

PETRO CHEMICALS

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The need to study petrochemicals?

- Most organic chemicals are derived from petrochemicals (PC).
- Most organic chemical industry is based on PC.
- The list include: polymer & plastic industry, synthetic fibres. fertilizers, and pharmaceuticals.
- It generates employment opportunity.
- It provides economic-growth of the country.
- Helps Make in India, Start up India, Atma-Nirbhar Bharat.



<https://www.youtube.com/watch?v=rKZJVLOIOFU>

You are advised go through this youtube link

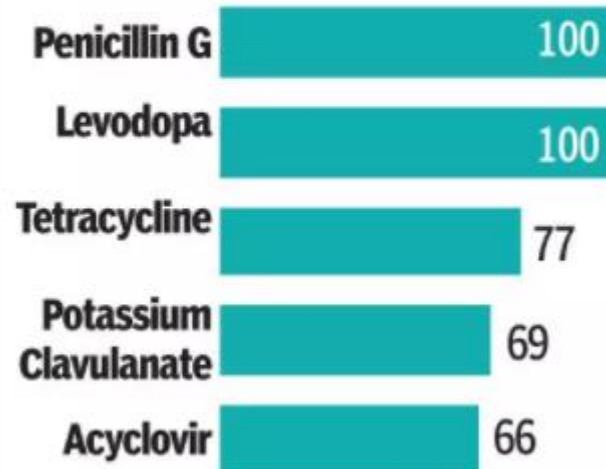
<https://www.youtube.com/watch?v=IOW6WsqAZzk>



HIGH DEPENDENCY

➤ India relies solely on Chinese imports for 8 out of 68 APIs

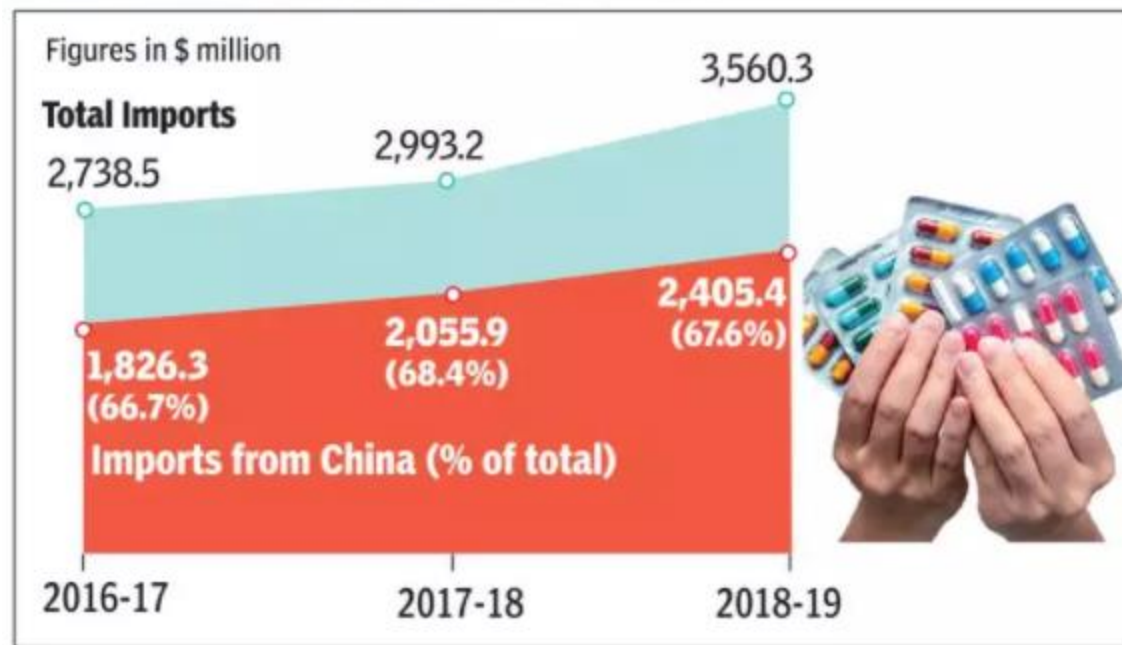
API imports from China (in %)



