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## 5.4 Register of substances

### 5.4.1 Table: Chemical substances of environmental relevance arranged according to selected laws and guidelines; also, list of information sheets in register of substances

*Notes:*

The following table is based on:

- the EC Water Protection Directive 76/464/EEC (1982),
- the Soil Conservation Concept of the Federal Government (1986/87) and
- the Technical Instructions on Air Quality Control TA-Luft (1986).

All the substances addressed by these legal provisions were incorporated into the list. They represent the basis for substance selection. An indication is also given of whether these substances are contained in the:

- catalogue of substances hazardous to water (1987)
- MAK list (1989).

The MAK list and the catalogue of substances hazardous to water both encompass some 550 substances which were only incorporated into the table if they are listed in the EC Water Protection Directive, the Soil Conservation Concept or the Technical Instructions on Air Quality Control TA-Luft.

Consistent alphabetical arrangement of the substances in line with chemical/systematic rules as used by WAGNER (1989) is likewise appropriate to a compilation of this size for reasons of clarity and comprehension. This is made all the more important by the fact that the headings to the information sheets sometimes employ more common substance names to make the register easier to deal with. The following table outlines these designations (with * in parentheses) after the systematic substance names.

The numbers at the top of the various columns have the following significance:

Column 2 = EC Water Protection Directive 76/464/EEC (1982)
Column 3 = Catalogue of Substances Hazardous to Water (1987)
Column 4 = Soil Conservation Concept of the German Federal Government (1986/87)
Column 5 = TA-Luft (1986)
Column 6 = List of MAK values (1989)
Column "register of substances" = Information sheet in catalogue section "chem. substances: register of substances"

For the most part, the data were taken from WAGNER (1989).

The substance list in the Soil Conservation Concept was produced by resolving the substance groups in line with chemical practice and environmental presence. Radionuclides were not considered (see WAGNER, 1989).

The substances are arranged alphabetically according to their chemical/systematic names.

Common names in standard usage are marked with an * in parentheses.

| **Name of substance** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|
| **A** | | | | | |
| Acenaphthylene, 1,2-dihydro (*acenaphthene) | | | x | | |
| Acetaldehyde | | x | | x | x |
| Acetaldehyde, chloro (*chloroacetaldehyde) | | | | x | x |
| Acetic acid | | x | | x | x |
| Acetic acid, butyl ester (*n-butyl acetate) | | x | | x | x |
| Acetic acid, chloro (*chloroacetic acid) | x | x | | x | |
| Acetic acid, (4-chloro-2-methylphenoxy) (*MCPA) | x | | | | |
| Acetic acid, (2,4-dichlorophenoxy) (*2,4-D) | x | | x | | x |
| Acetic acid, ethylene ester (*vinyl acetate) | | x | | x | x |
| Acetic acid, ethyl ester (*ethyl acetate) | | x | | x | x |
| Acetic acid, methyl ester (*methyl acetate) | | x | | x | x |
| Acetic acid, (2,4,5-trichlorophenoxy) (*2,4,5-T) | x | x | x | | x |
| Aluminium | | | x | | x |

| | | | | | |
|---|---|---|---|---|---|
| Aminobenzene, 2-chloro (*2-chloroaniline) | x | | | | |
| Aminobenzene, 3-chloro (*3-chloroaniline) | x | | | | |
| Aminobenzene, 2-chloro-4-methyl (*2-chloro-4-methylaniline) | x | | | | |
| Aminobenzene, 2-chloro-6-methyl (*2-chloro-6-methylaniline) | x | | | | |
| Aminobenzene, 3-chloro-2-methyl (*3-chloro-2-methylaniline) | x | | | | |
| Aminobenzene, 3-chloro-4-methyl (*3-chloro-4-methylaniline) | x | | | | |
| Aminobenzene, 4-chloro-2-methyl (*4-chloro-2-methylaniline) | x | | | | x |
| Aminobenzene, 5-chloro-2-methyl (*5-chloro-o-toluidine) | x | | | | x |
| Aminobenzene, ar-chlor-ar-methyl (*chlorotoluidine) | x | | | | |
| Aminobenzene, 4-chloro-2-nitro | x | | | | |
| Aminobenzene, 2-chloro-4-nitro (*2-chloro-4-nitroaniline) | | | x | | |
| Aminobenzene, 4-chloro (*p-chloroaniline) | x | | | | |
| Aminobenzene, ar,ar-dichloro (*dichloroaniline) | x | | | | |
| Aminobenzene, 2,3-dichloro (*2,3-dichloroaniline) | x | | | | |
| Aminobenzene, 2,4-dichloro (*2,4-dichloroaniline) | x | | | | |
| Aminobenzene, 2,5-dichloro (*2,5-dichloroaniline) | x | | | | |
| Aminobenzene, 2,6-dichloro (*2,6-dichloroaniline) | x | | | | |
| Aminobenzene, 3,4-dichloro (*3,4-dichloroaniline) | x | | | | |
| | x | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Aminobenzene, 3,5-dichloro (*3,5-dichloroaniline) | x | | | | |
| Aminobenzene, 2,6-dinitro N,N-dipropyl-4-(trifluoromethyl) (*2,6-dinitro-N,N-dipropyl-4-trifluoromethylaminobenzene) | x | | | | |
| Aminobenzene, 2-methyl (*o-toluidine) | | x | | x | x |
| Aminobenzene, 4-methyl (*p-toluidine) | x | | | | |
| Aminobenzene, 2-nitro (*o-nitroaniline) | | x | | | |
| Aminobenzene, 4-nitro (*p-nitroaniline) | | x | x | | x |
| Aminobenzene (*aniline) | | x | | x | |
| Aminoethane, N,N-diethyl (*triethylamine) | | x | | x | x |
| Aminoethane, N-ethyl (*diethylamine) | x | x | | x | x |
| Aminoethane (*ethylamine) | | x | | x | x |
| Aminomethane, N-methyl (*dimethylamine) | x | x | | x | x |
| Aminomethane (*methylamine) | | x | | x | x |
| 2-aminonaphthalene | | | | x | x |
| Ammonium cation | | | x | | |
| Anthracene | x | | x | | |
| Antimony | | | x | | x |
| Arsenic | x | | x | | |
| Arsenic(V) oxide (*arsenic pentoxide) | x | x | | x | x |
| | x | x | | x | x |

