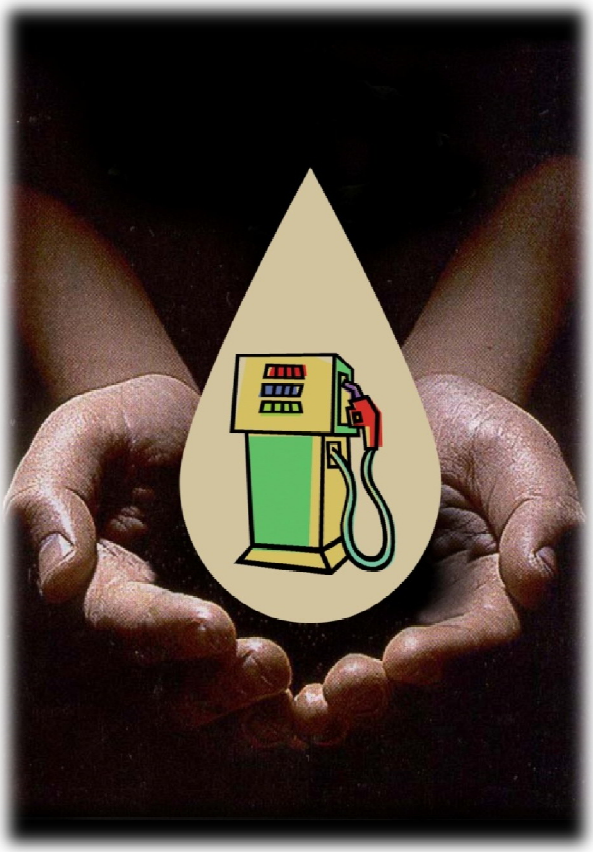
GASOLINE



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Article — Research ☑

Gasoline or Petrol is a fuel,derived from petroleum crude oil, used in spark-ignited internal combustion engines. Conventional gasoline is mostly a blended mixture of more than 200 different hydrocarbon liquids ranging from those containing 4 to11or 12 carbon atoms.It has an initial boiling point about 35°C (95°F) and a final boiling point of about 200°C(395°F) at atmospheric pressure. Gasoline is used primarily as fuel for the internal combustion engines in automotive vehicles as well in some small airplanes.

In Canada and the United States, the word "gasoline" is commonly used and it is often shortened to "gas" inspite of being a liquid rather than a gas.In fact,gasoline-dispensing facilities are referred to as "gas stations."

Most current or former Commonwealth countries use the term "petrol" and their dispensing facilities are referred to as "petrol stations".The term "petrogasoline" is also used sometimes. In some European countries and some where else, the term "Benzin" (or a variant of that word) is used to denote gasoline.

In aviation,"mogas" (an abbreviation for "motor gasoline") is used to distinguish automotive vehicle fuel from aviation fuel known as "avgas."

Gasoline production from petroleum crude oil

Gasoline and other end-products are produced from Petroleum crude oil in petroleum refineries. For a number of reasons it is very difficult to quantify the amount of gasoline produced by refining a given amount of crude oil :

- There are quite literally hundreds of different crude oil sources worldwide and each crude oil has its own unique mixture of thousands of hydrocarbons and other materials.
- There are also hundreds of crude oil refineries worldwide and each of them is designed to process a specific crude oil or a specific set of crude oils. Furthermore, each refinery has its own unique configuration of

Petroleum refining processes that produces its own unique set of gasoline blend components.Some crude oils have a higher proportion of hydrocarbons with very high boiling points than other crude oils and therefore require more complex refinery configurations to produce lower boiling point hydrocarbons that are usable in gasolines.

- There are a great many different gasoline specifications that have been mandated by various local, state or national governmental agencies.
- In many geographical areas, the amount of gasoline produced during the summer season (i.e., the season of the greatest demand for automotive gasoline) varies significantly from the amount produced during the winter season .