Source: IPA member cos;
Data is for April 2019-January 2020

80%+
Of total API imports

PHARMA IMPORTS FROM CHINA



pharma industry faces raw material shortage
tribuneindia.com

Drug-makers warn against banning raw ...
dawn.com

The Covid-19 effect

challenges to India's pharma sector ...
orfonline.org

Basic drugs dearer after govt bans ...
indiatoday.in

Beginning of Petrochemicals

- The petrochemical industry had its birth in the early 1900s.
- In 1913 **propylene**, a by-product of cracking, was introduced.
- Prior to 1919, organic chemicals were manufactured from coal, wood and agricultural raw materials.
- Resources were enough to meet the small demand of organic chemicals.
- Demand became large with progressive civilization.
- Availability of agricultural raw material like cotton, rubber, sugarcane dependent on natural phenomena.
- Inadequate supply of raw material of vegetable origin prompted search for alternative source. **(the trend is reversing now!!)**

Beginning of Petrochemicals

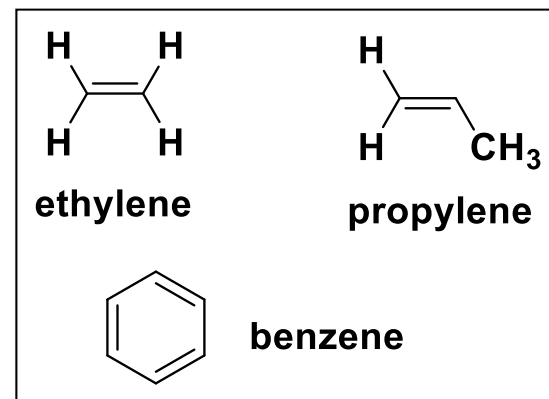
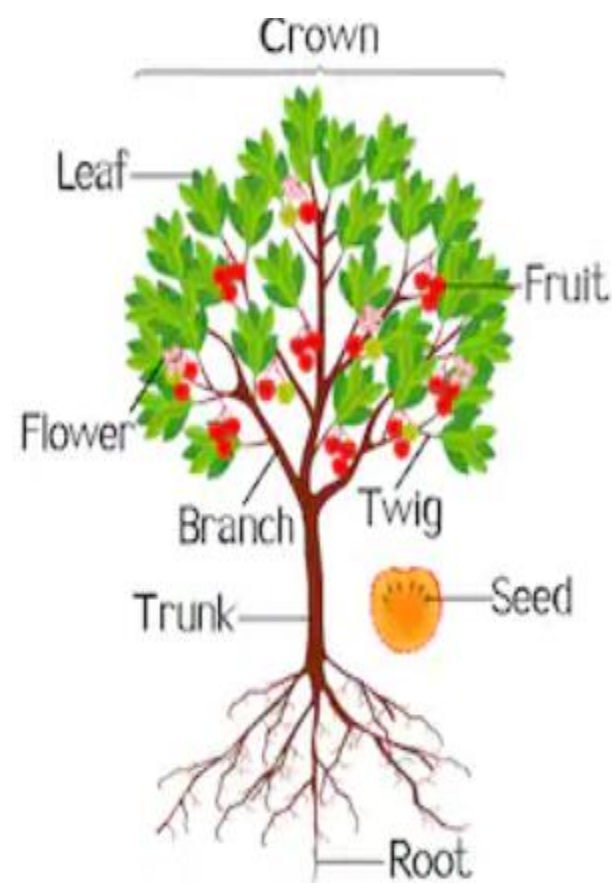
- Lead to the birth of synthesis of **organic materials** as substitute for **natural essential commodities**.
- In 1920 **isopropyl alcohol** was made from propylene (Standard oil company, USA).
- In 1923 the first **derivatives of ethylene** were commercialized: ethylene chlorohydrin, ethylene glycol, and dichloroethane (Union carbide, USA).
- By the 1940s petrochemicals were fully developed in the U.S in the 1950s and 1960's saw rapid production increases.

What are Petrochemicals?

