SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF CHEMISTRY

19CHB101 – CHEMISTRY FOR ENGINEERS

I YEAR I SEM

UNIT III – FUELS AND COMBUSTION

TOPIC 6 –KNOCKING

Guess the Topic

INTRODUCTION

KNOCKING

Causes

Knocking combustion causes

•a frustrating noise

• potential damage to engine’s cylinder walls and pistons

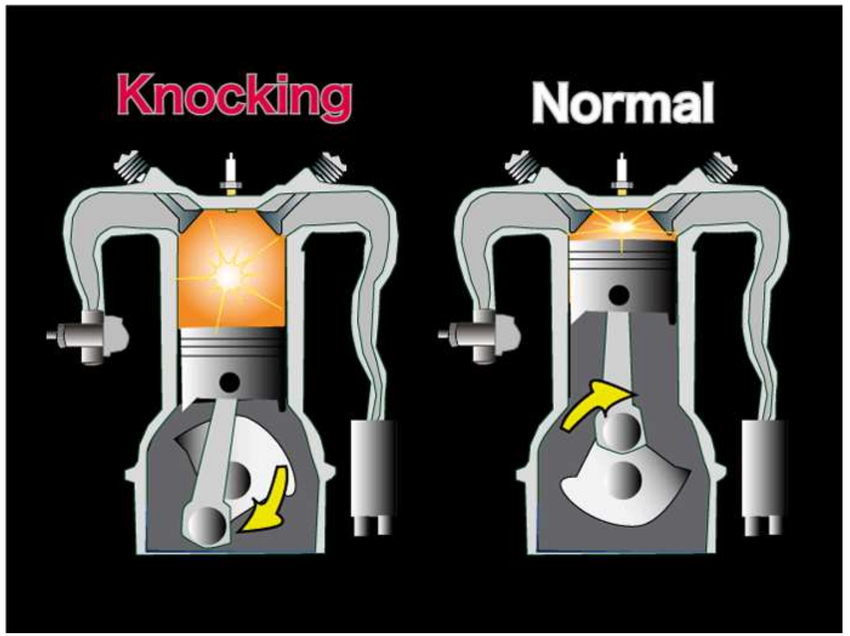
•reduces the efficiency

Reason

Fuel burns unevenly in engine’s cylinders

Definition

Knocking is a kind of explosion due to rapid pressure rise occurring in an IC engine.



Causes of knocking in S.I Engine [Petrol engines]

❖In a petrol engine, a mixture of gasoline vapour and air at 1: 17 ratio is used as fuel.

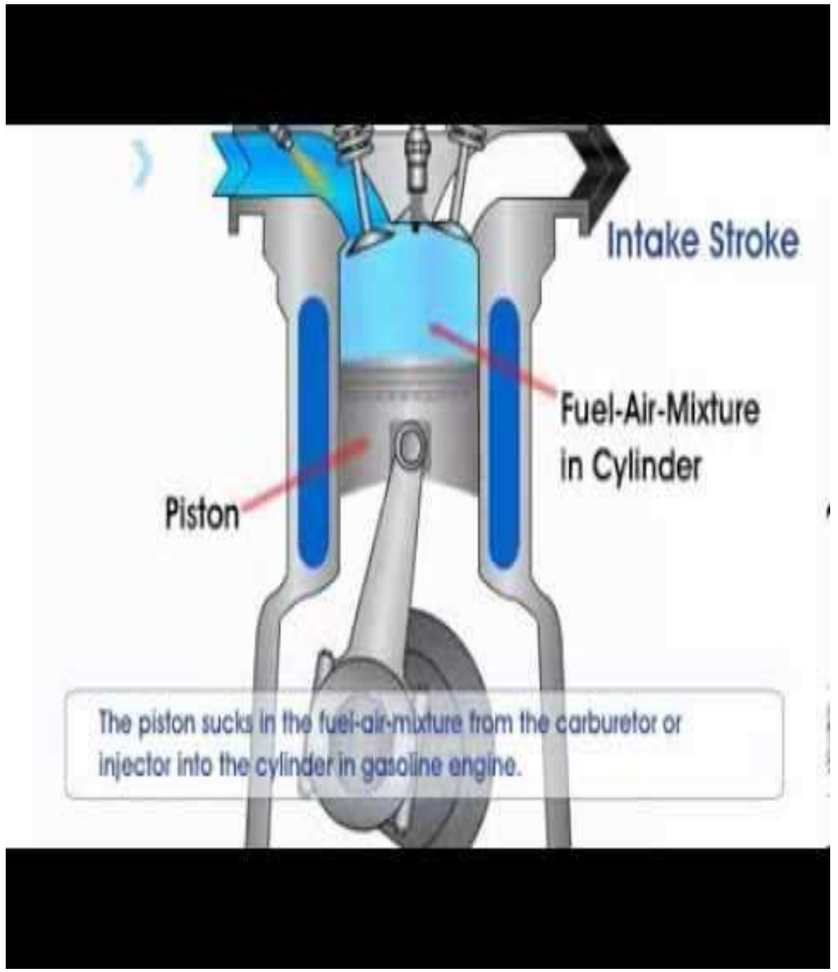
❖This mixture is compressed and ignited by an electric spark.