| | | | | | |
|---|---|---|---|---|---|
| Arsenic(III) oxide (*arsenic trioxide) | x | x | | x | x |
| Arsenic acid | x | x | | x | x |
| Arsenic acid, calcium salt (*calcium arsenate) | | x | | x | x |
| Arsenic acid, monopotassium salt (*potassium dihydrogen arsenate) | | x | | x | x |
| Arsenic acid, trisodium salt (*sodium arsenate) | | x | | x | x |
| Arsine (*arsenic hydride) | | x | | x | x |
| Asbestos | | | | x | x |
| Aziridine (*ethyleneimine) | | x | | x | x |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **B** | | | | | |
| Barium | | | | | |
| Benz[e]acephenanthrylene (benzo[b]fluoranthene) | x | | x | | x |
| Benz[a]anthracene | | | x | | |
| Benzene | x | x | x | x | x |
| Benzene acetonitrile, alpha-[(diethoxyphosphinothiolyl)-oxy]imino (*phoxim) | x | | | | |
| Benzene, C1-9 alkyl deriv (*alkyl benzenes) | | | | | |
| | | | x | | |

| | | | | | |
|---|---|---|---|---|---|
| Benzene, chloro (*chlorobenzene) | x | x | x | x | x |
| Benzene, 1-chloro-2-[2,2-dichloro-1-(4-chlorophenyl)-ethyl] (*o.p-DDD) | | | | x | |
| Benzene, 1-chloro-2,4-dinitro | x | | x | | |
| Benzene, chloromethyl (*benzyl chloride) | x | x | | x | x |
| Benzene, 1-chloro-3-methyl (*m-chlorotoluene) | x | | | | |
| Benzene, 1-chloro-2-methyl-4-nitro | x | | | | |
| Benzene, 2-chloro-1-methyl-4-nitro (*1-chloro-2-methyl-5-nitro-benzene) | x | | | | |
| Benzene, chloromethylnitro (*chloronitrotoluene) | x | | | | |
| Benzene, 1-chloro-2-methyl-3-nitro (*2-chloro-6-nitrotoluene) | x | | x | | |
| Benzene, 1-chloro-4-methyl-2-nitro (*4-chloro-3-nitrotoluene) | x | | | | |
| Benzene, 4-chloro-1-methyl-2-nitro (*4-chloro-2-nitrotoluene) | x | | | | |
| Benzene, 1-chloro-2-methyl (*o-chlorotoluene) | x | x | | | |
| Benzene, 1-chloro-4-methyl (*p-chlorotoluene) | x | x | | | |
| Benzene, 1-chloro-3-nitro (*m-chloronitrobenzene) | x | | x | | |
| Benzene, 1-chloro-2-nitro (*o-chloronitrobenzene) | x | | x | | |
| Benzene, 1-chloro-4-nitro (*p-chloronitrobenzene) | x | x | x | | x |
| Benzene, 1,1'- (2,2,2-trichloroethylidene)bis[4-chloro] (*o,p-DDT) | | | x | | |
| Benzene, 1,1'-(2,2-dichloroethylidene)bis[4-chloro] (*p,p'-DDD) | x | x | x | | |
| Benzene, 1,1'-(dichloroethylidene)bis[4-chloro] (*p,p'-DDE) | x | x | x | | |

| | | | | | |
|---|---|---|---|---|---|
| Benzene, 1,3-dichloro (*meta-dichlorobenzene) | x | | | | |
| Benzene, (dichloromethyl) (*benzal chloride) | x | | | | |
| Benzene, 1,3-dichloro-5-nitro | x | | | | |
| Benzene, dichloronitro (*dichloronitrobenzene) | x | | | | |
| Benzene, 1,2-dichloro-3-nitro (*2,3-dichloronitrobenzene) | | | x | | |
| Benzene, 1,2-dichloro-4-nitro (*3,4-dichloronitrobenzene) | x | | x | | |
| Benzene, 1,4-dichloro-2-nitro (*2,5-dichloronitrobenzene) | x | | | | |
| Benzene, 2,4-dichloro-1-nitro (*2,4-dichloronitrobenzene) | x | | | | |
| Benzene, 1,2-dichloro (*o-dichlorobenzene) | x | x | x | x | x |
| Benzene, 1,4-dichloro (*p-dichlorobenzene) | x | | x | x | x |
| Benzene, diethyl (*diethylbenzene) | | x | x | | |
| Benzene, 2,4-diisocyanato-1-methyl (*2,4-toluylene diisocyanate) | | x | | x | x |
| Benzene, (1,1-dimethylethyl) (*tert-butylbenzene) | | x | x | | |
| Benzene, 1,3-dimethyl (*m-xylene) | x | x | x | x | x |
| Benzene, 1,3-dimethyl-2-nitro (*1,3-dimethyl-2-nitro benzene) | | | x | | |
| Benzene, 1,2-dimethyl (*o-xylene) | x | x | x | x | x |
| Benzene, 1,4-dimethyl (*p-xylene) | x | x | x | x | x |
| Benzene, dimethyl (*xylene) | x | x | x | x | x |
| | | | x | | x |

