# 2. PHYSICAL AND CHEMICAL PROPERTIES OF MEK

## 2.1 PHYSICAL PROPERTIES:-

MEK is a low boiling solvent with an atmospheric boiling point of 175.3 $^0$F (79.6$^0$C). Methyl Ethyl Ketone (MEK) is a chemically stable compound also known as 2-butanone. MEK is a flammable, colourless liquid possessing a typical ketonic odor. It has very good solvent properties, a fast evaporation rate, and is miscible with organic solvents. MEK is an excellent solvent for a variety of resin systems used in the preparation of paints and lacquers. It is highly miscible with water and many conventional organic solvents and forms azeotrope with number of organic solvents.

Some of the physical properties are listed below.

Physical Properties of MEK (all values are at 20$^0$c, except where noted)

| | |
|---|---|
| Boiling point at 1 atm, $^0$C | 79.6 |
| Azeotrope with water , bp, $^0$C | 73.4 |
| $W_t$.% ketone in vapor | 88.7 |
| Autoignition temperature, $^0$C | 515.6 |
| Coefficient of cubic expansion, per $^0$C | 0.00119 |
| Critical pressure, atm | 43 |
| Critical temperature , $^0$C | 260 |
| Density, g/mL at 20$^0$C | 0.8037 |
| Dielectric constant | 18.51 |
| Dipole moment, debye units | 2.74 |
| Electrical conductivity, mho | $5.0 \times 10^{-8}$ |
| Explosive limits in air, vol.% | |
| Upper | 10 |
| Lower | 1.8 |
| Flash point, $^0$C | |
| Tag open Cup | 1.11 |
| Tag Closed Cup | -2.22 |
| Freezing point, $^0$C | -86.3 |
| Heat of combustion, cal/g | 8084 |
| Heat of fusion, cal/g | 24.7 |
| Heat of vaporization, cal/g | 106 |
| Molecular weight | 72.104 |
| Refractive index $n_D$ | 1.3791 |
| Solubility, wt. % | |
| Ketone in water | 26.3 |
| Water in ketone | 11.8 |
| Solubility parameter | 9.3 |
| Specific heat, cal/g $^0$C | 0.549 |
| Surface tension, dyn/cm | 24.6 |

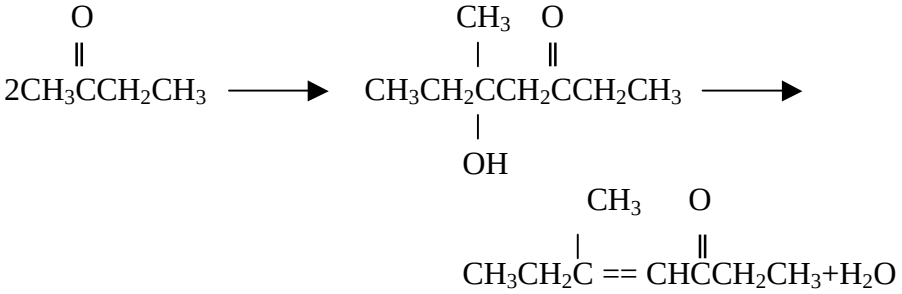
| | |
|---|---|
| Thermal conductivity, cal/cm$^2$ .s. ($^0$C/cm) | 3.58 x $10^{-4}$ |
| Vapor pressure, mm$H_g$ | 80.21 |
| Viscosity, cP | 0.43 |

**2.2 <u>Chemical properties</u>**:-

Methyl Ethyl ketone can be widely utilized in chemical synthesis. Its reactivity centers around the carbonyl group and its adjacent hydrogen atoms. Condensation, ammonolysis, halogenations, and oxidation can be carried out under the proper conditions. Some typical reactions are described below.

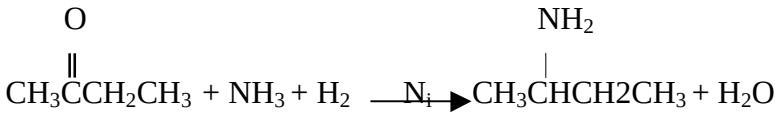
<u>Self-Condensation</u>

Aldol condensation of 2 moles of MEK yields a hydroxy ketone, which readily dehydrates to an unsaturated ketone:



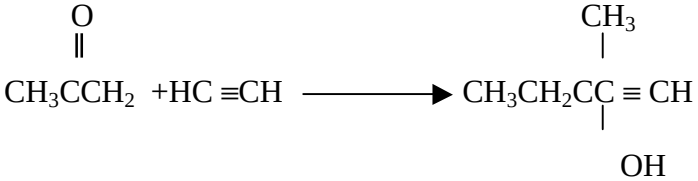
<u>Condensation with other Compounds</u>

Reaction with aldehydes gives higher ketones, as well as ketals and cyclic compounds, depending on reaction conditions. $\beta$ - ii ketones are produced by the condensation of MEK with aliphatic esters. MEK condenses with glycols and organic oxides to give derivatives of dioxolane. *sec*-Butyl amine is formed by reacting MEK with aqueous ammonia and hydrogen:



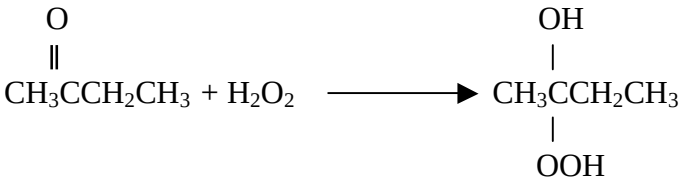
An excess of MEK in this reaction will produce di-*sec*-butylamine.

Reacting MEK with acetylene gives methyl pentynol, a hypnotic compound:

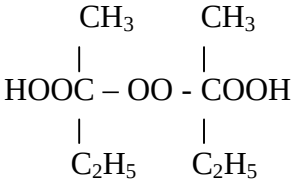


Miscellaneous Reactions

Oxidation of MEK with oxygen produces diacetyl, a flavouring material. Chlorination yields mixtures of several monochloro and dichloro derivatives in various percentages depending on reaction conditions. The reaction of MEK with hydrogen peroxide gives a mixture of peroxides and hydro peroxides which is used to cure polyester resins at room temperature:



This initial addition product is the unstable precursor of seven stable peroxides and hydro peroxides. Of these, 2,2 –dihydroperoxy-2,2'-dibutyl peroxide is present in the largest amount (about 45%) in the peroxide mixture:



MEK peroxides are widely used as catalysts for the polymerisation of polyester resins at room temperature. The condensation product of MEK and *m*-phenyl diamine is an efficient curing agent for epoxy resins. MEK and cobalt acetate function together as a specific catalyst for single-stage oxidation of *p*-xylene to terephthalic acid. Aliphatic monoketones, such as MEK also function as catalysts in the polymerisation of polyethylene terephthalate where, it is claimed, they speed condensation times and cause less yellowing of the polymer than antimony trioxide. MEK is also used in the preparation of complex catalysts used in the syndiotacic polymerisation of $\alpha$- olefins such as propylene.

Phenol, glyoxal, formaldehyde, acetaldehyde, furfuraldehyde, and other chemicals can be reacted with MEK to form resins useful for adhesives, coatings, molded products, and electrical insulation. MEK reacts with acrylonitrile to produce a dinitrile, which upon hydrogenation produces amines.