2.6 Petroleum

Petroleum (crude oil) consists of a mixture of alkanes and alkenes (both unbranched, branched, and cyclic) of widely assorted lengths and boiling points. The boiling point of these molecules increases as the length of the chain increases as shown in chart below.

	Boiling point (^{o}C at 1 atmosphere pressure)
Methane	-182.77
Ethane	-88.6
Propane	-42
Butane	-0.5
Pentane	36
Hexane	68.7
Heptane	98.4
Octane	125.67
Nonane	150.82
Decane	174
Eicosane (20 C atoms)	343

(Source, CRC Handbook of Chemistry and Physics, 88th ed, 2007)

Even though the bonds in these alkanes are quite non-polar, there are very weak attractions (called **van der Waals attractions**) between molecules and as the molecules become larger and larger, these attractions between molecules become larger and result in increased boiling points.

These different molecules are partially purified by **fractional distillation** where lower boiling liquids are preferentially boiled off and separated from higher boiling substances. This process does not separate out pure compounds, but it does separate the crude oil into separate fractions with similar boiling points.

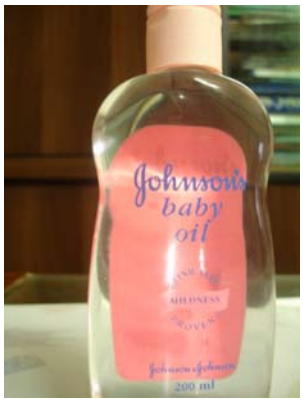
A brief summary of some of the fractions from a petroleum refinery is shown in the chart below

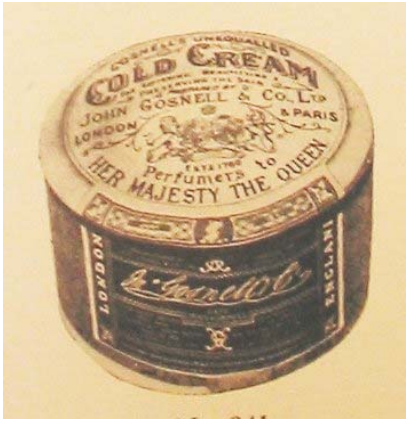
	C chain length	boiling point range
Gasoline	5-12	< 200 C
Kerosene	12-15	150-275
Diesel	10-19	200-350
Mineral oil	15-40	~300
Lubricating oil	20-40	>370
Asphalt	>40	very high

One of the most desirable properties of gasoline is that it does not actually ignite (burn) until a spark is applied. This property is measured by the octane number and the higher the octane number, the more resistant the gasoline is to premature ignition. Branched alkane chains and cyclic alkanes have higher octane values than unbranched chains. Given that gasoline is a major product from petroleum, a lot of reforming reactions are carried out in petroleum refineries to increase the % of branched and cyclic alkanes and hence to increase the octane value of gasoline fractions from the distillation.

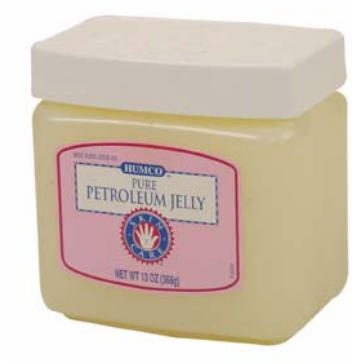
Mineral oil consists of a mixture of alkanes from 15-~40C atoms that is commonly used (with the addition of fragrances) as baby oil. It is also used in some cold creams and ointments. It can replace the natural oils that may be removed from a baby's skin with routine cleaning and may reduce the irritation and rash from diapers by applying a non-polar barrier on the baby's skin which will not allow urine and feces direct contact with skin.

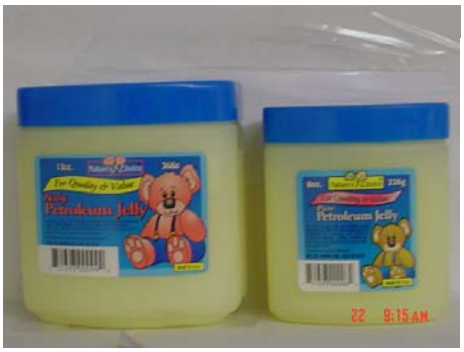
It is also occasionally used internally as a laxative to treat constipation. The non-polar mineral oil can coat the lining of the large intestine, inhibit water reabsorption in the intestine and thus increase the fluidity and volume of the bowel contents. There are other OTC treatments available and this use is not recommended by many doctors.
It can also be used to dissolve impacted ear wax.

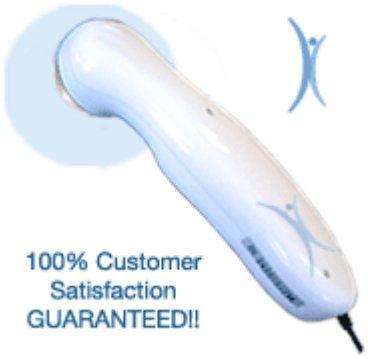




Petroleum jelly (petrolatum, Vaseline) is a semi-solid mixture of alkanes of slightly higher molecular weight than mineral oil (more than 25 C atoms) and is used in a similar fashion. It is also used as a component of some lip balms and moisturizers.







Some ultrasound gels