| | | | | | |
|---|---|---|---|---|---|
| Benzene, dinitro (*dinitrobenzene) | | | x | | x |
| Benzene, ethenyl (*styrene) | | x | x | x | x |
| Benzene, ethyl (*ethylbenzene) | x | x | x | x | x |
| Benzene, 1-ethyl-3-methyl (*m-ethyltoluene) | | | x | | |
| Benzene, 1-ethyl-2-methyl (*o-ethyltoluene) | | | x | | |
| Benzene, 1-ethyl-4-methyl (*p-ethyltoluene) | | | x | | |
| Benzene, hexachloro (*hexachlorobenzene) | x | x | x | | |
| Benzene, methoxy (*anisol) | | x | x | | |
| Benzene, 1-methoxy-2-nitro (*o-nitroanisol) | | | x | | |
| Benzene, 1-methoxy-4-nitro (*p-nitroanisol) | | | x | | |
| Benzene, methyl, pentachloro derivatives | | | x | | |
| Benzene, 1-methyl-2,4-dinitro (*2,4-dinitrotoluene) | | x | x | | x |
| Benzene, 2-methyl-1,3-dinitro (*2,6-dinitrotoluene) | | | x | | x |
| Benzene, methyldinitro (*dinitrotoluene) | | | x | | x |
| Benzene, 2-methyl-1,4-dinitro (*2-methyl-1,4-dinitrobenzene) | | | x | | x |
| Benzene, (1-methylethenyl) (*1-methyl-1-phenyl-ethylene) | x | | | x | x |
| Benzene, (1-methylethyl) (*cumol) | | x | x | x | x |
| Benzene, 1-methyl-3-nitro (*m-nitrotoluene) | | | x | x | x |
| | | | | x | x |

| | | | | | |
|---|---|---|---|---|---|
| Benzene, methylnitro (*nitrotoluene) (isomers) | | | | x | x |
| Benzene, 1-methyl-2-nitro (*o-nitrotoluene) | | x | x | x | x |
| Benzene, 1-methyl-4-nitro (*p-nitrotoluene) | | | x | x | x |
| Benzene, methyl (*toluene) | x | x | x | x | x |
| Benzene, nitro (*nitrobenzene) | | x | x | x | x |
| Benzene, 1,1'-oxybis (*diphenyl ether) | | x | x | | x |
| Benzene, 1,1'-oxybis[methyl] (*ditolyl ether) | | | x | | |
| Benzene, 1,1'-[oxybis(methylene)]bis (*dibenzyl ether) | | | x | | |
| Benzene, pentachloronitro (*pentachloronitrobenzene) | | | x | | |
| Benzene, pentachloro (*pentachlorobenzene) | | | x | | |
| Benzene, pentachloro (trichloroethenyl) (*octachlorostyrene) | | | x | | |
| Benzene, phenylethyl (*diphenylethane) | | | x | | |
| Benzene, propyl (*propylbenzene) | | | x | | |
| Benzene, 1,2,3,4-tetrachloro (*1,2,3,4-tetrachlorobenzene) | | | x | | |
| Benzene, 1,2,3,5-tetrachloro (*1,2,3,5-tetrachlorobenzene) | | | x | | |
| Benzene, 1,2,4,5-tetrachloro (*1,2,4,5-tetrachlorobenzene) | x | | x | | |
| Benzene, tetramethyl (*tetramethylbenzene) | | | x | | |
| Benzene, 1,1' (2,2,2-trichloroethylidene)bis[4-chloro] (*DDT) | x | x | x | | x |
| | | | x | | x |

| | | | | | |
|---|---|---|---|---|---|
| Benzene, 1,1' (2,2,2-trichloroethylidene)bis[4-methoxy] (*methoxychlor) | | | | | |
| Benzene, trichloro (*trichlorobenzene) | x | | x | | |
| Benzene, 1,2,3-trichloro (*1,2,3-trichlorobenzene) | | | x | | |
| Benzene, 1,2,4-trichloro (*1,2,4-trichlorobenzene) | x | | x | | x |
| Benzene, 1,3,5-trichloro (*1,3,5-trichlorobenzene) | | | x | | |
| Benzene, 1,3,5-trimethyl (*mesitylene) | | | x | x | |
| Benzene, trimethyl (*trimethylbenzene) | | | x | x | |
| Benzene, 1,2,3-trimethyl (*1,2,3-trimethylbenzene) | | | x | x | |
| Benzene, 1,2,4-trimethyl (*1,2,4-trimethylbenzene) | | | x | x | |
| 1,2-benzene dicarboxylic acid, bis (2-ethylhexyl) ester (*di-(2-ethylhexyl)phthalate) | | | x | x | |
| 1,2-benzene dicarboxylic acid, bis (2-methylpropyl) ester (*diisobutyl phthalate) | | | x | | |
| 1,2-benzene dicarboxylic acid, bis (2-butyl-phenylmethyl) ester (*butylbenzyl phthalate) | | x | x | | |
| 1,2-benzene dicarboxylic acid, dibutyl ester (*dibutyl phthalate) | | | x | | |
| 1,2-benzene dicarboxylic acid, didecyl ester (*didecyl phthalate) | | | x | | |
| 1,2-benzene dicarboxylic acid, diethyl ester (*diethyl phthalate) | | x | x | | |
| 1,2-benzene dicarboxylic acid, dimethyl ester (*dimethyl phthalate) | | | x | | |
| 1,2-benzene dicarboxylic acid, dioctyl ester (*dioctyl phthalate) | | | x | | |

