Organic Solvent

Editors

Noora Falah Abd Al Hassn Haban
Department of Chemistry, College of Science, University of Karbala, Iraq

Ahmed Omer Ismail Khalaf
Department of Applied Chemistry, College of Applied Science, University of Falllujah, Iraq

Zainab Saleem Abdulrasool Hassoon
Department of Chemistry, College of Science, University of Baghdad, Iraq

Dawood Salim Mohammed Hussein
Department of Applied Chemistry, College of Applied Science, University of Samarra, Iraq

AkiNik Publications®
New Delhi

Published By: *AkiNik Publications*

AkiNik Publications
169, C-11, Sector - 3,
Rohini, Delhi-110085, India
Toll Free (India) – 18001234070
Phone No.: 9711224068, 9911215212
Website: www.akinik.com
Email: akinikbooks@gmail.com

Editors: *Noora Falah Abd Al Hassn Haban, Ahmed Omer Ismail Khalaf, Zainab Saleem Abdulrasool Hassoon and Dawood Salim Mohammed Hussein*

Publication Year: *2024*

Edition: *1st*

Pages: *21*

E-book ISBN: *978-93-6135-672-8*

Paperback ISBN: *978-93-6135-095-5*

Book DOI: *https://doi.org/10.22271/10.22271/ed.book.2842*

Price: *₹175/-*

Registration Details

- *Printing Press License No.: F.1 (A-4) press 2016*
- *Trade Mark Registered Under*
  - *Class 16 (Regd. No.: 5070429)*
  - *Class 35 (Regd. No.: 5070426)*
  - *Class 41 (Regd. No.: 5070427)*
  - *Class 42 (Regd. No.: 5070428)*

Contents

Chapter - 1

Introduction

1.1 Introduction

A solute is a liquid or gas that dissolves solid, liquid, or gaseous solutes to produce a solution.

Water is the most common solvent in daily life. Most other commonly used solvents are organic chemicals (i.e. contain carbon and hydrogen), and these solvents are called organic solvents. Solvents generally have a low boiling point and evaporate easily or can be isolated by distillation, leaving behind the solutes.

To distinguish between solvents and solutes, solvents are usually present in large proportions. Solvents can be used to extract soluble substances from the dissolved substance. The closest example of this is boiling coffee or tea in water. Solvents are usually clear, colorless liquids and most have a distinct odor.

As for the solute, its percentage is usually small in the solution, such as a salt solution, where salt represents the solute and water is the solvent.

The concentration of a solution is the amount of solute in a given volume of solvent and can be estimated as grams/liter or mol/liter. Solubility is defined as the maximum amount of a compound soluble in a given volume of solvent at a given temperature.

Organic solvents are generally used in dry cleaning (e.g. tetrachloroethylene), as paint extenders (e.g. toluene, turpentine), as nail polish removers and glue solvents (e.g. acetone, methyl acetate, ethyl acetate), and as stain removers (e.g. hexane, petroleum ether), in detergents (limonene), in perfume (ethanol), and in chemical synthesis. The use of inorganic solvents other than water is limited to chemical research and some technical processes.

In 2005, the global solvents market reached a total volume 17.9 million tons with revenues amounting to approximately 8 billion euros.

Solvents are divided into two types, inorganic solvents and inorganic solvents. Other than water, most solvents used are organic solvents. The

solvent must be inert relative to the solute so that a reaction does not occur and produce new compounds).

1.2 Solvent properties

Solvents are divided into polar solvents, divided into protonated polar solvents and non-protonated polar solvents. Protonated polar solvents contain a positively charged hydrogen ion and can give it away to help dissolve. Examples of protonated polar solvents include compounds containing hydrogen combined with oxygen, such as water or amines.

1.3 Solvent classification

- We generally divide solvents into three main types, which are [1]:
- Molecular structure of solvents: They include three types: (protonated solvents, non-protonated dipolar solvents, and non-polar solvents).
- Inorganic solvents: They are inorganic solvents, that is, they do not contain a carbon atom, and the most famous of them is the water molecule H_2O, which is considered a universal inorganic solvent, and aqueous solutions such as buffer solutions that are fair to the pH, and also include liquid non-aqueous ammonia NH_3. Concentrated sulfuric acid, H_2SO_4, as well as a solution of sulfonyl chloride fluoride (SO_2ClF)

Organic solvents: As for organic solvents; It includes solvents containing a carbon atom.