From the viewpoint of performance when used in automotive spark-ignited internal combustion engines, the most important characteristic of a gasoline is its octane rating . Paraffinic hydrocarbons (Alkanes),where in all of the carbon atoms are in a straight chain, have the lowest octane ratings. Hydrocarbons with more complicated configurations such as Aromatics, Olefins and branched Paraffins have much higher octane rate. To that end, many of the refining processes used in petroleum refineries are designed to produce hydrocarbons with those more complicated configurations.

Some of the most important refinery process streams that are combined together to obtain the end-product gasolines are :

- Reformate(produced in a catalytic reformer): has a high content of aromatic hydrocarbons and a very low content of olefinic hydrocarbons (Alkenes).
- Catalytically cracked gasoline (produced in a Fluid Catalytic Cracker): has a high content of olefinic hydrocarbons and a moderate amount of aromatic hydrocarbons.

- ❖ Hydrocrackate (produced in a hydrocracker): has a moderate content of aromatic hydrocarbons.
- ❖ Alkylate (produced in an alkylation unit): has a high content of highly branched paraffinic hydrocarbons such as isooctane.
- ❖ Isomerate (produced in a catalytic isomerization unit): has a high content of the branched isomers of pentane and hexane.

Vapor Pressure

The vapor pressure of a gasoline is a measure of its propensity to evaporate (i.e., its volatility) and high vapor pressures resulted in high evaporative emissions of Smog-Forming hydrocarbons which are undesirable from the environmental viewpoint. However, from the viewpoint of gasoline performance :

*The gasoline must be volatile enough that engines can start easily at the lowest expected temperature in the geographical area of the gasoline's expected market. For that reason, in most areas, gasoline marketed during the winter season has a higher vapor pressure than gasoline marketed in the summer season .

*Too high a volatility could cause excessive vapor leading to vapor locking in the fuel pump and fuel piping.

Thus, gasoline producers must provide gasolines that make possible the easy starting of engines and avoid vapor locking problems while at the same time complying with the environmental regulatory limitations regarding the hydrocarbon emissions.

Chemical analysis and production

Gasoline is produced in oil refineries. Roughly 19 US gallons of gasoline is derived put from a 42-gallon barrel of crude oil. Material separated from crude oil via distillation called virgin or straight-run gasoline,does not meet specifications for modern engines (particularly the octane rating, see below), but can be pooled to the gasoline blend.

The bulk of a typical gasoline consists of hydrocarbons with between 4 and 12 carbon atoms per molecule (commonly referred to as C_4-C_{12}). It is a mixture of Paraffins (alkanes), cycloalkanes (naphthenes), and olefins (alkenes), where the usage of the terms paraffin and olefin is particular to the oil industry. The actual ratio depends on:

- The oil refinery that makes the gasoline, because all refineries do not have the same set of processing units;
- The crude oil feed used by the refinery;
- The grade of gasoline, in particular, the octane rating.

Sulfur Content

When gasoline is combusted, any sulfur compounds in the gasoline are converted into gaseous sulfur dioxide emissions which are undesirable from the environmental point of view. Some of the sulfur dioxide also combines with the water vapor formed when gasoline combusts and the result is the formation of an acidic, corrosive gas that can damage the engine and its exhaust system. Furthermore, sulfur interferes with the efficiency of the on-board catalytic converters.Thus,sulfur compounds in gasoline are highly undesirable from either the environmental point of view or the engine performance point of view.Many countries now mandate that the sulfur content of gasoline be limited to 10ppm by weight.

Storage stability

Gasoline stored in fuel tanks and other containers will,in time,undergo oxidative degradation and form sticky resins referred to as gums.Such gums can precipitate out of the gasoline and cause fouling of the various components of internal combustion engines which reduces the performance of the engines and also makes it harder to start them either.Relatively small amounts of various anti-oxidation additives are included in end-product gasoline to improve the gasoline stability during storage throught inhibiting the formation of gums.

Other additives are also provided in end-product gasolines, such as corrosion inhibitors to protect gasoline storage tanks , freezing point depressants to prevent icing, and color dyes for safety or governmental regulatory requirements .

