PROPERTIES AND USES

CHEMICAL AND PHYSICAL PROPERTIES OF NAPHTHALENE:

PROPERTY	VALUE
Molecular Weight	1228
Melting point, ^{0}C	80.290
Normal Boiling point (at 101.3kpa),^{0}C	217.993
Triple point (t_{tp}), ^{0}C	80.28
Critical temperature (t_c), ^{0}C	475.2
Critical pressure (p_c),kpa	4051
Flash point (closed cup), ^{0}C	79
Ignition temperature, ^{0}C	526
Flammable limits, Vol% Upper Lower	5.9 0.9
Heat of Vaporisation, KJ/mol	43.5
Heat of fusion at triple point, KJ/mol	18.979
Heat of combustion(15.5^{0}C, 101.3kpa), KJ/mol	-5158.41
Heat capacity (at 15.5^{0}C, 101.3kpa), KJ/mol^{0}C	159.28
Heat of formation (at 25^{0}C), KJ/mol Solid Gas	 78.53 150.58
Density (at 25^{0}C), g/cm^3	1.175
Density (at90^{0}C), g/cm^3	0.97021

VAPOR PRESSURE TEMPERATURE RELATIONSHIP FOR NAPHTHALENE:

TEMPRATURE,^{0}C	**PRESSURE, KPa**
0	0.0008
10	0.003
20	0.007
40	0.043
87.6	1.33
119.1	5.33
166.3	26.66
191.3	53.33
214.3	93.33
218.0	101.33
230.5	133.32
250.6	199.98

VISCOSITY-TEMPERATURE RELATIONSHIP FOR LIQUID NAPHTHALENE:

TEMPERATURE,^{0}C	**VISCOSITY, mP$_a$.s**
80.3	0.960
90	0.846
100	0.754
110	0.678
120	0.616
150	0.482
180	0.394
220	0.320

NAPHTHALENE AZEOTROPES:

Naphthalene forms azeotropes (constant-boiling mixtures) with various compounds. Some of them are listed below.

COMPOUND	**BOILING POINT AT 760, ^{0}C**	**NAPHTHALENE WEIGHT%**
Benzoic acid	217.7	95
1,2-benzenedion (catechol)	216.3	98.8
4-chlorophenol	216.3	63.5
2-nitrophenol	215.75	40
1,3,5-triethylbenzene	215.0	15
Benzyl acetate	214.65	28
Benzyl alcohol	204.1	40
m-cresol	202.08	97.2
Acetamide	199.55	72.8
Ethylene glycol	183.9	49

Naphthalene is only slightly soluble in water (0.019g/l at 0^0C and 0.030g/l at 100^0C) but is soluble in many organic compounds. The best solvent is tetrahydronaphthalene, which of are solvents has the greatest configurationally similarity to naphthalene. Naphthalene is soluble in liquid sulfur dioxide, giving it a greenish yellow color, in phenols, ethers and acetic acid, and in fats and volatile oils. Naphthalene is a good solvent for many compounds including such inorganic substances as phosphorus, iodine, sulfur and several metal sulfides.

Naphthalene derivatives are important intermediates in dyes, pharmaceuticals, agriculture chemical, surface-active agents, etc. the reaction of naphthalene are of three distinct types:

1) Substitution, 2) Addition, and 3) Rupture of one or both rings

Substitution:

The industrially important substituents in naphthalene are the nitro, hydroxy, sulfonic, amino and alkyl groups, and chlorine. Reactants at lower temperature tend towards alpha- or 1-position substitution; at higher temperatures, toward beta- or 2-position substitution.

The four alpha (1,4,5 or 8) and the four beta (2,3,6 or 7) position are equivalent. There are therefore two possible isomers when there is substituent, ten isomers when naphthalene is di-substituted with the same group or fourteen when the two substituents are different.

Addition Reaction:

The important addition products or naphthalene are made by the addition to it of hydrogen or the halogens. Addition and substitution may occur in the same naphthalene molecule.

Ring Rupture:

Oxidation of naphthalene under normal condition conditions lead to naphthaquinone, but if the oxidation is continued beyond naphthaquinone, one ring of naphthalene ruptures with further oxidation of two carbons to carbon dioxide. The two remaining carbons, ortho to each other on the remaining ring, form carboxy groups to yield o-phthalic acid, which dehydride is the largest use for naphthalene.

Uses:

The largest-volume use of naphthalene is for the manufacture of phthalic anhydride. Insecticides (q.v.) now from the second largest outlet for naphthalene. At one time naphthalene itself, in flake, ball or cake form, found extensive use against cloths moths. Some of the major uses of naphthalene are shown in the diagram.