Common Solvents

Name [CAS Number]	Molecular Formula	Structure	Formula Weight	Boiling Point °C	Density g/mL
acetic acid [64-19-7]	$C_2H_4O_2$		60.05	116–118	1.05
acetic anhydride [108-24-7]	$C_4H_6O_3$		102.09	138–140	1.08
acetone [67-64-1]	C_3H_6O		58.08	55–56	0.79
acetonitrile [75-05-8]	C_2H_3N	CH_3CN	41.05	80–81	0.79
1-butanol [71-36-3]	$C_4H_{10}O$		74.12	117	0.81
carbon tetrachloride [56-23-5]	CCl_4	CCl_4	153.82	76–77	1.59
chloroform [67-66-3]	$CHCl_3$	$CHCl_3$	119.38	60–62	1.49
dichloromethane methylene chloride [75-09-2]	CH_2Cl_2	CH_2Cl_2	84.93	39–40	1.32
diethyl ether [60-29-7]	$C_4H_{10}O$		74.12	35	0.71
N,N-dimethylformamide [68-12-2]	C_3H_7NO		73.10	152–153	0.95
dimethyl sulfoxide [67-68-5]	C_2H_6OS		78.14	189	1.10
1,4-dioxane [123-91-1]	$C_4H_8O_2$		88.11	100–101	1.03
1,3-dioxolane [646-06-0]	$C_3H_6O_2$		74.08	74–75	1.06
ethanol [64-17-5]	C_2H_6O		46.07	78	0.79
ethyl acetate [141-78-6]	$C_4H_8O_2$		88.11	76–77	0.90
n-hexane* [110-54-3]	C_6H_{14}		86.18	68–69	0.66
methanol [67-56-1]	CH_4O	CH_3OH	32.04	64–65	0.79
n-pentane [109-66-0]	C_5H_{12}		72.15	35–36	0.63
1-propanol [71-23-8]	C_3H_8O		60.10	96–97	0.80
2-propanol [67-63-0]	C_3H_8O		60.10	80–83	0.78
tetrahydrofuran [109-99-9]	C_4H_8O		72.11	65–67	0.89
toluene [108-88-3]	C_7H_8		92.14	110-111	0.87
water [7732-18-5]	H_2O	H_2O	18.02	100	1.00

* The term **hexanes** refers to a mixture of hexane isomers that has a density of 0.67.

1.4 Solutions and Decomposition

When one substance dissolves in another, what is called a solution [4] is formed. It is the opposite of the concept of a mixture, where one compound is added to another and no chemical bonds are formed. To visualize the difference between a mixture and a solution, one can imagine a cup of water with mixed sand versus a cup of water containing some carbonate, for

example, where all the contents are homogeneous and form a new substance, and no sediment remains at the bottom of the cup.

Mixability is referred to as miscibility, while the ability of one compound to dissolve in another is referred to as solubility. The difference between dissolution and dissolution is the formation of bonds between components in a state of dissolution, and here comes the definition of dissolution that describes this interaction. When something dissolves, the solvent molecules arrange themselves around the molecules of the dissolved object. Heat is released and the temperature increases, making the solution more thermodynamically stable than the solute alone. This arrangement depends on the chemical properties of the solvent and solute, such as hydrogen bonds, dipole moments and molecular polarizabilities [5].

1.5 Class of solvents

Solvents can be classified into two categories: polar and nonpolar. The dielectric constant generally gives a rough measure of the polarity of the solvent. Solvents with a dielectric constant of less than 15 are generally nonpolar solvents. The dielectric constant measures the ability of a solvent to decrease the strength of the electric field surrounding charged particles in a vacuum. In Laymen's terms, the dielectric constant of a solvent can be considered its ability to decrease the internal charge of the solute [6].

1.6 Solvent effects

Boiling point

Boiling point determines the speed of evaporation. Small amounts of low-boiling-point solvents, such as diethyl ether, dichloromethane, or acetone, will evaporate within seconds at room temperature, while high-boiling-point solvents, such as water or dimethyl sulfoxide, require high temperatures, air flow, or Apply vacuum for rapid evaporation [1].

Density

Most organic solvents have a low density relative to water. This means that they are lighter than water and form a separate layer above the water if they are together. There are exceptions: many halogenated solvents such as dichloromethane or chloroform will sink to the bottom of the vessel, leaving water in the upper layer. The density feature is very important when separating solvents from water using a separating funnel during chemical synthesis. It also has the ability to mix.