Many gasolines today contain Ethanol which is a kind of alcohol. Gasoline is insoluble in water but ethanol and water are mutually soluble.Thus, end-product gasolines containing ethanol will, at certain temperatures and water concentrations, separate into a gasoline phase and an aqueous ethanol phase. In the same temperature range, the portion of water that an ethanol-containing gasoline can hold without the phase of separation, increases based on the percentage of ethanol. Thus, gasolines containing more than 10 volume percent ethanol will be less likely to experience separation phase .

Octane Rating

Octane rating is a standard measure of the performance of an engine or aviation fuel. The higher the octane number , the more compression the fuel can withstand before detonating (igniting). In broad terms,fuels with a higher octane rating are used in high performance gasoline engines that require higher compression ratios. In contrast, fuels with lower octane numbers (but higher

cetane index) are ideal for diesel engines,because diesel engines (also referred to as compression-ignition engines) do not compress the fuel but rather compress only air and then inject the fuel into the air heated up by compression. Gasoline engines rely on ignition of air and fuel compressed together as a mixture without ignition, which is then ignited at the end of the compression stroke using spark plugs.Therefore, high compressibility of the fuel matters mainly for gasoline engines. Using gasoline with lower octane numbers may lead to the problem of engine knocking.

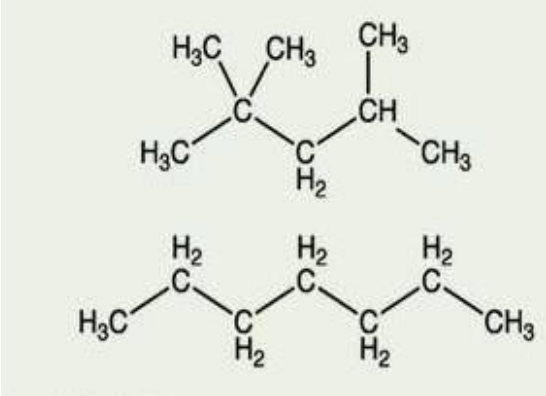
In a normal spark-ignition engine, the air-fuel mixture is heated due to being compressed and then triggered to burn rapidly by the spark plug and ignition system. If it is heated or compressed too much, then it will explode when triggered, or even self-ignite before the ignition system sparks. This causes much higher pressures than engine components are designed for and can cause a "knocking" or "pinging" sound. Knocking sound can alert major engine damage if severe.

The most typically used engine management systems found in automobiles today have a knock sensor that monitors if knock is caused by the fuel being used. In modern computer controlled engines, the ignition timing will be automatically altered by the engine management system to reduce the impacts of knock to an acceptable level.

Octanes are a family of hydrocarbon that are typical components of gasoline. They are colorless liquids with boiling point around 125°C (260°F).One member of the octane family,isooctane,is used as a reference standard to benchmark the tendency of gasoline or LPG fuels to resist self-ignition.

The octane rating of gasoline is measured in a test engine and is defined by comparison with the mixture of 2,2,4-trimethylpentane(iso-octane) and heptanes that would have the same anti-knocking capacity as the fuel under test

the percentage, by volume, of 2,2,4-trimethylpentane in that mixture is the octane number of the fuel.



The methods of measurement :

Research Octane Number (RON)

The most common type of octane rating worldwide is the Research Octane Number (RON). RON is determined by running the fuel in a test engine with a variable compression ratio under controlled conditions, and comparing the results with those using mixtures of iso-octane and n-heptane.

Motor Octane Number (MON)

Another type of octane rating,called Motor Octane Number (MON),is determined at 900 rpm engine speed instead of the 600 rpm for RON.MON testing uses a similar test engine to that used in RON testing,but with a preheated fuel mixture,higher engine speed,and variable ignition timing to further stress the fuel's knock resistance.Depending on the composition of the fuel, the MON of a modern pump gasoline will be about 8 to 12 octane lower than the RON,but there is no direct link between RON and MON.Pumped gasoline specifications typically require both a minimum RON and a minimum MON.

