SI Engine Fuels

- Antiknock property is compared with reference to
  - iso-octane (C_8H_{18}) $\Rightarrow$ 100 Octane No.
  - heptane (C_7H_{16}) $\Rightarrow$ Zero Octane No.

Very poor antiknock fuel

Very good antiknock fuel

- Fuel with Octane Number of 70 indicates
  - 70 % octane, and
  - 30 % heptane

Octane Number (ON)

- **Definition:** It indicates the % by volume of iso-octane in a mixture of iso-octane and heptane which exhibit the same characteristics of the fuel in a standard engine under a set of operating conditions.

- Common octane numbers for gasoline fuels used in automobile range from 87 to 95, with higher values for special high performance and racing cars.

Knock Rating of C. I. Fuels : CETANE NUMBER

Cetane number is the rating assigned to diesel fuel to rate its combustion quality.

It denotes the volume percentage of cetane in a combustible mixture (cetane and alpha-methyl napthalene) whose ignition characteristics match those of the diesel fuel being tested.

Reference Fuels	Cetane Number	
Cetane (n-hexadecane)	100	(highest purity of diesel fuel possible)
alpha-methylnaphthalene	0	

Knock Rating of C. I. Fuels : CETANE NUMBER

Diesel's cetane number is a **measure of the fuel's delay of ignition time** (the amount of time between the injection of fuel into the combustion chamber and the actual start of combustion of the fuel charge)

Because diesels rely on compression ignition (no spark), the fuel must be able to auto-ignite — and generally, the quicker the better.

A **higher cetane number means a shorter ignition delay time** and more complete combustion of the fuel charge in the combustion chamber. This, of course, translates into a smoother running, better performing engine with more power and fewer harmful emissions.

Cetane Numbers of Various Diesel Fuels

Normal modern highway diesels run best with a fuel rated between 45 and 55.

- Regular diesel -- 48
- Premium diesel -- 55
- Biodiesel (B100) -- 55
- Synthetic diesel -- 55

$$Cetane\ Number = 60 - \frac{Octane\ Number}{2}$$

Higher Cetane Number -> Lower Octane Number

Hence, a good C. I. Engine fuel is a bad S. I. Fuel

DOPES / ADDITIVES

Some compounds called additives or dopes are used to improve combustion performance of fuels / produces a pronounced antiknock effect.

REQUIREMENTS OF AN ADDITIVE:

- It must be effective in desired reaction, i.e., knock-resistant.
- It should be soluble in fuel under all conditions.
- It should be stable in storage and have no adverse effect on fuel stability.
- It should be in the liquid phase at normal temperature, and volatile to give rapid vaporization in manifold.
- It must not produce harmful deposits.

DOPES / ADDITIVES

Examples:

Tetra-ethyl lead (TEL), $Pb(C_2H_5)_4$

- Prevents the deposition of lead inside the engines.

Tetra-methyl lead (TML),

- Same as TEL but more stable than it.

Ethyl fluoride

- Reduces the knocking tendency in petrol engines.

INHIBITORS

Antioxidants when retard the formation of olefins peroxides when added to the fuels of SI engines.

Olefins peroxides are responsible for GUM formation.

Example:

Benzyl amino phenol (1 c.c. for 1 liter of fuel)