Solvent free energy

Solvent free energy is energy released when the ions of a crystal engage molecules in solution [2].

1.7 For health and safety

The fire

Most organic solvents are flammable or highly flammable, depending on their volatility. There are some exceptions, such as chlorinated solvents such as dichloromethane and chloroform. The mixture of solvent vapors and air can explode. Solvent vapors are heavier than air, meaning that the vapors will sink to the bottom and can travel great distances almost without expanding. Virtually solvent vapors can also be found in empty cans and drums, posing a sudden fire hazard, so empty containers of volatile solvents should be stored open and upside down.

Diethyl ether and carbon disulfide have very low autoignition temperatures, which greatly increases the fire risks associated with these solvents. The autoignition temperature of carbon disulfide is less than 100°C.

Health effects

Effects

Inhaling solvents may produce a feeling of euphoria or an 'excitement rush' similar to what an intoxicated person feels. The effects of the solvent usually go away after about half an hour. You may appear intoxicated and suffer from slurred speech, staggering, hysterical laughter, and an inability to control yourself. You may then feel sleepy.

Side effects

Your judgment may be affected and you may exhibit aggressive tendencies. Hallucinations, vomiting, and bouts of temporary loss of consciousness are also common. Using solvents usually leaves you with unfavorable effects, including headaches and poor concentration.

Risks

Death from solvent misuse is rare, but it may occur for a number of reasons and may occur the first time you use a solvent. Under the influence of solvents, you are more susceptible to accidents. You may also choke - on the solvent you spray into your lungs, during vomiting, or on materials you use to help you inhale the solvent [3].

Chapter - 2

Organic Solvent

2.1 Organic solvent

An organic solvent [1] is a substance capable of dissolving another substance in it without affecting the chemical properties of both substances, as the liquid substance here is called (the solvent), and the solid substance is called (the solute).

Organic solvents are carbon-based substances capable of dissolving or dispersing one or more other substances. Organic solvents can be carcinogens, reproductive hazards, and neurotoxins. Carcinogenic organic solvents include benzene, carbon tetrachloride, and trichloroethylene.

Organic solvents recognized as reproductive hazards include 2-ethoxyethanol, 2-methoxyethanol, and methyl chloride. Organic solvents recognized as neurotoxins include n-hexane, tetrachloroethylene, and toluene. Many classes of chemicals are used as organic solvents, including aliphatic hydrocarbons, aromatic hydrocarbons, amines, esters, ethers, ketones, and nitrated or chlorinated hydrocarbons.

Organic solvents are used in many industries. They are used in paints, varnishes, lacquers, adhesives, glues, and in degreasing and cleaning agents, and in the production of dyes, polymers, plastics, textiles, printing inks, agricultural products, and pharmaceuticals. Millions of U.S. workers are exposed to organic solvents. The level of exposure depends upon the dose, duration, and work being done [1].

2.2 Common organic solvents: Table of Properties [6, 7, 8, 9]

Acetic Acid
Formula $C_2H_4O_2$
Boiling point (°C) 118
Melting point(°C) 16.6
Density (g/mL) 1.0446
Solubility in water (g/100g) miscible
Dielectric Constant[3] 6.20
Flash point (°C) 39

Acetone
Formula C_3H_6O
Boiling point (°C). 56.05
Melting point (°C). -94.7
Density (g/mL). 0.7845
Solubility in water (g/100g). Miscible
Dielectric Constant [3]. 21.01
Flash point (°C). -20

Acetonitrile
Formula C_2H_3N
Boiling point (°C). 81.65
Melting point (°C). -43.8
Density (g/mL). 0.7857
Solubility in water (g/100g). Miscible
Dielectric Constant[3] 36.64
Flash point (°C). 6

Benzene
Formula C_6H_6
Boiling point (°C). 80.1
Melting point (°C). 5.5
Density (g/mL). 0.8765
Solubility in water (g/100g). 0.18
Dielectric Constant[3]. 2.28
Flash point (°C). -11

Butanol
Formula $C_4H_{10}O$
Boiling point (°C). 99.5
Melting point (°C). -88.5
Density (g/mL). 0.8063
Solubility in water (g/100g). 15
Dielectric Constant[3] 17.26
Flash point (°C). 24

