

HALOGENATED SOLVENTS

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

- ☐ **Chlorinated solvents**
- ☐ **Fluorocarbon solvents**
- ☐ **Brominated solvents**
- ☐ **Iodinated solvents**
- ☐ **Properties of some halogenated solvents**

Chlorinated solvents

- ☐ The common chlorinated solvents are Trichlorethylene (CICH- CCl_2), Perchlorethylene (tetrachlorethylene, $\text{Cl}_2\text{C}-\text{CCl}_2$), Methylene chloride (CH_2Cl_2), Carbon tetrachloride (CCl_4), Chloroform (CHCl_3), 1,1,1-trichloroethane (methyl chloroform, CH_3-CCl_3). Chlorinated solvents are the most popular halogenated solvents.
- ☐ Chlorinated solvents are used in dry cleaning, metal cleaning, degreasing, automotive aerosols, printing, paper and textile industries, paint removal, furniture industry, Thermoplastics production.
- ☐ Health effect of chlorinated solvents:

They may affect central nervous system, kidneys and liver, cause dermatitis and irritation of skin, eyes, upper respiratory tract and mucous membranes.

Over-exposure in poorly ventilated space may lead to depression, headache, sleepiness, unconsciousness and even death.

Some chlorinated solvents cause cancer in rats and mice at high exposure levels.

According to the National Institute for Occupational Safety (NIOSH), National Toxicology Program (NTP), International Agency for Research on Cancer (IARC) and American Conference of Governmental Industrial Hygienists (ACGIH):

- Trichlorethylene is a suspect carcinogen;
- Perchlorethylene is not classified as carcinogen;
- Methylene chloride is a potential carcinogen (ACGIH);
- Carbon tetrachloride is a suspect carcinogen, carcinogen Cat. 3 (ACGIH);
- Chloroform is a suspect carcinogen;
- 1,1,1-Trichloroethane is not listed as carcinogen.

- ☐ Environmental effect of chlorinated solvents:

Vapors of chlorinated solvent degrade in the atmosphere for a period between one week (trichloroethylene) to 5-6 months (perchloroethylene and methylene chloride).

Ozone Depletion Potential (ODP) of carbon tetrachloride and chloroform is high (more than 0.2) and their use is forbidden. ODP of trichloroethylene, perchloroethylene and methylene chloride is low and they are not regulated by the Montreal Protocol.

Spillage of chlorinated solvents to soil or water cause contamination. Methylene chloride is biodegradable. Other chlorinated solvents degrade only after reevaporation to the atmosphere.

Contributions of chlorinated solvents to global warming, acid rain production and smog formation are low.

Fluorocarbon solvents

- ☐ Examples of fluorocarbon solvents: Dichlorofluoromethane (freon 21, CHCl_2F), Trichlorofluoromethane (Freon 11, CCl_3F), Tetrafluoromethane (Freon 14, CF_4), Difluorodichloromethane (Freon 12, CHCl_2F_2), Hydrochlorofluorocarbon (Chlorodifluoromethane, Freon 22, CHClF_2).
- ☐ Fluorocarbon solvents are widely used as refrigerants.
- ☐ Health effect of fluorocarbon solvents: They may cause heart damage, dizziness, headache, nausea.
- ☐ Environmental effect of fluorocarbon solvents: Some of fluorocarbon solvents (freon 11, freon 21) are forbidden in most countries because of their high ozone depletion potential (Montreal Protocol).

Brominated solvents

- ☐ Examples of brominated solvents: Ethylene Dibromide (1,2-dibromoethane, $\text{BrCH}_2\text{-CH}_2\text{Br}$), methylene chlorobromide (bromochloromethane, CH_2BrCl), methyl bromine (bromomethane, CH_3Br).
- ☐ Brominated solvents are used as additives in leaded gasoline, soil sterilants, for manufacturing pesticides and fumigants.
- ☐ Health effect of brominated solvents: They affect liver and kidneys, cause dermatitis and irritation of skin, eyes, upper respiratory tract and mucous membranes.

Inhaling brominated solvents may cause dizziness, weakness, depression, headache, sleepiness.

- ☐ Environmental effect of brominated solvents: Some of brominated solvents (methylene chlorobromide, methyl bromine) are forbidden in most countries because of their high ozone depletion potential (Montreal Protocol).

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, CH_3I), ethyl iodide (iodoethane, $\text{C}_2\text{H}_5\text{I}$), n-propyl iodide (1-iodopropane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{I}$).

- ☐ Iodinated solvents are used as intermediates for numerous chemicals, dyes, fumigants, X-ray contrast media, antiseptics, insecticides, quaternary ammonium compounds, flavors and fragrances and pharmaceuticals, in microscopy and in testing for pyridine.
- ☐ Health effect of iodinated solvents: They are suspected carcinogen and may cause irritation of skin and eyes.

Properties of some halogenated solvents

(Materials Data)

- ☐ Trichlorethylene
- ☐ Perchlorethylene
- ☐ Methylene chloride
- ☐ Carbon tetrachloride
- ☐ Chloroform
- ☐ 1,1,1-trichloroethane
- ☐ Trichlorofluoromethane
- ☐ Difluorodichloromethane
- ☐ Tetrafluoromethane
- ☐ Dichlorofluoromethane
- ☐ Hydrochlorofluorocarbon
- ☐ Ethylene Dibromide
- ☐ Methyl Iodide

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