- **Hydrocarbons obtained from the gaseous components** on fractional distillation of crude oil are used for production of other organic compounds called **petrochemicals** and they are utilized in industrial and household markets.examples
- Starting material / raw material, undergoes chemical transformation, using heat or catalyst wherein the desired product as well as by-products are obtained in a special equipment called **reactor**.
- The finished product (or chemical) is separated from the rest by employing “**unit operation**” such as distillation, crystallization, centrifuging, drying, etc.
- The product is then stored, its quality checked and verified, and if it is found suitable, packed for sale. **The by-products are also useful materials, which also find applications.**

What are Petrochemicals?

- Petroleum refining, petrochemicals and polymer industry are a single chain in real sense and the three industries should be considered as one interdependent family (just like a tree).
- Any dislocation in one of the segments, the whole chain or cycle feels the tremor.
- Petrochemicals like ethylene, propylene and benzene are converted to a multitude of intermediate and products on large scale throughout the world.



May change this table

Fractions of Crude Oil & Their Properties

Name	Number of Carbon Atoms	Boiling Point (°C)	Uses
Refinery Gas	3 or 4	below 30	Bottled Gas (propane or butane).
Gasoline	7 to 9	100 to 150	Fuel for car engines.
Naphtha	6 to 11	70 to 200	Solvents and used in gasoline.
Kerosene (paraffin)	11 to 18	200 to 300	Fuel for aircraft and stoves.
Diesel Oil	11 to 18	200 to 300	Fuel for road vehicles and trains.
Lubricating Oil	18 to 25	300 to 400	Lubricant for engines and machines.
Fuel Oil	20 to 27	350 to 450	Fuel for ships and heating.
Greases and Wax	25 to 30	400 to 500	Lubricants and candles.
Bitumen	above 35	above 500	Road surface and roofing.

50 x 720

What Is Petroleum Jelly? Uses, Benefits, Dangers & More



Two popular brands of **petroleum jelly** are: **Vaseline** (which is 100 percent petroleum) and **Aquaphor** (which contains other moisturizing ingredients, too).

Both are very versatile products that have been used for a variety of skincare and household purposes for many decades.



Petroleum Jelly has been used in a wide variety of beauty and healthcare products such as lotions, chapsticks, soaps, oils, lipsticks and even baby products!



Although Petroleum Jelly is 'refined' to remove the majority of the most harmful ingredients, it still contains **Polycyclic Aromatic Hydrocarbons (PAHs)**

Exposure to higher levels of PAHs has been linked to a number of cancers such as bladder, liver, lung and skin cancers. It has also been suggested that PAHs can contribute to the development of breast cancer, although it's not clear whether such side effects can be attributed to the use of petroleum-based products.

Five Alternatives To Petroleum-Based Skincare Products

1. Unrefined Coconut Oil:

High level of phytonutrients and polyphenols

Unrefined coconut oil is also an excellent moisturizer, antifungal and offers antibacterial properties to help strengthen the skin and remove dead cells from the skin's surface.

It's also antioxidant-rich, which means that it can act as a sunblock and help prevent sunburn.

2. Cocoa Butter:

Cocoa butter or Theobroma Oil is extracted from the beans of the Theobroma Cacao tree beauty products and it is great for healing dry, sensitive skin and preventing stretch marks during pregnancy.

Like coconut oil, cocoa butter is full of natural polyphenol and flavonoid antioxidants so acts as a great natural sunblock.



3. Shea Butter



4. Jojoba Oil



5. Extra Virgin Olive Oil



Olive oil contains vitamin E, **squalene** and other compounds, which help prevent aging of the skin, help with hydration, and can reduce damage from free radicals



Squalene

What Is Petroleum Jelly?

Petroleum jelly (PJ) is a semi-solid skin protectant that is applied topically to help treat dry, cracked skin or lips.

Its chemical composition is a mix of hydrocarbons, and it's made using mineral oil and wax. Technically it's considered an “occlusive” moisturizer, since it creates a hydrophobic barrier over the skin.

