Alkanes are **not very reactive** when compared with other chemical species. This is because the backbone carbon atoms in alkanes have attained their octet of electrons through forming four covalent bonds (the maximum allowed number of bonds under the octet rule; which is why carbon's valence number is 4). These four bonds formed by carbon in alkanes are sigma bonds, which are more stable than other types of bond because of the greater overlap of carbon's atomic orbitals with neighboring atoms' atomic orbitals. To make alkanes react, the input of additional energy is needed; either through heat or radiation.

Gasoline is a mixture of the alkanes and unlike many chemicals, can be stored for long periods and transported without problem. It is only when ignited that it has enough energy to continue reacting. This property makes it difficult for alkanes to be converted into other types of organic molecules. (There are only a few ways to do this). Alkanes are also **less dense than water**, as one can observe, oil, an alkane, floats on water.

**Alkanes are non-polar solvents.** Since only C and H atoms are present, alkanes are nonpolar. Alkanes are immiscible in water but freely miscible in other non-polar solvents. Alkanes consisting of weak dipole dipole bonds can not break the strong hydrogen bond between water molecules hence it is not miscible in water. The same character is also shown by alkenes. Because alkanes contain only carbon and hydrogen, combustion produces compounds that contain only carbon, hydrogen, and/or oxygen. Like other hydrocarbons, combustion under most circumstances produces mainly carbon dioxide and water. However, alkanes require more heat to combust and do not release as much heat when they combust as other classes of hydrocarbons. Therefore, combustion of alkanes produces higher concentrations of organic compounds containing oxygen, such as aldehydes and ketones, when combusting at the same temperature as other hydrocarbons.

The general formula for alkanes is C\(_n\)H\(_{2n+2}\); the simplest possible alkane is therefore methane, CH\(_4\). The next simplest is ethane, C\(_2\)H\(_6\); the series continues indefinitely. Each carbon atom in an alkane has sp\(^3\) hybridization.

Alkanes are also known as paraffins, or collectively as the paraffin series. These terms are also used for alkanes whose carbon atoms form a single, unbranched chain. Branched-chain alkanes are called isoparaffins.

**Methane** through **Butane** are very flammable gases at standard temperature and pressure (STP). **Pentane** is an extremely flammable liquid boiling at 36 °C and boiling points and melting points steadily increase from there; octadecane is the first alkane which is solid at room temperature. Longer alkanes are waxy solids; candle wax generally has between C\(_{20}\) and C\(_{25}\) chains. As chain length increases ultimately we reach polyethylene, which consists of carbon chains of indefinite length, which is generally a hard white solid.

### Reactions

Alkanes react only very poorly with ionic or other polar substances. The pKa values of all alkanes are above 50, and so they are practically inert to acids and bases. This inertness is the source of the term paraffins (Latin para + affinis, with the meaning here of "lacking affinity"). In crude oil the alkane molecules have remained chemically unchanged for millions of years.

However redox reactions of alkanes, in particular with oxygen and the halogens, are possible as the carbon atoms are in a strongly reduced condition; in the case of methane, the lowest possible oxidation state for carbon (−4) is reached.
Reaction with oxygen leads to combustion without any smoke; with halogens, substitution. In addition, alkanes have been shown to interact with, and bind to, certain transition metal complexes.

Free radicals, molecules with unpaired electrons, play a large role in most reactions of alkanes, such as cracking and reformation where long-chain alkanes are converted into shorter-chain alkanes and straight-chain alkanes into branched-chain isomers.

In highly branched alkanes and cycloalkanes, the bond angles may differ significantly from the optimal value (109.5°) in order to allow the different groups sufficient space. This causes a tension in the molecule, known as steric hinderance, and can substantially increase the reactivity. The same is preferred for alkenes too.

Contributors

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