



19CH101 – ENGINEERING CHEMISTRY

Unit-4

FUELS AND COMBUSTION

KNOCKING

Fractions like petrol and diesel oil are used as engine fuels. Piston engines can be divided into spark ignition (SI) and compression ignition (CI) engines. The former consumes petrol and the latter operates on diesel oil.

SI Engines

In a four stroke SI engine, petrol vapour is mixed with air in the carburetor. It is sucked into the cylinder during the suction stroke. The mixture is compressed by the piston in the compression part of the cycle. Then the compressed mixture is ignited by an electric spark. The product of combustion increases pressure and pushes the piston out, providing an output of power. In the last part of the cycle, the piston ascends and expels the exhaust gases from the cylinder.

Knocking in SI Engines (Petrol Engines)

Normally the fuel - air mixture should burn smoothly and rapidly by sparking. In some cases, as a result of compression, the fuel-air mixture may get heated to a temperature greater than its ignition temperature and spontaneous combustion occurs even before sparking. This is called pre-ignition.

Further, the spark also is emitted which makes the combustion of the rest of the mixture faster and explosive. So, we have a sudden, badly controlled burning and explosion results a characteristic metallic or rattling sound from the engine. This is called knocking or detonation or pinking. Knocking lowers the efficiency of engine which results in loss of energy.

OCTANE NUMBER

Octane number expresses the knocking characteristics of petrol. n - heptane (a constituent of petrol) knocks very badly, so its anti-knock value has been given zero. On the other hand, isooctane (also a constituent of petrol) gives very little knocking, so its anti-knock value has been given 100.

Percentage of iso-octane present in iso octane & n-heptane mixture, which matches the same knocking characteristics of gasoline mixture test sample.

If a petrol sample behaves like a mixture of 60% iso-octane and 40% n-heptane, its octane number is taken as 60.



Leaded Petrol (or) Improvement of Anti-knock Value

Adding some additives in it increases octane number of petrol. In motor fuel about 1.0 to 1.5 ml tetra ethyl lead (TEL) is added per litre of petrol. Petrol to which TEL is added is called leaded petrol.

Mechanism of knocking

Knocking follows free radical mechanism, leading to a chain growth. If the chains are terminated before their growth, knocking will cease. TEL decomposes thermally to form ethyl free radicals, which combines with the free radicals of knocking process and thus the chain growth is stopped.

CETANE NUMBER

Cetane number (or) Cetane Rating Cetane number expresses the knocking characteristics of diesel. Cetane (C₁₆ H₃₄) has a very short ignition delay and hence its cetane number is taken as 100. On the other hand, α -methyl naphthalene has very large ignition delay and hence its cetane number is taken as zero.

Cetane number is defined as “the percentage of cetane present in a mixture of α -methyl naphthalene and cetane”.