This so-called “healing jelly” works by creating a barrier on the surface of the skin that helps lock in moisture and prevent water loss and drying. It makes sense then that petroleum jelly uses include treating cracked lips, diaper rash, irritation due to **chafing** and much more

Benefits/Uses

1. Hydrating Cracked, Dry Skin
2. Helping Prevent Diaper Rash and Irritation
3. Treating Dry Lips
4. Protecting Cuticles
5. Removing Makeup



Dangers, Risks and Side Effects

Why may petroleum jelly be bad? Petroleum jelly side effects are rare but still possible.

This product should not be used internally, such as inside the nose or by mouth. Be careful not to put it up your nose and breath it in, which can possibly lead to conditions such as **pneumonia or respiratory** issues if you inhale too much-unrefined mineral oil.

Is petroleum jelly toxic?

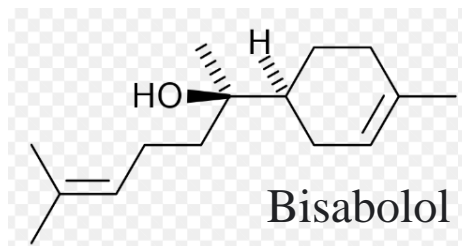
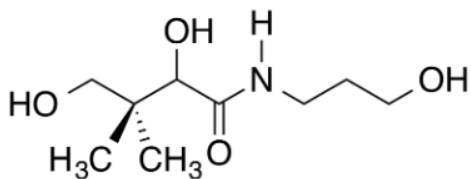
Generally safe. However, in 2015, one analysis of cosmetics containing mineral oils found that some do possibly have carcinogenic qualities — therefore researchers from this particular study [recommend](#) not using PJ/Vaseline directly on the lips.

Petroleum Jelly vs. Vaseline

Vaseline is 100 percent pure petroleum jelly. It is *one brand name* for PJ and the *original* PJ product that was created in the 1800s, but now there are many generic brands of PJ available in stores.

Aquaphor, on the other hand, contains PJ along with [mineral oil](#), [glycerin](#) and other ingredients. PJ, Vaseline and Aquaphor can all be applied to the lips and face to improve moisture and act as barriers.

Panthenol



Mineral Oil, Ceresin, Lanolin Alcohol, Panthenol, Glycerin, Bisabolol.

Can you make petroleum jelly at home (or Vaseline)?

Since it's made via a somewhat complex chemical process, it's not something you'll be able to make a DIY version of.

However you can [make alternatives at home](#) using coconut oil, cocoa butter, olive oil or even [beeswax](#), which are used in many of the same ways.



Try combining about 1 ounce (28 g) of beeswax and ½ cup (118 ml) of olive or coconut oil by melting them in a pan and stirring, which will have similar effects as PJ.

Lubricating oil

Lubricating oil, sometimes simply called **lubricant/lube**, is a class of [oils](#) used to reduce the [friction](#), [heat](#), and wear between mechanical components that are in contact with each other.

Lubricating oil is used in motorized [vehicles](#), where it is known specifically as **motor oil** and **transmission fluid**.



There are two basic categories of lubricating oil: mineral and synthetic.

Mineral oils are lubricating oils [refined](#) from naturally occurring [crude oil](#).

Synthetic oils are lubricating oils that are manufactured.

Mineral lubricating oils are currently the most commonly used type because of the low cost of extracting the oils from crude oil




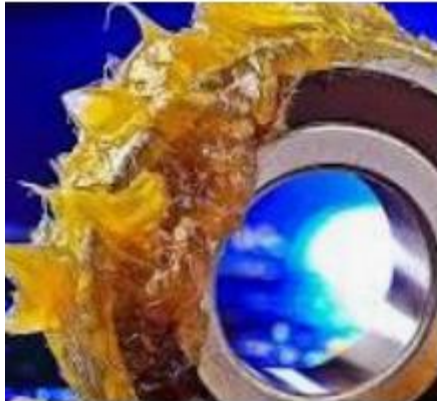
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Grease is a solid or semisolid lubricant formed as a dispersion of **thickening agents** in a liquid lubricant.

Grease generally consists of a **soap emulsified** with mineral or vegetable oil.