2-Butanone
Formula C_4H_8O
Boiling point (°C). 79.6
Melting point (°C). -86.6
Density (g/mL). 0.7999
Solubility in water (g/100g). 25.6
Dielectric Constant[3] 18.6
Flash point (°C). -9

T-Butyl alcohol
Formula $C_4H_{10}O$
Boiling point (°C). 82.4
Melting point (°C). 25.7
Density (g/mL). 0.7887
Solubility in water (g/100g). Miscible
Dielectric Constant[3]. 12.5
Flash point (°C). 11

Carbon Tetrachloride
Formula CCl_4
Boiling point (°C). 76.8
Melting point (°C). -22.6
Density (g/mL). 1.594
Solubility in water (g/100g). 0.08
Dielectric Constant[3] 2.24
Flash point (°C). ____

Chlorobenzene
Formula C_6H_5Cl
Boiling point (°C). 131.7
Melting point (°C). -45.3
Density (g/mL). 1.1058
Solubility in water (g/100g). 0.05
Dielectric Constant[3] 5.69
Flash point (°C). 28

Chloroform.
Formula $CHCl_3$

Boiling point (°C). 61.2
Melting point (°C). -63.4
Density (g/mL). 1.4788
Solubility in water (g/100g). 0.795
Dielectric Constant[3] 4.81
Flash point (°C). _____

Cyclohexane
Formula C_6H_{12}.
Boiling point (°C). 61.2
Melting point (°C). -63.4
Density (g/mL). 1.4788
Solubility in water (g/100g). 0.795
Dielectric. Constant[3] 4.81
Flash point (°C). _____

Dichloroethane
Formula $C_2H_4C_{l2}$
Boiling point (°C). 83.5
Melting point (°C). -35.7
Density (g/mL). 1.245
Solubility in water (g/100g). 0.861
Dielectric. Constant[3]. 10.42
Flash point (°C). 13

Diethylene Glycol
Formula $C_4H_{10}O_3$
Boiling point (°C). 246
Melting point (°C). -10
Density (g/mL). 1.1197
Solubility in water (g/100g). 10
Dielectric. Constant[3]. 31.8
Flash point (°C). 124

Diethyl Ether
Formula $C_4H_{10}O$
Boiling point (°C). 34.5

Melting point (°C). -116.2
Density (g/mL). 0.713
Solubility in water (g/100g). 7.5
Dielectric. Constant[3]. 4.267
Flash point (°C). -45

Diglyme (Diethylene glycol dimethyl ether)
Formula. $C_6H_{14}O_3$
Boiling point (°C). 162
Melting point (°C). -68
Density (g/mL). 0.943
Solubility in water (g/100g). Miscible
Dielectric .Constant[3]. 7.23
Flash point (°C). 67

Dimethoxy Ethane (glyme, DME)
Formula. $C_4H_{10}O_2$
Boiling point (°C). 84.5
Melting point (°C). -69.2
Density (g/mL). 0.8637
Solubility in water (g/100g). Miscible
Dielectric. Constant[3]. 7.3
Flash point (°C). -2

Dimethyl formamide (DMF)
Formula. C_3H_7NO
Boiling point (°C). 153
Melting point (°C). -60.48
Density (g/mL). 0.9445
Solubility in water (g/100g). Miscible
Dielectric. Constant[3] 38.25
Flash point (°C) 58

Dimethyl sulfoxide (DMSO)
Formula C_2H_6OS
Boiling point (°C). 189
Melting point (°C). 18.4

Density (g/mL). 1.092
Solubility in water (g/100g). Miscible
Dielectric .Constant[3]. 47
Flash point (°C). 95

Dioxane
Formula. $C_4H_8O_2$
Boiling point (°C). 101.1
Melting point (°C). 11.8
Density (g/mL). 1.033
Solubility in water (g/100g). Miscible
Dielectric .Constant[3] 2.21(25)
Flash point (°C). 12

Ethanol
Formula C_2H_6O
Boiling point (°C). 78.5
Melting point (°C). -114.1
Density (g/mL). 0.789
Solubility in water (g/100g). Miscible
Dielectric. Constant[3]. 24.6
Flash point (°C). 13

Ethyl acetate
Formula $C_4H_8O_2$
Boiling point (°C). 77
Melting point (°C). -83.6
Density (g/mL). 0.895
Solubility in water (g/100g). 8.7
Dielectric. Constant[3]. 6(25)
Flash point (°C). -4