Anti-Knock Index (AKI) or (R+M)/2

In most countries, including Australia, New Zealand and all of those in Europe the "headline" octane rating shown on the pump is the RON, but in Canada, the United States, Brazil, and some other countries, the headline number is the average of the RON and the MON, called the Anti-Knock Index (AKI), and often written on pumps as (R+M)/2). It may also sometimes be called the Posted Octane Number (PON).

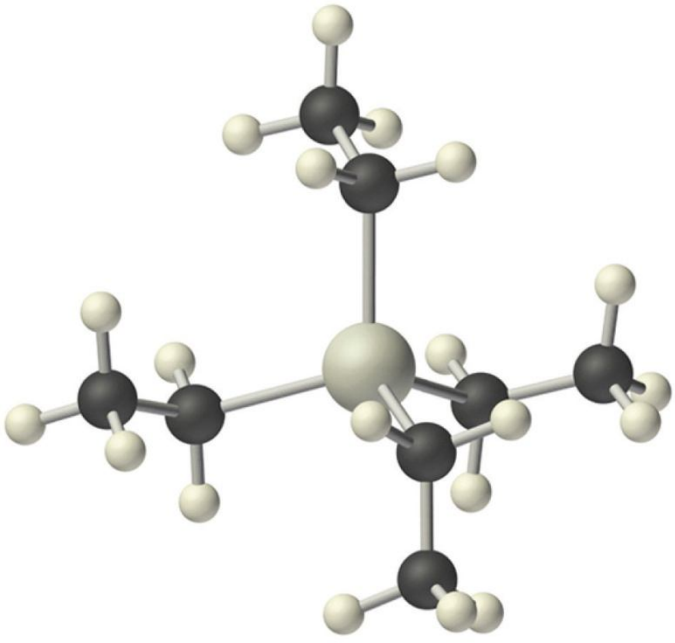
Additives

Inhaled (huffed) gasoline vapor is a common intoxicant that has become epidemic in some poorer communities and indigenous groups in Australia, Canada, New Zealand, and some Pacific Islands. In response, Opal fuel has been developed by the BP Kwinana Refinery in Australia, and contains only 5% aromatics, which weakens the side-effects of inhalation.

Almost all countries in the world have phased out automotive leaded fuel. In 2011 six countries in the world were still using leaded gasoline: Afghanistan, Myanmar, North Korea, Algeria, Iraq and Yemen.It was expected that by the end of 2013 those countries would ban leaded gasoline,but actually it will take longer. Algeria will replace leaded with unleaded automotive fuel only in 2015.Different additives have replaced the lead compounds.The most popular additives include aromatic hydrocarbons, ethers and alcohol(usually ethanol or methanol).For technical reasons the use of leaded additives is still permitted world-wide for the formulation of some grades of gasoline used in aviation such as 100LL, because the required octane rating would be technically infeasible to reach without the use of leaded additives.

Tetraethyl Lead

Gasoline, when used in high-compression internal combustion engines, tends to autoignite(detonate) causing damaging "engine knocking" (also called "pinging" or "pinking") noise. To address this problem, Tetraethyl Lead (TEL) was widely adopted as an additive for gasoline in the 1920s.With the discovery of the extent of environmental and health damage caused by the lead, however, and the incompatibility of lead with catalytic converters, leaded gasoline was phased out in beginning of 1973. By 1995, leaded fuel accounted for only 0.6% of total gasoline sales and less than 2000 short tons (1814 t) of lead per year in the USA. From 1 January 1996, the U.S. Clean Air Act banned the sale of leaded fuel for use in on-road vehicles in the USA.The use of TEL also necessitated other additives,such as dibromoethane.First European countries started replacing lead by the end of the 1980s and by the end of the 1990s leaded gasoloine was banned within the entire Europen Union.



Tetraethyllead

MMT

Methyl Cyclo Pentadienyl manganese Tricarbonyl (MMT) is used in Canada and in Australia to boost octane. It also helps old cars designed for using leaded fuel run on unleaded fuel without need for additives to prevent valve problems. Its usage in the US has been restricted by regulations.