The basic raw materials used in the manufacture of grease are **fats, metallic hydroxides, oils (mineral), and additives**. Fats are usually defined as being a solid at room temperature whereas an oil would be a liquid at that temperature.

Using the right grease for a suitable application can save you a lot. Here are the different types of industrial-grade greases.

1) Calcium-Based Grease

As one of the first greases manufactured for general purposes, calcium grease is helpful in various applications. It helps in industrial, automotive, and agricultural applications. Besides, it's water resistant and possesses good rust and corrosion protection features. However, this grease is ideal for low-temperature applications.

2) Lithium-Based Grease

Lithium grease is another multipurpose lubricant known for its stability, durability, and high viscosity. It can offer long-lasting protection against corrosion, oxidation, wear and tear, and extreme temperatures. Besides, lithium greases are well-defined by their high water resistance and excellent lubrication. Moreover, they can withstand high pressure.

3) Bentone-Based Grease

This grease is clay-based as it gets manufactured with bentonite clay. It's a “non-melt lubricant” since it has no **dropping point**. Bentone grease's primary properties include better temperature change resistance, great tear and wear protection, excellent water tolerance, and improved shear stability. Notably, it's ideal for heavy-duty applications.

4) Barium Complex Grease

Barium complex grease is the best grease for heavy loads and high-speed applications. Its high performance, mechanical stability, and high-temperature resistance make it the number-one choice for marine, industrial, and manufacturing applications. Besides, it has great oxidation stability, excellent chemical resistance, and high water tolerance.



Fractions from distillation of crude oil

Fraction	Boiling point (°C)	Applications
Gases	<20	refinery fuel, LPG
Light gasoline	20-75	gasoline blending
Naphtha	75-200	solvents and gasoline
Kerosine	200-250	jet, domestic and tractor fuels
Gas oil	200-350	diesel fuel, heating fuel
Atmospheric residue	>350	heavy fuel oil

The unfortunate confusion!

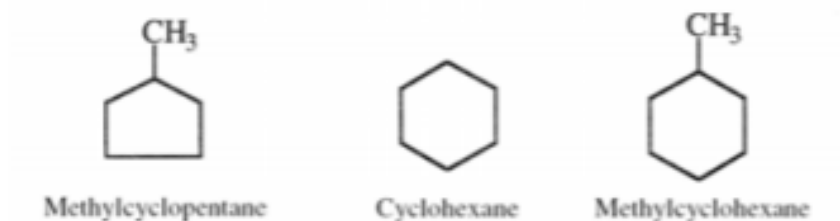
The term “**Naptha**” has different meanings in “oil industry”
and “petrochemical industry”

In “oil industry”: Fraction between 20-200 °C (some book 70-200 °C) used for feedstock for **ethylene manufacture**.

If light gasoline (20-75 °C) is used it is called “light naptha”, it is more often used in the petrochemical sense.

1. **“Naptha”** are mixtures of alkanes, cycloalkanes, and aromatic hydrocarbons, which vary in composition depending on the types of oil (source), it contains C-4 to C-12

“Naphthenes” contains five and six membered ring compounds

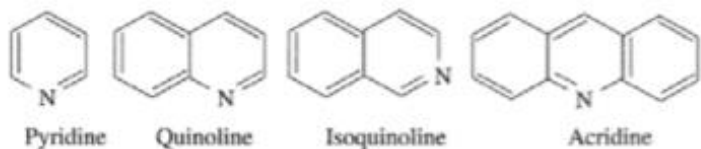


Cycloalkanes (or cycloparaffins or naphthenes), also called naphthenes in the petroleum industry, are saturated hydrocarbons containing structures with carbon atoms linked in a ring. The cycloalkane composition in crude oil worldwide typically varies from 30% to 60%.

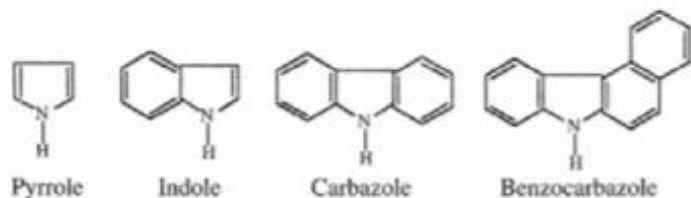
Are they good as fuel???.... feedstock for **ethylene manufacture???**

Are these naphthenes?

