called power alcohol
- Ethyl alcohol is used in an internal combustion (IC) engine
- The addition of ethyl alcohol to petrol increases its octane number
- When ethyl alcohol is blended with diesel it is called E diesel



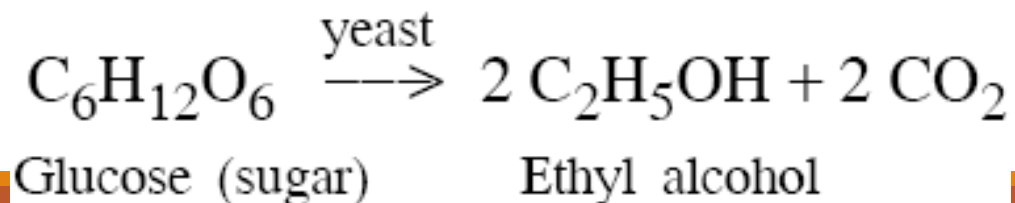
Manufacture

Manufacture of power alcohol involves the following two steps

Step I

Manufacture of Ethyl alcohol

- Ethyl alcohol can be synthesised by fermentation of carbohydrates (sugar material)
- Fermentation of molasses, which is the residue left after the crystallization of sugar, with yeast generates alcohol
- This fermentation yields only about 20% alcohol





- Concentration of alcohol can be increased up to 97.6% by fractional distillation yields rectified spirit
- The concentration of alcohol cannot be increased by distillation above 97.6%, because it forms a constant boiling mixture with water
- The constant boiling mixture has a lower boiling point than alcohol

Step II

Conversion of ethyl alcohol into power alcohol

- 100% alcohol (absolute alcohol) is prepared by removing last traces of water from rectified spirit



It can be done by the following two methods

(i) Alcohol, containing traces of water, is distilled with benzene

- When benzene passes over with a portion of alcohol and water, it leaves behind absolute (power) alcohol.

(ii) Alcohol is distilled in the presence of dehydrating agent, which holds the water

Finally absolute alcohol is mixed with petrol at concentration of 5-10% to get power alcohols.



Properties

1. Power alcohol has a lower calorific values (7000 k.cal/kg).
2. It has high octane number (90).
3. Its anti-knocking properties are good.
4. It generates 10% more power than the gasoline of same quantity.
5. Its compression ratio is also higher.

Uses

It is used, as a very good fuel, in motors.



Advantages of power alcohol

- It is cheaper than petrol.
- If any moisture is present, power alcohol absorbs it.
- As ethyl alcohol contains oxygen atoms, complete combustion occurs, so emission of CO, hydrocarbon, particulates are reduced.

Disadvantages

1. As the calorific value of power alcohol (7000 cal/gm) is lower than petrol (11,500 cal/gm), specially designed engine is required.
2. Output power is reduced upto 35%
3. Due to its high surface tension, atomization of power alcohol is difficult



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- Power alcohol as a fuel causes starting trouble
 - It may under go oxidation to give acetic acid, which corrodes engine part.
 - As it contains oxygen atoms, the amount of air required for combustion is less
 - The air required is less so the engine and carburetor need to be modified



Vegetable oils

- Vegetable oils comprise of 90-95% triglycerides with small amount of diglycerides, free fatty acids, phospholipids, etc.,
- Triglycerides are esters of long chain fatty acids, like stearic acid and palmitic acid
- The viscosity of vegetable oils are higher
- The molecular weights are in the range of 600 to 900, which are about 3 times higher than those of the diesel fuels



Problems in using vegetable oil

- As the viscosity of vegetable oils are high, atomization is very poor and hence inefficient mixing of oil with air leads to incomplete combustion
- Oxidation and thermal polymerization of vegetable oils cause deposit formation
- Their high viscosity causes misfire and ignition delay
- Their high volatility and consequent high flash point lead to more deposit formation
- The use of vegetable oils as direct fuel requires modification of the conventional diesel engine design



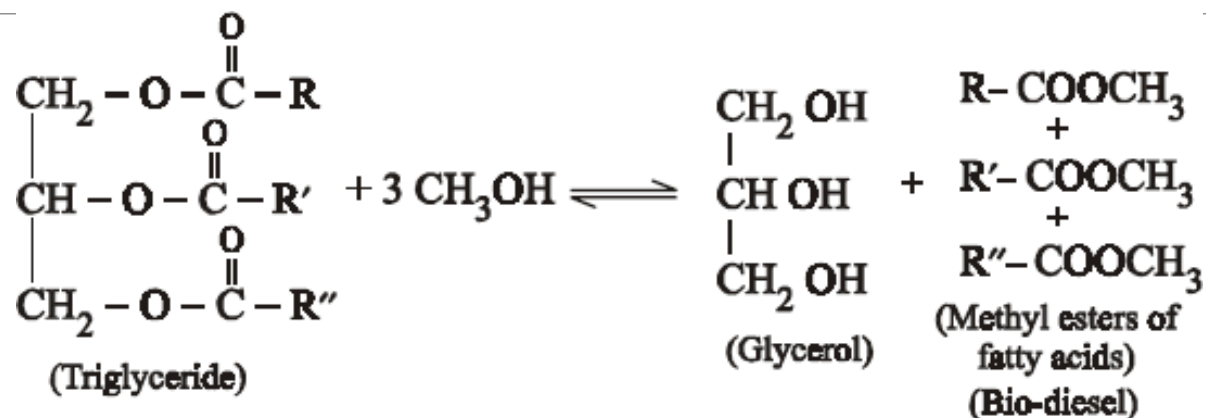
Manufacture

Trans- esterification or alcoholysis

- The problems of vegetable oils overcome by reducing the viscosity
- the process known as trans-esterification or alcoholysis
- Alcoholysis is the displacement of alcohol from an ester by another alcohol
- It involves treatment of vegetable oil (sunflower oil, palm oil, soyabean oil, mustard oil, etc) with excess of methanol in presence of catalyst to give mono ethyl esters of long chain fatty acid and glycerine
- It is allowed to stand for some time and glycerine is separated.



Alcoholysis reaction is represented as



- Methyl esters of fatty acids, thus formed, are called “Bio-diesel”
- Bio-diesel is defined as mono-alkyl esters of long chain fatty acids derived from vegetable oils or fats
- It is a pure fuel before blending with conventional diesel fuel
- Bio-diesel can be blended with petroleum diesel.



Advantages of Biodiesel

- Bio-diesel is bio-degradable
- It is prepared from renewable resources
- The gaseous pollutants are lesser as compared to the conventional diesel fuel
- Bio-diesel can be produced from different types of vegetable oils
- Best engine performance and less smoke emission are achieved

Disadvantages

- Bio-diesel gels in cold weather
- As bio-materials are hygroscopic, bio-diesel can absorb the water from atmosphere



Disadvantages

- Bio-diesel gels in cold weather
- As bio-materials are hygroscopic, bio-diesel can absorb the water from atmosphere
- Bio-diesel decreases the horse power of the engine
- Bio-diesel degrades and softens the rubber and plastics, that are used in some old cars.
- Bio-diesel has about 10% higher nitrogen-oxide (NO_x) emission than conventional petroleum.

THANK YOU
