

MODULE – IV

FUELS AND COMBUSTION

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4.4 Gaseous fuels

4.4.1 Natural Gas

- Natural gas is obtained from wells dug in the oil bearing regions during the mining of petroleum.
- Natural gas containing low molecular weight hydrocarbons is called dry or lean gas.
- Natural gas containing high molecular weight hydrocarbons is called wet or rich gas.

- Calorific value ranges from 12,000 – 14,000 kcal / m³.

Composition of natural gas

Methane - 88.5 %

Ethane - 5.5%

Propane - 3.7 %

Butane -1.8%

Uses

It is used as a domestic fuel.

It is used in the manufacture of number of chemicals.

It is used as a raw material for the manufacture of carbon black , methanol, etc.

4.4.3 Compressed natural gas (CNG) or Marsh gas

- Natural gas is compressed to high pressure of 1000 atm or cooled to -160⁰C to get compressed natural gas.
- It can be stored in steel cylinders.
- It is a less polluting fuel.
- During combustion, there is no evolution of sulphur and nitrogen gases. It is a better fuel than petrol and diesel for automobiles.

Composition

Methane – 88.5%

Ethane – 5.5%

Propane – 3.7%

Butane – 1.8%

Pentane – 0.5%

Properties

- i) It is a colourless gas.
- ii) It is a safer fuel.
- iii) It's ignition temperature is 550⁰C (higher temperature than gasoline and diesel).

- iv) It mixes with air easily.
- v) It leads to lesser emission than gasoline.

Uses

- i) It is an excellent domestic fuel that can be transported through pipes.
- ii) It is used as a fuel in thermal power plants for generating electricity.
- iii) It is used as a source of hydrogen gas in fertilizer industries.
- iv) It is used as an alternative to petrol and diesel for transport of vehicles.

4.4.3 Liquefied petroleum gas (LPG)

- It is obtained as one of the top fractions in the fractional distillation of petroleum.
- It can be easily liquefied under pressure & stored in cylinders.
- It is a mixture of propane and butane.
- The composition is,

n-butane – 38.5%

iso-butane – 37 %

Propane – 24.5%

Butylene and ethane - rest

- Its calorific value is **27,800 Kcal /m³**.

Characteristics

- It is a colourless gas stored in metallic cylinders in liquid state.
- It is less polluting.
- The products of combustion are non toxic.
- It doesnot give out ash or smoke on burning.
- It has a special odour due to the addition of methyl mercaptan for safety purpose.
- It burns cleanly without leaving any residue.
- It has higher calorific value than coal gas & natural gas.
- It has high thermal efficiency.
- It needs little care for maintenance.

Uses

- It is used as cooking gas.
- It is used as a heating source in hotels, bakeries, ang many other industries.
- It is used as a motor fuel.

4.4.4 Power Alcohol

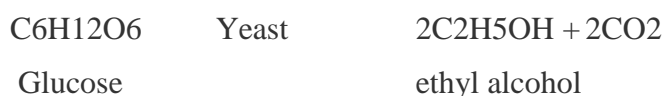
Power alcohol is a mixture of 75-80 % petrol, 20-25 % ethanol, and minute amount of **aromatic** compounds such as benzene . It can be used as a fuel for internal combustion engines. It is used as a very good fuel in motors.

Production of power alcohol

It involves two stages. They are as follows,

1. Synthesis of ethyl alcohol

Ethyl alcohol can be synthesized by the fermentation of carbohydrates. This fermentation leaves only about 20% alcohol.



The concentration of the obtained alcohol can be increased up to 97.6% by fractional distillation which is called rectified spirit.

- For the conversion of 97.6% of ethyl alcohol to absolute alcohol (100%) last traces of water must be removed.
- This can be done by distilling rectified spirit with benzene.

2. Production of power alcohol from ethyl alcohol.

- Finally absolute alcohol is mixed with petrol at a concentration of 5 – 25% to get power alcohol.

Properties

- i) Power alcohol has a lower calorific value (7000 cal / g).
- ii) It has high octane number (90).
- iii) It's anti knocking properties are good.
- iv) It generates 10% more power than the gasoline of small quantity.
- v) It's compression ratio is also higher.

Advantages

- Power alcohol is cheaper than petrol.
- Alcohol has property of absorbing any traces of water if present in petrol.
- Ethyl alcohol contains 'O' atoms, which helps for complete combustion of power alcohol and the polluting emissions of CO, hydrocarbon, particulates are reduced largely.

Disadvantages

- Power alcohol has calorific value 7000 cal/gm much lower than calorific value of petrol 11500cal/gm. So use of power alcohol reduces power output up to 35%.
- Ethyl alcohol may undergo oxidation reaction to form acetic acid, which corrodes engine parts.
- As it contains 'O' atoms, the amount of air required for complete combustion of power alcohol is lesser and therefore carburetor and engine need to be modified.
- Due to high surface tension, it causes starting trouble in motors.

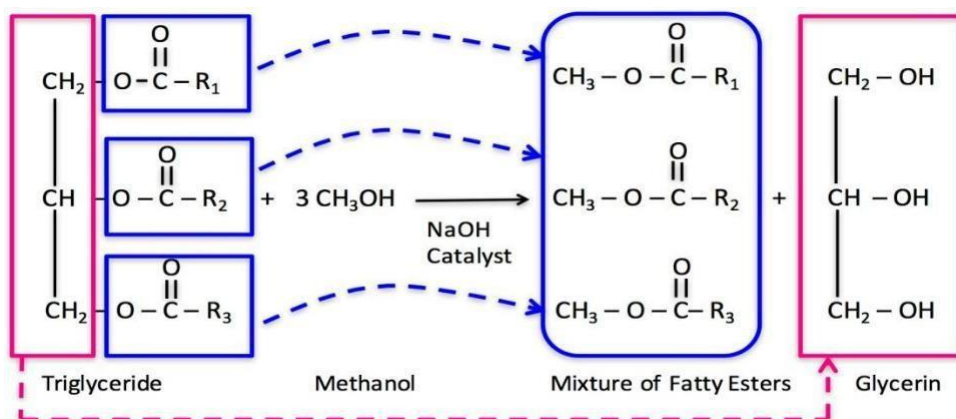
4.4.5 BIODIESEL

Definition & Explanation

- Biodiesel is a renewable, clean-burning diesel.
- Biodiesel is defined as mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats which conform to ASTM D6751 specifications for use in diesel engines.
- Biodiesel can be used alone, or blended with petro-diesel in any proportions.
- Biodiesel can also be used as a low carbon alternative to heating oil.

Making of biodiesel

Biodiesel is made through a chemical process called trans - esterification. The process leaves behind two products -- methyl esters (biodiesel) and glycerine (a valuable by-product usually sold to be used in soaps and other products).



Advantages

- Biodiesel is environment friendly because it is made from renewable resources.
- It has lower emissions compared to petroleum diesel.
- It is less toxic than table salt and biodegrades as fast as sugar.

- It is produced domestically from natural resources. So it is bio degradable.
- It's use decreases our dependence on imported fuel and contributes to our own economy.

Disadvantages

- It gels during cold weather.
- It absorbs water from atmosphere.
- It decreases the efficiency of the engine.
- It emits about 10% higher nitrogen oxides than conventional petroleum.

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