| | | | | | |
|---|---|---|---|---|---|
| 1,2-benzene dicarboxylic acid, dipropyl ester (*dipropyl phthalate) | | | x | | |
| 1,2-benzene dicarboxylic acid, diundecyl ester (*diundecyl phthalate) | | | x | | |
| Benzoic acid, methyl ester (*methyl benzoate) | | x | | x | |
| Benzo[ghi]fluoranthene | | | x | | |
| Benzo[k]fluoranthene | | | x | | |
| Benzofluoranthene | | | x | | |
| Benzo[j]fluoranthene (*benzo-1.2,1.3-fluoranthene) | | | x | | |
| 11H-benzo[a]fluorene | | | x | | |
| 7-benzofuranol, 2,3-dihydro-2,2-dimethyl, methylcarbamate (*carbofuran) | | | | x | |
| Benzonaphthothiophene | | | x | | |
| Benzonitrile, 2,6-dichloro | | | x | | |
| Benzo[ghi]perylene | | | x | | |
| Benzo[c]phenanthrene | | | x | | |
| Benzo[a]pyrene | x | | x | x | x |
| Benzo[e]pyrene | | | x | | |
| Beryllium | | | x | x | x |
| Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene (*beta-pinene) | | | | x | |
| Bicyclo[3.1.1]heptane, 2,6,6-trimethyl, didehydro derivative | | | | x | |
| Bicyclo[3.1.1]heptane, 2,6,6-trimethyl (*alpha pinene) | | | | x | |

| | | | | | |
|---|---|---|---|---|---|
| 1,1'-biphenyl, chlorinated (*PCB) | x | x | x | x | x |
| 1,1'-biphenyl, chloro (*monochlorobiphenyl) | | | x | | |
| 1,1'-biphenyl, dichloro (*dichlorobiphenyl) | | | x | | |
| 1,1'-biphenyl, heptachloro (*heptachlorobiphenyl) | | | x | | |
| 1,1'-biphenyl, hexabromo | | | | x | |
| 1,1'-biphenyl, hexachloro (*hexachlorobiphenyl, aroclor 1260) | | | x | | |
| 1,1'-biphenyl, pentachloro (*pentachlorobiphenyl, aroclor 1254) | | | x | | |
| 1,1'-biphenyl, trichloro (*trichlorobiphenyl, aroclor 1242) | | | x | | |
| 1,1'-biphenyl, (*biphenyl) | x | x | x | x | x |
| [1,1'-biphenyl]-4-carboxylic acid | x | | | | |
| [1,1'-biphenyl]-4,4'-diamino, 2,2'-dichloro | x | | | | |
| [1,1'-biphenyl]-4,4'-diamino, 3,3'-dichloro (*dichlorobenzidine) | x | | | x | x |
| [1,1'-biphenyl]-4,4'-diamino, (*benzidine) | x | | | | x |
| 4,4'-bipyridinium, 1,1'-dimethyl, dichloride (*paraquat dichloride) | | | x | | x |
| 4,4'-bipyridinium, 1,1'-dimethyl (*paraquat ion) | | | x | | |
| Bromine | | | | x | x |
| 1,3-butadiene | | x | | x | x |
| 1,3-butadiene, 2-chloro (*chloroprene) | x | | | x | x |
| 1,3-butadiene, 1,1,2,3,4,4-hexachloro (*hexachloro-1,3-butadiene) | x | x | x | | x |

| | | | | | |
|---|---|---|---|---|---|
| 1,3-butadiene, pentachloro (*pentachlorobutadiene) | | | x | | |
| 1,3-butadiene, tetrachloro (*tetrachlorobutadiene) | | | x | | |
| Butane | x | | | x | x |
| Butane, 2,2-dimethyl (*2,2-dimethylbutane) | | | | x | |
| Butane, 2,3-dimethyl (*2,3-dimethylbutane) | | | | x | |
| Butane, 2-methyl (*i-pentane) | | | | x | x |
| Butane, 1,1'-oxybis (*di-n-butyl ether) | | x | | x | |
| Butanal (*n-butyl aldehyde) | | x | | x | |
| Butanedioic acid,[(dimethoxythiophosphinyl)thio], diethyl ester (*Malathion) | x | x | | | x |
| 1-butanol, 3-methyl (*isoamyl alcohol) | | | | x | x |
| 1-butanol (*butanol) | | x | | x | x |
| 2-butanol (*sec. butanol) | | x | | x | x |
| 2-butanone (*ethyl methyl ketone) | | x | | x | x |
| 1-butanethiol (*n-butanethiol) | | x | | x | x |
| 2-butene, (Z) (*cis-2-butylene) | | | | x | |
| 2-butene, (E) (*trans-2-butylene) | | | | x | |
| 1-butene, 2,3-dimethyl | | | | x | |
| | | | | x | |

| | | | | | |
|---|---|---|---|---|---|
| 2-butene, 2,3-dimethyl (*2,3-dimethyl-2-butene) | | | | x | |
| 2-butene, 3,3-dimethyl- (*3,3-dimethyl-1-butene) | | | | x | |
| 1-butene, 2-methyl | | | | x | |
| 1-butene, 3-methyl (*3-methyl-1-butene) | | | | x | |
| 2-butene, 2-methyl (*trimethylethylene) | | | | x | |
| 1-butene (butene-1) | | | | x | |
| Butene, (*butylene) | | | | x | |
| 2-butanoic acid, 3-[(dimethoxyphosphinyl)oxy], methyl ester (*mevinphos) | x | | | | |