Ethylene Glycol.
Formula $C_2H_6O_2$
Boiling point (°C). 195
Melting point (°C). -13
Density (g/mL). 1.115

Solubility in water (g/100g). Miscible
Dielectric. Constant[3]. 37.7
Flash point (°C). 111

Glycerin
Formula. $C_3H_8O_3$
Boiling point (°C). 290
Melting point (°C). 17.8
Density (g/mL). 1.261
Solubility in water (g/100g). Miscible
Dielectric. Constant[3]. 42.5
Flash point (°C). 160

Heptane.
Formula C_7H_{16}
Boiling point (°C). 98
Melting point (°C). -90.6
Density (g/mL). 0.684
Solubility in water (g/100g). 0.01
Dielectric .Constant[3]. 1.92
Flash point (°C. -4

Hexamethylphosphoramide HMPA
Formula $C_6H_{18}N_3OP$
Boiling point (°C). 232.5
Melting point (°C). 7.2
Density (g/mL). 1.03
Solubility in water (g/100g). Miscible
Dielectric. Constant[3]. 31.3
Flash point (°C). 105

Hexamethylphosphoroustriamide (HMPT)
Formula. $C_6H_{18}N_3P$
Boiling point (°C). 150
Melting point (°C). -44
Density (g/mL). 0.898
Solubility in water (g/100g). Miscible

Dielectric .Constant[3]. _____
Flash point (°C). 26

Hexane
Formula. C_6H_{14}
Boiling point (°C). 69
Melting point (°C). -95
Density (g/mL). 0.659
Solubility in water (g/100g). 0.0014
Dielectric. Constant[3]. 1.89
Flash point (°C). -22

Methanol
Formula CH_4O
Boiling point (°C). 64.6
Melting point (°C). -98
Density (g/mL). 0.791
Solubility in water (g/100g). Miscible
Dielectric Constant[3]. 32.6(25)
Flash point (°C). 12

Methyl T-Butyl Ether (MTBE)
Formula $C_5H_{12}O$
Boiling point (°C). 55.2
Melting point (°C). -109
Density (g/mL). 0.741
Solubility in water (g/100g). 5.1
Dielectric .Constant[3]. _____
Flash point (°C). -28

Methylene Chloride
Formula CH_2Cl_2
Boiling point (°C). 39.8
Melting point (°C). -96.7
Density (g/mL). 1.326
Solubility in water (g/100g). 1.32
Dielectric .Constant[3]. 9.08
Flash point (°C). _____

(N-methyl-2-pyrrolidinone NMP)
Formula CH_5H_9NO
Boiling point (°C). 202
Melting point (°C). -24.
Density (g/mL). 1.033.
Solubility in water (g/100g). Miscible
Dielectric .Constant[3]. 32
Flash point (°C). 91

Nitromethane
Formula. CH_3NO_2
Boiling point (°C). 101.2
Melting point (°C). -29
Density (g/mL). 1.382
Solubility in water (g/100g). 9.50
Dielectric .Constant[3]. 35.9
Flash point (°C). 35

Pentane
Formula C_5H_{12}
Boiling point (°C). 36.1
Melting point (°C). -129.7
Density (g/mL). 0.626
Solubility in water (g/100g). 0.04
Dielectric .Constant[3]. 1.84
Flash point (°C). -49

Petroleum Ether (ligroine)
Formula _____
Boiling point (°C). 30-60
Melting point (°C). -40
Density (g/mL). 0.656
solubility in water(g/100g) ____
Dielectric. Constant[3] _____
Flash point (°C). -30

Propanol
Formula C_3H_8O
Boiling point (°C). 97
Melting point (°C). -126
Density (g/mL). 0.803
Solubility in water (g/100g). Miscible
Dielectric .Constant[3]. 20.1(25)
Flash point (°C). 22

Propanol
Formula C_3H_8O
Boiling point (°C). 82.4
Melting point (°C). -88.5
Density (g/mL). 0.785
Solubility in water (g/100g). Miscible
Dielectric .Constant[3]. 18.3(25)
Flash point (°C). 12

Pyridine
Formula C_5H_5N
Boiling point (°C). 115.2
Melting point (°C). -41.6
Density (g/mL). 0.982
Solubility in water (g/100g). Miscible
Dielectric .Constant[3]. 12.3(25)
Flash point (°C). 17