❖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 suddenly producing an explosive sound known as"Knocking".




Teamwork
time

Octane Number

Pre-ignition and knocking

Octane number or octane rating is a measure of a fuel's ability to resist 'knock.' It is introduced to express the knocking characteristics of petrol.

Octane numbers are based on a scale on which isooctane is 100 (minimal knock) and n-heptane is 0 (bad knock).

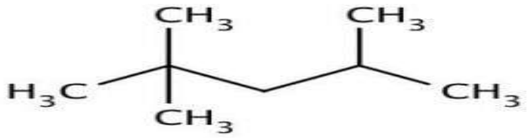
❖The higher the octane number, the more compression required for fuel ignition.

❖Fuels with high octane numbers are used in high performance gasoline engines.

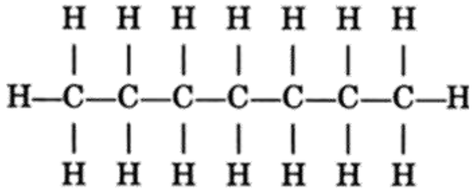
❖Fuels with low octane number (or high cetane numbers) are used in diesel engines, where fuel is not compressed.

Definition

Thus octane number is defined as 'the percentage of iso-octane present in a mixture of iso-octane and n-heptane.'



Iso octane



n-heptane

The octane number of fuel can be improved by The addition of anti-knock agents like Tetra-Ethyl Lead (TEL).

Cetane Number

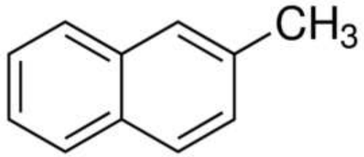
Ignition lag and knocking

Cetane number is a measure of the ignition value of a diesel fuel. It 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.

$CH_3 – (CH_2)_{14} – CH_3$ - n-Cetane (hexa decane)

Cetane number = 100



2-methyl naphthalene

(cetane number = 0)

Cetane Number

Definition

Thus the cetane number is defined as "the percentage of hexa decane present in a mixture of hexa decane and 2-methyl napthalene, 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 diesel oil can be increased by adding additives called dopes.

Important dopes: Ethyl nitrate, Iso-amyl nitrate.

ASSESSMENT

MCQ Questions

•Which compound of fuel is oxidised in the process of knocking?
a) Coke
b) Gasoline
c) Hydrocarbon
d) Compounds containing sulphur

•How will be the knocking sound produce in an engine?
a) Due to an increase in the rate of oxidation of hydrocarbon
b) Due to a decrease in the rate of oxidation of hydrocarbon
c) Due to the impurities present in fuel
d) Due to an increase in the percentile of ethanol molecule

•Which of the following compound produces the least knocking?
a) Benzyl
b) Paraffin
c) Olefin
d) Diesel

•knocking characteristic of gasoline fuel are expressed in terms of cetane number.
a) True
b) False

•Which of the following compound has the least knocking properties?
a) n-heptane
b) n-hexane
c) n-pentane
d) n-butane

•Which of the following compound is considered for calculating the octane number?
a) n-heptane
b) n-hexane
c) iso-octane
d) iso-butane

•Which of the following compound is considered for calculating the cetane number?
a) α-methyl naphthalene
b) n-hexane
c) iso-octane
d) cetane molecule

THANK YOU