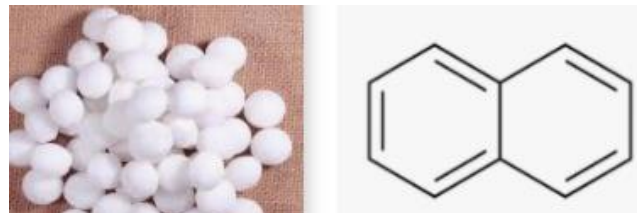
Basic Nitrogen Compounds



Non-Basic Nitrogen Compounds



“Naphthalene” is a polycyclic (bicyclic) aromatic compound



What chemicals are in mothballs? **Mothballs** are commonly made of **naphthalene** or **para-dichlorobenzene (PDB)**, both of which are toxic to humans. These chemicals are solids at room temperature and are made into round balls, flakes or cakes that **slowly change to a gas and become fumes in the air.**

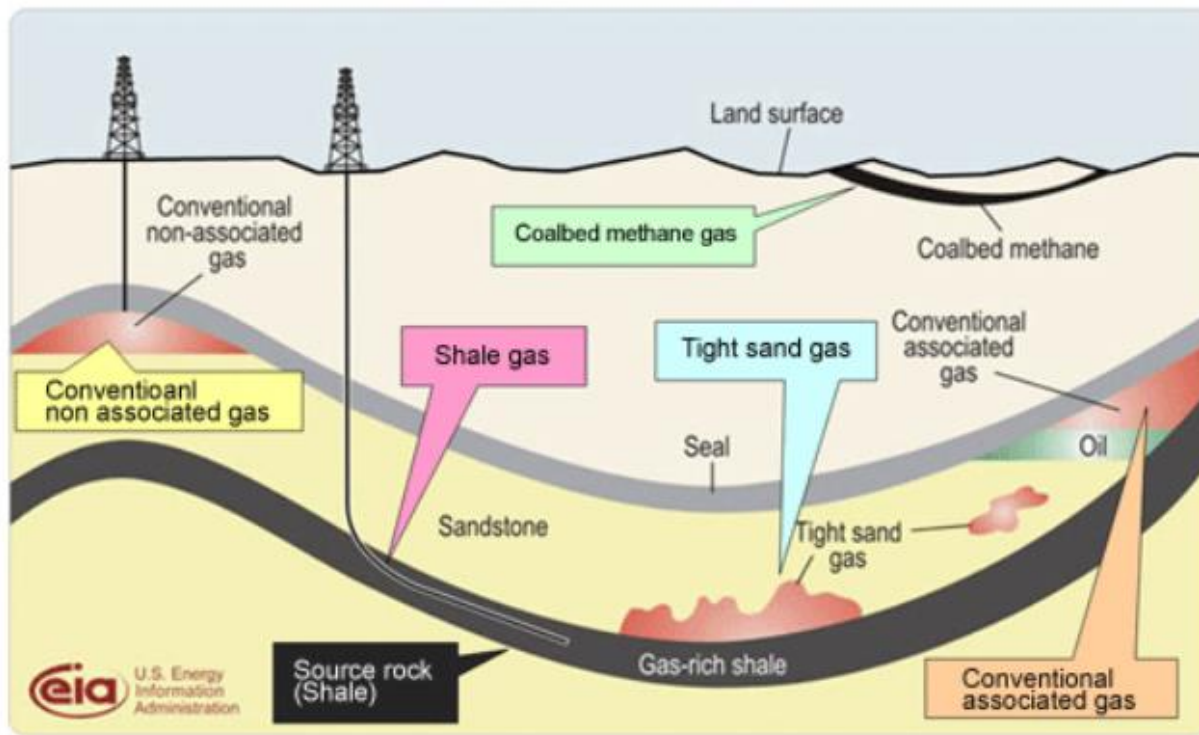
PDB moth balls are more effective at repelling moths than naphthalene moth balls. They are also more expensive and have a stronger smell. Naphthalene moth balls are less expensive and have a weaker smell, but they are not as effective at repelling moths.