Tetrahydrofuran (THF)
Formula C_4H_8O
Boiling point (°C). 65
Melting point (°C). -108.4
Density (g/mL). 0.8833
Solubility in water (g/100g). soluble[2]
Dielectric. Constant[3]. 7.52
Flash point (°C). -14

Toluene
Formula C_7H_8
Boiling point (°C). 110.6
Melting point (°C). -93
Density (g/mL). 0.867
Solubility in water (g/100g). 0.05
Dielectric. Constant[3]. 2.38(25)
Flash point (°C). 4

Triethyl Amine
Formula $C_6H_{15}N$
Boiling point (°C). 88.9
Melting point (°C). -114.7
Density (g/mL). 0.728
Solubility in water (g/100g). 0.02
Dielectric .Constant[3]. 2.4
Flash point (°C). -11

Water
Formula. H_2O
Boiling point (°C). 100.00
Melting point (°C). 0.00
Density (g/mL). 0.998
Solubility in water (g/100g). ------
Dielectric. Constant[3]. 78.54
Flash point (°C). _____

Water, Heavy
Formula D_2O
Boiling point (°C). 101.3
Melting point (°C). 4
Density (g/mL). 1.107
Solubility in water (g/100g). Miscible
Dielectric Constant. _____
Flash point (°C). _____

O-xylene
Formula. C_8H_{10}
Boiling point (°C). 144
Melting point (°C). -25.2
Density (g/mL). 0.897
Solubility in water (g/100g). Insoluble
Dielectric .Constant[3]. 2.57
Flash point(°C). 32

M-xylene
Formula. C_8H_{10}
Boiling point (°C). 139.1
Melting point (°C). -47.8
Density (g/mL). 0.868
Solubility in water (g/100g). Insoluble
Dielectric. Constant[3]. 2.37
Flash point (°C). 27

P-xylene
Formula C_8H_{10}
Boiling point (°C). 138.4
Melting point (°C). 13.3
Density (g/mL). 0.861
Solubility in water (g/100g). Insoluble
Dielectric. Constant[3]. 2.27
Flash point (°C). 27

2.3 Uses of organic solvents

1) Organic solvents of various types are used in the industrial field on a very wide and comprehensive scale, such as.
2) Manufacture of petroleum materials and important petroleum products.
3) Manufacture of some purposes for extracting mineral elements from natural raw materials.
4) Organic solvents are also used to increase the purity of various materials by purifying them of some impurities by dissolving them.
5) The manufacture of therapeutic drugs depends mainly on dissolving some substances in others and obtaining solutions with specific

concentrations and then using them in the manufacture and preparation of medicines. Organic solvents come among the list of the most important solvents widely used in the field of the drug industry and pharmacy.

6) Organic solvents are also relied upon mainly to conduct experiments and chemical reactions for scientific research, experiments and studies in order to discover modern and more effective industrial and pharmaceutical therapeutic elements and materials.
7) Manufacture of colors and materials of different colors for use in paint and coatings.
8) Organic solvents are also used in the manufacture of cleaning materials and various cleaning fluids, and in the manufacture of liquid materials used in photography, such as thinners, which consist mainly of ketones, alcohols, and esters.
9) These materials are also used in the manufacture of glue, dyeing, floor covering products, and others [18].

2.4 Properties of organic solvents

Organic solvents have a large number of important properties that are not provided by any other types of solvents, such as: [19, 20].

Volatile substances

All organic solvents are volatile, that is, their molecules disperse widely in the surrounding space, an example of this is when you open a perfume bottle or a paint bottle; You will find that there is a pungent smell coming from it immediately, and this applies to most organic solvents to varying degrees, of course, according to the nature and concentration of each substance.

Low boiling point

All organic solvents have a low boiling point, and it is stated that the boiling point is inversely proportional to the degree of volatility, therefore; The lower the boiling point, the greater the degree of volatility. This, of course, shows that all organic solvents have a high degree of volatility as a result of the low degree of reaching the boiling point and evaporation.

Highly flammable

It is noteworthy that organic solvents are also highly flammable, and therefore; Caution must be exercised when using them for daily, frequently used items such as perfumes, paint, some medicines, detergents, and others, and not to expose them to any sources of ignition, whether water or the burning rays of the sun, so that they do not ignite and cause severe damage.