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| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| C | | | | | |
| Cadmium | x | | x | x | x |

| | | | | | |
|---|---|---|---|---|---|
| Carbon disulphide | | x | | x | x |
| Carbon monoxide | | x | | x | x |
| Carbonic acid, nickel (2+) salt 1:1 (*nickel carbonate) | | | | x | x |
| Carbonyl dichloride (*phosgene) | | | | x | x |
| Chlorine | | x | | x | x |
| Chromium | | | x | x | |
| Chromic acid, calcium salt (1:1) (*calcium chromate) | | x | | x | x |
| Chromic acid, chromium (3+) salt (3:2) [Cr2(CrO4)3] (*chromium (III) chromate) | | | | x | x |
| Chromic acid, zinc salt (1:1) (*zinc chromate) | | | | x | x |
| Chrysene | | | x | | x |
| Chrysostile [Mg3(OH)4(Si2O5)] (*white asbestos) | | | | x | x |
| Cobalt | | | x | x | x |
| Copper | | | x | x | x |
| Coronene | | | x | | |
| Crocidolite (*blue asbestos) | | | | x | x |
| Cyanogen chloride | | | | x | x |
| Cyanide | | | x | x | |
| | | | | x | x |

| | | | | | |
|---|---|---|---|---|---|
| 2,5-Cyclohexadiene-1,4-dione (*p-benzoquinone) | | | | x | x |
| Cyclohexane, 1,2,3,4,5,6-hexachloro (1.alpha, 2.alpha, 3.beta, 4.alpha, 5.beta, 6.beta) (*alpha-HCH) | x | | x | | x |
| Cyclohexane, 1,2,3,4,5,6-hexachloro (1.alpha, 2.beta, 3.alpha, 4.beta, 5.alpha, 6.beta) (*beta-HCH) | x | | x | | x |
| Cyclohexane, 1,2,3,4,5,6-hexachloro (1.alpha, 2.alpha, 3.alpha, 4.beta, 5.alpha, 6.beta) (*delta-HCH) | x | | x | | |
| Cyclohexane, 1,2,3,4,5,6-hexachloro (1.alpha, 2.alpha, 3.alpha, 4.beta, 5.beta, 6.beta) (*epsilon-HCH) | | | x | | |
| Cyclohexane, 1,2,3,4,5,6-hexachloro (1.alpha, 2.alpha, 3.beta, 4.alpha, 5.alpha, 6.beta) (*gamma-HCH, lindane) | x | x | x | | x |
| Cyclohexane, 1,2,3,4,5,6-hexachloro (*hexachlorocyclohexane) | x | | x | | x |
| Cyclohexanone | | x | | x | x |
| Cyclohexanone, methyl | | | | x | |
| 4H-Cyclopenta[def]phenanthrene | | | x | | |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **D** | | | | | |
| Dibenzo[a,h]anthracene | | | x | x | x |
| Dibenzo[def,mno]chrysene (*anthanthrene) | | | x | | |

| | | | | | |
|---|---|---|---|---|---|
| Dibenzo[b,e][1,4]dioxin, heptachloro (*heptachloro-dibenzo-p-dioxin) | | | x | | |
| Dibenzo[b,e][1,4]dioxin, hexachloro (*hexachloro-dibenzo-p-dioxin) | | | x | x | |
| Dibenzo[b,e][1,4]dioxin, octachloro (*octachloro-dibenzo-p-dioxin) | | | x | | |
| Dibenzo[b,e][1,4]dioxin, pentachloro (*pentachloro-dibenzo-p-dioxin) | | | x | | |
| Dibenzo[b,e][1,4]dioxin, 2,3,7,8,-tetrachloro (*TCDD) | | | x | | x |
| Dibenzo[b,e][1,4]dioxin, tetrachloro (*tetrachloro-dibenzo-p-dioxin) | | | x | x | |
| Dibenzofluoranthene | | | x | | |
| Dibenzofuran, hexachloro | | | x | x | |
| Dibenzofuran, octachloro | | | x | | |
| Dibenzofuran, pentachloro | x | | | | |
| Dibenzofuran, tetrachloro | | | x | x | |
| Dibenzofuran, 2,3,7,8-tetrachloro | | | x | | |
| 1,4:3,6-dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro (1.alpha, 4.alpha, 4a.beta, 5.alpha, 8.alpha, 8a.beta) (*aldrin) | x | x | x | | x |
| 2,7:3,6-dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-(1a.alpha, 2.alpha, 2a.beta, 3.beta, 6.beta, 6a.alpha, 7.beta, 7a.alpha) (*dieldrin) | x | x | x | | x |
| 2,7:3,6-dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro (1a.alpha, 2.beta, 2a.beta, 3.alpha, 6.alpha, 6a.beta, 7.beta, 7a.alpha) (*endrin) | x | x | x | | x |
| | | x | | x | x |

| | | | | | |
|---|---|---|---|---|---|
| 1,4-dioxane (*diethylene dioxide) | | | | | |
| Dipyrido[1,2-a:2’,1’-c]pyrazinediium, 6,7-dihydro, dibromide (*diquat dibromide) | | | x | | |
| Dipyrido[1,2-a:2’,1’-c]pyrazinediium, 6,7-dihydro (*diquat) | | | x | | |
| Distannoxane, hexabutyl (*bistributyltin oxide) | x | x | | | |
| Distannoxane, hexakis (2-methyl)-2-phenyl-propyl (*fenbutatin oxide) | x | x | | | |
| Dithiophosphoric acid, 0,0-diethyl-S[2-(ethylthio)-ethyl] ester (*disulfoton) | x | | | | |
| Dithiophosphoric acid, 0,0-diethyl-S[(4-oxo-1,2,3-benzotriazine-3(4H)-yl)methyl] ester (azinphos ethyl) | x | | | x | |
| Dithiophosphoric acid, 0,0-dimethyl-S[2-(methylamino)-2-oxoethyl] ester (dimethoate) | x | x | | | |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **E** | | | | | |
| Ethane | | | | x | |
| Ethane, chloro (*chloroethane) | | | | x | x |
| Ethane, 1,2-dibromo (*ethylene dibromide) | x | x | | x | x |
| Ethane, 1,2-dichloro (*ethylene chloride) | x | x | | x | x |
| Ethane, 1,1-dichloro (*ethylidene chloride) | x | | | x | x |

