

# CLASSIFICATION OF SOLVENTS

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**Solvent** is a liquid substance capable to dissolve other substances (solutes) without chemical changes.

- ☐ **Molecular structure of solvents**
- ☐ **Inorganic solvents**
- ☐ **Organic solvents**

## Molecular structure of solvents

Ability of a substance to dissolve another substance is determined by compatibility of their molecular structures (like dissolves like).

Types of molecular structures of the solvents are as follows:

### ☐ **Polar protic solvents**

A polar protic molecule consists of a polar group OH and a non-polar tail. The structure may be represented by a formula R-OH. Polar protic solvents dissolve other substances with polar protic molecular structure. Polar protic solvents are miscible with water (hydrophilic).

Examples of polar protic solvents: water (H-OH), acetic acid (CH<sub>3</sub>CO-OH), methanol (CH<sub>3</sub>-OH), ethanol (CH<sub>3</sub>CH<sub>2</sub>-OH), n-propanol (CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>-OH), n-butanol (CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>-OH).

### ☐ **Dipolar aprotic solvents**

Dipolar aprotic molecules possess a large **bond dipole moment** (a measure of polarity of a molecule chemical bond). They do not contain OH group.

Examples of dipolar aprotic solvents: acetone ( (CH<sub>3</sub>)<sub>2</sub>C=O ), ethyl acetate (CH<sub>3</sub>CO<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>), dimethyl sulfoxide ( (CH<sub>3</sub>)<sub>2</sub>SO ), acetonitrile (CH<sub>3</sub>CN), dimethylformamide ( (CH<sub>3</sub>)<sub>2</sub>NC(O)H ).

### ☐ **Non-polar solvents**

Electric charge in the molecules of non-polar solvents is evenly distributed, therefore the molecules have low dielectric constant. Non-polar solvents are hydrophobic (immiscible with water). Non-polar solvents are lipophilic as they dissolve non-polar substances such as oils, fats, greases.

Examples of non-polar solvents: carbon tetrachloride (CCl<sub>4</sub>), benzene (C<sub>6</sub>H<sub>6</sub>), and diethyl ether ( CH<sub>3</sub>CH<sub>2</sub>OCH<sub>2</sub>CH<sub>3</sub> ), hexane (CH<sub>3</sub>(CH<sub>2</sub>)<sub>4</sub>CH<sub>3</sub>), methylene chloride (CH<sub>2</sub>Cl<sub>2</sub>).

## Inorganic solvents

The most popular inorganic (not containing carbon) solvents are water (H<sub>2</sub>O) and aqueous solutions containing special additives (surfactants, detergents, PH buffers, inhibitors). Other inorganic solvents are liquid anhydrous Ammonia (NH<sub>3</sub>), concentrated sulfuric acid (H<sub>2</sub>SO<sub>4</sub>), sulfuryl chloride fluoride (SO<sub>2</sub>ClF).

## Organic solvents

- ☐ **Oxygenated solvents**

Oxygenated solvent is an organic solvent, molecules of which contain oxygen. Oxygenated solvents are widely used in the paints, inks, pharmaceuticals, fragrance sectors, adhesives, cosmetics, detergents, food industries.

Examples of oxygenated solvents: alcohols, glycol ethers, methyl acetate, ethyl acetate, ketones, esters, and glycol ether/esters.

#### ☐ **Hydrocarbon solvents**

Molecules of hydrocarbon solvents consist only of Hydrogen and carbon atoms.

##### *-Aliphatic solvents*

Molecules of aliphatic solvents have straight-chain structure.

Hexane, gasoline, kerosene are aliphatic solvents.

##### *-White spirits (mineral turpentine spirits)*

White spirit is a mixture of aromatic and paraffinic hydrocarbons.

##### *-Pure aromatic solvents*

Molecules of pure aromatic solvents have benzene ring structure.

Examples of pure aromatic solvents are benzene, toluene and xylene.

#### ☐ **Halogenated solvents**

Halogenated solvent is an organic solvent, molecules of which contain halogenic atoms: chlorine (Cl), fluorine (F), bromine (Br) or iodine (I).

Accordingly to the type of halogen halogenated solvents are classified into the following categories:

##### *-Chlorinated solvents*

The common chlorinated solvents are trichlorethylene ( $\text{ClCH-CCl}_2$ ), perchlorethylene (tetrachlorethylene,  $\text{Cl}_2\text{C-CCl}_2$ ), methylene chloride ( $\text{CH}_2\text{Cl}_2$ ), carbon tetrachloride ( $\text{CCl}_4$ ), chloroform ( $\text{CHCl}_3$ ), 1,1,1-trichlorethane (methyl chloroform,  $\text{CH}_3\text{-CCl}_3$ ).

##### *-Fluorocarbon solvents*

Examples of fluorocarbon solvents: dichlorofluoromethane (freon 21,  $\text{CHCl}_2\text{F}$ ), trichlorofluoromethane (freon 11,  $\text{CCl}_3\text{F}$ ), tetrafluoromethane (freon 14,  $\text{CF}_4$ ), difluorodichloromethane (freon 12,  $\text{CHCl}_2\text{F}_2$ ), hydrochlorofluorocarbon (freon 22, HCFC).

##### *Brominated solvents*

Examples of brominated solvents: ethylene dibromide (1,2-dibromoethane,  $\text{BrCH}_2\text{-CH}_2\text{Br}$ ), methylene chlorobromide (bromochloromethane,  $\text{CH}_2\text{BrCl}$ ), methyl bromine (bromomethane,  $\text{CH}_3\text{Br}$ ).

##### *Iodinated solvents*

Examples of iodinated solvents: n-butyl iodide (1-iodobutane,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{I}$ ), methyl iodide (iodomethane,  $\text{CH}_3\text{I}$ ), ethyl iodide (iodoethane,  $\text{C}_2\text{H}_5\text{I}$ ), n-propyl iodide (1-iodopropane,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{I}$ ).

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