Dissolving inorganic materials

Organic solvents work to dissolve a huge and infinite number of inorganic substances, especially those in the solid state. However, organic solvents are also capable of dissolving fats. Here are some of the types of these natural solvents found in the body, and some of them are manufactured by humans.

2.5 Types of organic solvents

Organic solvents are mainly divided into two main sections:

Oxygenated solvents

Oxygenated solvents include all solvents that contain oxygen. These oxygenated solvents are widely used in the manufacture of ink, paints, perfumes, adhesives, cosmetics, medicines, food industries, detergents, and others. The most famous of them are: (alcohols, methyl and ethyl acetates, ketones, esters, and others).

Hydrocarbon solvents

As for hydrocarbon solvents, they include solvents that contain only carbon and hydrogen atoms, and are divided into and other types such as:

- **Aliphatic hydrocarbon solvents:** They are straight chain and include gasoline, kerosene, hexate, and others.
- **White spirit solvents:** Known as white spirit or mineral spirit, they are a group of complex hydrocarbons such as organic and paraffinic compounds.
- **Aromatic solvents:** They are hydrocarbon solvents containing benzene rings, including, of course, benzene, toluene, xylene, and others.

Halogenated solvents

Halogenated or halogenated solvents; It is a solvent organic compound that contains one or more halogen atoms, such as chlorine, fluorine, bromine, or iodine. The most famous of these solvents are: trichlorethylene, methylene chloride, carbon chloride, trichloroethane, dichlorofluoromethane, hydrochlorofluorocarbon, Freon (dichloroethane). Fluorochloromethane), ethylene dibromide, bromomethane, ethyl iodide, methyl iodide, and others [18].

2.6 Dangerous to health

Many types of organic solvents are very dangerous to health and may sometimes lead to sudden cardiac or cerebral arrest. They greatly affect the

nervous system, the digestive system, and the respiratory system, and their ignition may lead to very serious burns. Therefore, care must be taken as much as possible to do not inhale various organic substances and solvents that pose a high degree of danger to humans, including benzene and other substances that cause extremely harmful and dangerous health disorders, such as:

- Spinal cord atrophy
- Severe anemia
- Weak body immunity
- Poisoning
- Fluidity and slow wound healing
- Dry throat, shortness of breath, and cough
- Abdominal pain, cramps and diarrhea
- Lethargy and suffocation

And therefore, Given the importance of organic solvents and the danger of many of them at the same time; Every person must adhere to preventive measures and safety factors when using them, whether in laboratories, factories, homes, or any other place. Hands must also be cleansed well after coming into contact with some of these solvents, making sure they do not reach any parts of the body, such as the respiratory or digestive system. Or others in general.

References

1. Market Study Solvents from Ceresana Research.
2. Solvent Properties - Boiling Point.
3. Tinoco I, Sauer K, Wang JC, Puglisi JD. Physical Chemistry. Prentice Hall; 2002.
4. Lowery TH, Richardson KS. Mechanism and Theory in Organic Chemistry. 3rd ed. Harper Collins Publishers; 1987. p. 181-183.
5. Lowery TH, Richardson KS. Mechanism and Theory in Organic Chemistry. 3rd ed. Harper Collins Publishers; 1987. p. 177.
6. Myers BJ. Organic solvent table. ACS Division of Organic Chemistry (DOC); 2005. Adapted from Professor Murov's Organic Solvent Table.
7. CRC Handbook of Chemistry and Physics. 87th ed.; Vogel's Practical Organic Chemistry. 5th ed.
8. PubChem. Solubilities are in water and are reported as grams solvent/100 grams water. T = 20 °C unless specified otherwise.
9. PubChem. Solvent guides for following Green Chemistry principles. Available at: https://organicchemistrydata.org/gcipr/
10. Van KV, Ward J. DOC's Organic Chemistry Data Website; 2020. Table formatted and sorting added.
11. ACS Organic Division. PDF version available.
12. ACS Organic Division. Contact for questions or comments.
13. ACS Organic Division. Page updated August 9, 2020.
14. ACS Organic Division. Water solubility corrected October 2021.
15. ACS Division of Organic Chemistry. © 2022.
16. Covington A. Physical Chemistry of Organic Solvent Systems. 2012.
17. Lide DR. Properties of Organic Solvents. 1996.
18. Knochel P. Modern Solvents in Organic Synthesis. 2003.