| | | | | | |
|---|---|---|---|---|---|
| Ethane, hexachloro (*hexachloroethane) | x | | x | | x |
| Ethane, methylthio | | | | x | |
| Ethane, 1,1’-oxybis (*diethyl ether) | | x | | x | x |
| Ethane, 1,1,2,2-tetrachloro (*1,1,2,2-tetrachloroethane) | x | | x | x | x |
| Ethane, 1,1’-thiobis (*diethyl sulphide) | | | | x | |
| Ethane, 1,1,1-trichloro (*1,1,1-trichloroethane) | x | x | x | x | x |
| Ethane, 1,1,2-trichloro (*1,1,2-trichloroethane) | x | | | x | x |
| Ethane, 1,1,2-trichloro-1,2,2-trifluoro (*frigen) | x | x | | | x |
| 1,1-ethanediol, 2,2,2-trichloro (*chloralhydrate) | x | x | | | |
| 1,2-ethanediol (*ethylene glycol) | | x | | x | |
| Ethanol, 2-butoxy (*2-butoxyethanol) | | x | | x | x |
| Ethanol, 2-chloro (*2-chloroethanol) | x | x | | | x |
| Ethanol, 2-ethoxy (*ethyl glycol) | | | | x | x |
| Ethanol, 2,2’-iminobis (*diethanolamine) | | x | | x | |
| Ethanol, 2-methoxy (*methyl glycol) | | x | | x | x |
| Ethanol (*ethyl alcohol) | | x | | x | x |
| Ethanethiol (*ethyl mercaptane) | | x | | x | x |
| Ethene, chloro, homopolymer (*polyvinyl chloride) | | | | x | x |

| | | | | | |
|---|---|---|---|---|---|
| Ethene, chloro (*vinyl chloride) | x | x | x | x | x |
| Ethene, 1,2-dichloro | x | | x | x | x |
| Ethene, 1,1-dichloro (*vinylidene chloride) | x | | x | x | x |
| Ethene, tetrachloro (*tetrachloroethene) | x | x | x | x | x |
| Ethene, trichloro (*trichloroethene) | x | x | x | x | x |
| Ethene (*ethylene) | | | | x | |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **F** | | | | | |
| Fluorine | | | | x | x |
| Fluoranthene | | | x | | |
| 9H-fluorene (*fluorene) | | | x | | |
| Fluoride anion | | | x | x | |
| Formaldehyde | | x | | x | x |
| Formamide, N,N-dimethyl (*formic acid dimethylamide) | | x | | x | x |
| Formic acid | | x | | x | x |
| Formic acid, methyl ester (*methyl formate) | | | | x | x |
| | | x | | x | x |

| | | | | | |
|---|---|---|---|---|---|
| Furan, tetrahydro (tetrahydrofuran) | | | | | |
| 2,5-furandione (*maleic anhydride) | | x | | x | x |
| Furfural | | x | | x | x |
| 2-furanmethanol (*furfuryl alcohol) | | x | | x | x |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **G** | | | | | |
| Glycine, N,N-bis(carboxymethyl) (*nitrilotriacetic acid) | | x | x | | |
| Glycine, N,N’-1,2-ethanediyl bis [N-(carboxymethyl)] (ethylenediaminetetraacetic acid) | | x | x | | |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **H** | | | | | |
| Heptane | | x | | x | x |
| 4-heptanone, 2,6-dimethyl (*diisobutyl ketone) | | | | x | x |
| Heptene | | | | x | |
| 1-heptene | | x | | x | |
| Hexane, 3-methyl (*3-methylhexane) | | | | x | |

| | | | | | |
|---|---|---|---|---|---|
| Hexane (*n-hexane) | | x | | x | x |
| 2-hexanol | | x | | x | |
| 3-hexanol | | x | | x | |
| 1-hexanol (*hexanol-1) | | x | | x | |
| Hexene | | | | x | |
| 1-hexene (*hexene-1) | | | | x | |
| Hydrazine | | x | | x | x |
| Hydrobromic acid (*hydrogen bromide) | | x | | x | x |
| Hydrocyanic acid (*hydrogen cyanide) | | x | | x | x |
| Hydrofluoric acid | | x | | x | x |
| Hydrogen cation | | | x | | |
| Hydrogen fluoride | | | | | |
| Hydrogen sulphide | | x | | x | x |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **I** | | | | | |
| Indeno[1,2,3-cd]fluoranthene | | | x | | |
| | | | x | | x |

| | | | | | |
|---|---|---|---|---|---|
| Indeno[1,2,3-cd]pyrene (*Indenopyrene) | | | x | | x |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **L** | | | | | |
| Lead | | | x | x | x |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **M** | | | | | |
| Manganese | | | | x | x |
| Mercury | x | x | x | x | x |
| Mercury(II) oxide | x | | | | |
| Methane, bromo (*bromomethane) | | | | | |
| Methane, chloro (*chloromethane) | | x | | x | x |
| Methane, dichloro (*dichloromethane) | x | x | x | x | x |
| Methane, dichlorodifluoro (*dichlorodifluoromethane) | | | | x | x |
| Methane, oxybis (*dimethyl ether) | | | | x | |
| Methane, tetrachloro (*carbon tetrachloride) | x | x | x | x | x |