2. “Gas oil” are also mixtures of alkanes, cycloalkanes, and aromatic hydrocarbons (250-350 °C), but the components have higher molecular weights than naphtha.

“Gas oil as feedstock (for ethylene) is technologically inconvenient. It is only used when it is available at much cheaper price than naphtha.

“Kerosin” as feed stock for ethylene is also technologically inconvenient. Although it is sometimes used but its value as a fuel is high. (Indian scenario is different)

“Gasoline” in UK and India is called petrol, the term is often used with petroleum.



Natural gas: Occurs in gas field, underground reservoir similar to oil reservoir.

Associated gas: Lower gaseous alkanes are often in solution under pressure. When the oil is brought to the surface the pressure is released and C1-C4 alkane boils off. This is called associated gas (or dissolved gas).

Q. What is the associated gas in water? And in coca-cola?

Q. Looking at the diagram can you tell the composition of Associated gas and non-associated gas.

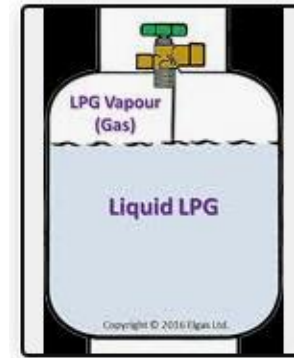


Dry natural gas or non-associated gas: Some natural gas contains mostly methane and a small amount of other alkane. Such gas when compressed at room temperature no liquid is formed. (Also called non-associated gas)

Wet natural gas: Some natural gas contains substantial amounts of ethane, propane and butane which liquefy if the gas is compressed.

Shale gas: It is natural gas trapped within the pores of sedimentary rock.

Non hydrocarbon constituents: vary from one gas field to another. The components are weak acids, H_2S , CO_2 , N_2 , **He and Ar**.



PET/MRI Scan | Stanford Health Care



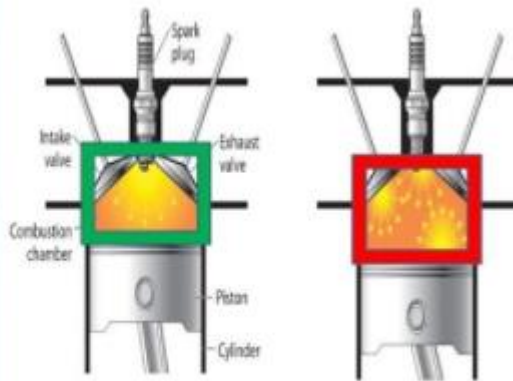
Magnetic Resonance Imaging (M...



NMR Instrument Price ...

The quality requirement of gasoline:

1. **Correct volatility characteristic:** Vaporises adequately in the carburettor, but does not undergo excessive evaporation from the fuel tank, or give rise to “vapour locking” in the fuel pipe. Fraction between 20-200 °C is the best.
2. **Correct knocking properties:** Improper burning results in **knocking or pinking**, which results in power loss and engine damage.



In an engine, when the fuel remaining after normal combustion ignites explosively due to high temperature and pressure rather than the spark from the spark plug, it causes **knocking or detonation**. This explosive release energy causes characteristic knocking.

3. **The octane number** of a fuel is a measure of its quality. The higher the octane number, the lesser the tendency of the fuel to knock.

It can be caused either by an engine malfunction or by a fuel that burns too fast. In either case, the gasoline-air mixture detonates at the wrong point in the engine cycle, which reduces the power output and can damage valves, pistons, bearings, and other engine components.

The octane scale was established in 1927 using a standard test engine and two pure compounds: **n-heptane** and **isooctane** (2,2,4-trimethylpentane).

n-Heptane, which causes a great deal of knocking on combustion, was assigned an **octane rating of 0**, whereas isooctane, a very smooth-burning fuel, was assigned an octane rating of 100.

Chemists assign octane ratings to different blends of gasoline by burning a sample of each in a test engine and comparing the observed knocking with the amount of knocking caused by specific mixtures of n-heptane and isooctane