



SNS COLLEGE OF TECHNOLOGY AN AUTONOMOUS INSTITUTION



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DEPARTMENT OF AGRICULTURAL ENGINEERING

COURSE CODE & NAME: 19AGT301 & HEAT POWER ENGINEERING

III YEAR / V SEMESTER

UNIT : 1 FUELS AND COMBUSTION

TOPIC 7 : Octane Number and Cetane Number



Knocking



- Knocking is a kind of explosion due to rapid pressure rise occurring in an IC engine.
- In a petrol engine, a mixture of gasoline vapour and air at 1: 17 ratio is used as fuel. This mixture is compressed and ignited by an electric spark. The products of oxidation reaction (combustion) increases the pressure and pushes the piston down the cylinder. If the combustion proceeds in a regular way, there is no problem in knocking.
- But in some cases, the rate of combustion (oxidation) will not be uniform due to unwanted chemical constituents of gasoline. The rate of ignition of the fuel gradually increases and the final portion of the fuel-air mixture gets ignited instantaneously producing an explosive sound known as "Knocking".
- Knocking property of the fuel reduces the efficiency of engine. So a good gasoline should resist knocking.



- **Chemical structure and knocking**
- The knocking tendency of fuel hydrocarbons mainly depends on their chemical structures. The knocking tendency decreases in the following order.
- Straight chain paraffins > Branched chain paraffins > Cycloparaffins > Olefins > Aromatics.

- **Improvement of antiknock characteristics**
- The octane number of fuel can be improved by
- (i) blending petrol of high octane number with petrol of low octane number, so that the octane number of the latter can be improved.
- (ii) the addition of anti-knock agents like Tetra-Ethyl Lead (TEL).



Anti-Knocking agent



- **LEADED PETROL (ANTI-KNOCK AGENT)**

- The anti-knock properties of a gasoline can be improved by the addition of suitable additives. Tetraethyl lead (TEL) or $(C_2H_5)_4 Pb$ is an important additive added to petrol. Thus the petrol containing tetra ethyl lead is called leaded petrol.
- TEL reduces the knocking tendency of hydrocarbon. Knocking follows a free radical mechanism, leading to a chain growth which results in an explosion. If the chains are terminated before their growth, knocking will cease. TEL decomposes thermally to form ethyl free radicals which combine with the growing free radicals of knocking process and thus the chain growth is stopped.



Disadvantages of using TEL



- When the leaded petrol is used as a fuel, the TEL is converted to lead oxide and metallic lead. This lead deposits on the spark plug and on cylinder walls which is harmful to engine life. To avoid this, small amount of ethylene dibromide is added along with TEL.
- This ethylene dibromide reacts with Pb and PbO to give volatile lead bromide, which goes out along with exhaust gases.
- But this creates atmospheric pollution. So nowadays aromatic phosphates are used instead of TEL
- (iii) Nowadays aromatic phosphates are used as antiknock agent because it avoids lead pollution.



OCTANE NUMBER (or) OCTANE RATING



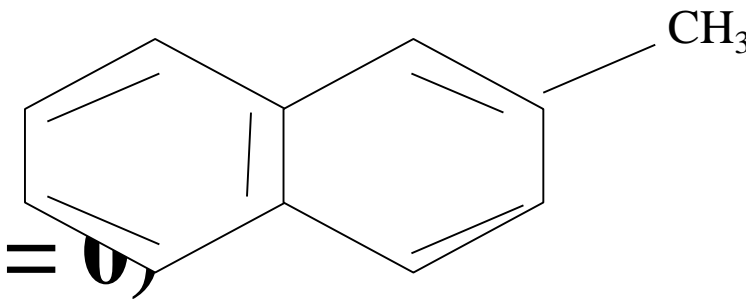
- Octane number is introduced to express the knocking characteristics of petrol. It has been found that n-heptane knocks very badly and hence, its anti-knock value has been given zero. On the other hand, iso-octane gives very little knocking and so, its anti-knock value has been given 100.
- *Thus octane number is defined as 'the percentage of iso-octane present in a mixture of iso-octane and n-heptane.'*
- **Iso-octane (Octane number = 100)**
- $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
- **n - heptane (Octane number = 0)**



CETANE NUMBER (or) CETANE RATING

Cetane number is introduced to express the knocking characteristics of diesel. Cetane has a very short ignition lag and hence its cetane number is taken as 100. On the other hand 2-methyl naphthalene has a long ignition lag and hence its cetane number is taken as zero.

- $\text{CH}_3 - (\text{CH}_2)_{14} - \text{CH}_3$
- n-cetane (hexa decane)
- cetane number = 100



- **2-methyl naphthalene (cetane number = 0)**
- Thus the cetane number is defined as "the percentage of hexa decane present in a mixture of hexa decane and 2-methyl naphthalene, which has the same ignition lag as the fuel under test".
- The cetane number decreases in the following order.
- n-alkanes > Cycloalkanes > alkenes > branched alkanes > aromatics
- The cetane number of a diesel oil can be increased by adding additives called dopes.
- **Important dopes:** *Ethyl nitrate, Iso-amyl nitrate.*
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THANK YOU..!!