| | | | | | |
|---|---|---|---|---|---|
| Methane, thiobis (*dimethyl sulphide) | | | | x | |
| Methane, trichloro (*chloroform) | x | x | x | x | x |
| Methane, trichlorofluoro (*trichlorofluoromethane) | | x | | x | x |
| 6,9-methano-2,4,3-benzo-dioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro, 3-oxide, (3.alpha, 5a.beta, 6.alpha, 9.alpha, 9a.alpha) (*alpha-endosulfan) | | | x | | |
| 6,9-methano-2,4,3-benzo-dioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro, 3-oxide, (3.alpha, 5a.alpha, 6.beta, 9.beta, 9a.alpha) (*beta-endosulfan) | | | x | | |
| 6,9-methano-2,4,3-benzo-dioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro, 3-oxide (endosulfan) | x | x | x | | |
| 4,7-methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro (*heptachlor) | x | | x | | x |
| 4,7-methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro (*chlordane) | x | | x | | x |
| 2,5-methano-2H-indeno[1,2-b]oxirene, 2,3,4,5,6,7,7-heptachloro-1a,1b,5,5a,6,6a-hexahydro (*heptachlorepoxide) | x | | x | | |
| Methanol (*methyl alcohol) | | x | | x | x |
| Methanethiol (*methyl mercaptane) | | x | | x | x |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **N** | | | | | |
| Naphthalene | x | x | x | x | x |
| Naphthalene, 1-chloro | x | | | | |
| Naphthalene, chlorine derivatives | x | x | x | | |
| Naphthalene, 2,6-dimethyl (*2,6-dimethylnaphthalene) | | | x | | |
| Naphthalene, 1-methyl (*1-methylnaphthalene) | | | x | | |
| Naphthalene, 2-methyl (*2-methylnaphthalene) | | | x | | |
| 1-Naphthalenyl-methyl-carbamate (*carbaryl) | | | | | |
| Nickel | | | x | x | x |
| Nickel carbonyl, (T-4)-[Ni(CO)4] (*nickel tetracarbonyl) | | | | x | x |
| Nickel oxide [NiO] | | | | x | |
| Nickel sulphide [NiS] | | | | x | |
| Nitrate anion | | | x | | |
| Nitrogen dioxide | | x | | x | x |
| Nitrogen monoxide | | x | | x | |

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| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **O** | | | | | |
| Octane (*n-octane) | | x | | x | x |
| Octene (*octene, dimersol) | | | | x | |
| Oxirane, (chloromethyl) (*epichlorohydrin) | x | x | x | x | x |
| Oxirane, methyl (*propylene oxide) | | | | x | x |
| Oxirane (*ethylene oxide) | | x | | x | x |
| Ozone | | | | | |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **P** | | | | | |
| Palladium | | | | x | |

| | | | | | |
|---|---|---|---|---|---|
| Paraffin oil (*mineral oil) | | | x | | |
| Pentane | | x | | x | x |
| Pentane, 3-methylene (*3-methylenepentane) | | | | x | |
| Pentane, 2-methyl (*iso-hexane) | | | | x | |
| Pentane, 3-methyl (*3-methylpentane) | | | | x | |
| 1-pentanol, (*n-amyl alcohol) | | x | | x | |
| 2-pentanone, 4-hydroxy-4-methyl (*diacetone alcohol) | | x | | x | x |
| 2-pentanone, 4-methyl (*methyl isobutyl ketone) | | x | | x | x |
| 1-pentene, 2-methyl (*1-methyl-1-propylethylene) | | | | x | |
| 2-pentene, (Z) (*2-cis-pentene) | | | | x | |
| 2-pentene, (E) (*2-trans-pentene) | | | | x | |
| Pentene (*amylene) | | | | x | |
| 1-pentene, 4-methyl | | | | x | |
| 1-pentene (*propylethylene) | | | | x | |
| Perylene | | | x | | |
| Phenanthrene | | | x | | |
| Phenanthrene, methyl (*methylphenanthrene) | | | x | | |
| Phenol | | x | x | x | x |
| | x | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Phenol, 2-amino-4-chloro | x | | | | |
| Phenol, 2,6-bis (1,1-dimethylethyl) 4-methyl (*2,6-di-tert.-butyl-4-methyl-phenol) | | | x | | |
| Phenol, 3-chloro (*m-chlorophenol) | x | | x | | |
| Phenol, 2-chloro-5-methyl (*6-chloro-m-cresol) | | | x | | |
| Phenol, 4-chloro-3-methyl (*4-chloro-m-cresol) | x | x | x | | |
| Phenol, 2-chloro (*o-chlorophenol) | x | x | x | | |
| Phenol, 4-chloro (*p-chlorophenol) | x | | x | | |
| Phenol, 3,4-dichloro (*3,4-dichlorophenol) | | | | x | |
| Phenol, 3,5-dichloro (*3,5-dichlorophenol) | | | | x | |
| Phenol, dichloro (*dichlorophenol) | | | | x | |
| Phenol, 2,3-dichloro (*2,3-dichlorophenol) | | x | x | x | |
| Phenol, 2,4-dichloro (*2,4-dichlorophenol) | x | x | x | x | |
| Phenol, 2,5-dichloro (*2,5-dichlorophenol) | | | x | x | |
| Phenol, 2,6-dichloro (2,6-dichlorophenol) | | | x | x | |
| Phenol, 2,4-dichloro-3,5-dimethyl (*2,4-dichloro-3,5-xylenol) | | | x | | |
| Phenol, dimethyl (*xylenol) | | | | x | |
| Phenol, 2,3-dimethyl (*2,3-xylenol) | | | | x | |
| Phenol, 2,4-dimethyl (*2,4-xylenol) | | | | | |
| | | | x | x | |

| | | | | | |
|---|---|---|---|---|---|
| Phenol, 2,5-dimethyl (*2,5-xylenol) | | | | x | |
| Phenol, 3,4-dimethyl (*3,4-xylenol) | | | x | x | |
| Phenol, 2,4-dinitro (*2,4-dinitrophenol) | | | x | | |
| Phenol, 4-ethyl (*p-ethylphenol) | | | x | | |
| Phenol, 2-methyl-4,6-dinitro (*4,6-dinitro-o-cresol) | | | | x | x |
| Phenol, 4,4’-(1-methylethylidene)bis (*bisphenol A) | | | x | | |
| Phenol, methyl (*cresol) | | | | x | x |
| Phenol, 3-methyl (*m-cresol) | | x | | x | x |
| Phenol, 2-methyl-4-nitro | | | x | | |
| Phenol, 2-methyl-5-nitro | | | x | | |
| Phenol, 4-methyl-3-nitro | | | x | | |
| Phenol, 5-methyl-2-nitro | | | x | | |
| Phenol, 4-methyl-2-nitro (*mononitrocresol) | | | x | | |
| Phenol, methylnitro (*nitrocresol) | | | x | x | |
| Phenol, 3-methyl-4-nitro (*p-nitro-m-cresol) | | | | x | |
| Phenol, 2-methyl (*o-cresol) | | | x | | x |
| Phenol, 4-methyl (*p-cresol) | | | x | x | x |
| Phenol, 3-nitro (*m-nitrophenol) | | | | x | |
| Phenol, nitro (*nitrophenol) | | | x | | |

| | | | | | |
|---|---|---|---|---|---|
| Phenol, 2-nitro (*2-nitrophenol) | | | x | x | |
| Phenol, 4-nitro (*4-nitrophenol) | | | x | x | |
| Phenol, 4-nonyl | | x | x | | |
| Phenol, pentachloro (*pentachlorophenol) | x | x | x | | x |
| Phenol, 2-(phenylmethyl) (*o-benzylphenol) | | | x | | |
| Phenol, 4-(phenylmethyl)- (*p-benzylphenol) | | | x | | |
| Phenol, 4-propyl | x | | | | |
| Phenol, 2,3,4,5-tetrachloro (*2,3,4,5-tetrachlorophenol) | | | x | | |
| Phenol, 2,3,4,6-tetrachloro (*2,3,4,6-tetrachlorophenol) | | | x | | |
| Phenol, 2,3,5,6-tetrachloro (*2,3,5,6-tetrachlorophenol) | | | x | | |
| Phenol, trichloro (*trichlorophenol) | | | | x | |
| Phenol, 2,3,4-trichloro (*2,3,4-trichlorophenol) | | | x | x | |
| Phenol, 2,3,5-trichloro (*2,3,5-trichlorophenol) | | | x | x | |
| Phenol, 2,3,6-trichloro (*2,3,6-trichlorophenol) | x | | x | x | |
| Phenol, 2,4,5-trichloro (*2,4,5-trichlorophenol) | x | | x | x | |
| Phenol, 2,4,6-trichloro (*2,4,6-trichlorophenol) | x | | x | x | |
| Phenol, 3,4,5-trichloro (*3,4,5-trichlorophenol) | | | x | | |
| Phosphine (*hydrogen phosphide) | | x | | x | x |
| | x | | | | x |

| | | | | | |
|---|---|---|---|---|---|
| Phosphoric acid, 2,2-dichloroethenyl dimethyl ester (*dichlorvos) | x | | | | x |
| Phosphoric acid, tributyl ester (*tributyl phosphate) | x | | | | |
| Platinum | | | | x | x |
| Potassium | | | | | |
| Propanal (*propionaldehyde) | | | | x | |
| Propane | | x | x | x | |
| Propane, 1-chloro (*1-chloropropane) | | | | x | |
| Propane, 1,2-dichloro (*1,2-dichloropropane) | x | x | | | x |
| Propane, 2,2-dimethyl (*tert. Pentane) | | x | | x | x |
| Propane, 2-methyl (*isobutane) | | x | | x | x |
| Propane, 2,2’-oxybis[1-chloro-(*bis(1-chloroisopropyl)ether) | x | | | | |
| Propane, 2,2’-oxybis (*diisopropylether) | | | | x | x |
| Propane, 1,1’-thiobis | | | | x | |
| Propane, 2,2’-thiobis | | | | x | |
| Propane, 1,2,3-trichloro (*1,2,3-trichloropropane) | | | x | | x |
| 1-propanol | | x | | x | |
| Propanol, 1,3-dichloro | x | | | | |
| 1-propanol, 2-methyl (*isobutanol) | | x | | x | x |
| 2-propanol, 2-methyl (*tert. Butanol) | | x | | x | x |

| | | | | | |
|---|---|---|---|---|---|
| 2-propanol (*isopropanol) | | x | | x | x |
| 2-propanone (*acetone) | | x | | x | x |
| Propionic acid | | x | | x | x |
| Propionic acid, 2-(4-chloro-2-methylphenoxy) (*mecoprop) | x | | | | |
| Propionic acid, 2-(2,4-dichlorophenoxy) (*dichloroprop) | x | | | | |
| Propionic acid, 3,4-dichloroanilide (*propanil) | x | | | | |
| 1-propanethiol, 2-methyl | | | | x | |
| 1-propanethiol (*n-propylmercaptan) | | | | x | |
| 2-propanethiol (*propane-2-thiol) | | x | | x | |
| 1-propene, 3-chloro (*allyl chloride) | x | x | | | x |
| 1-propene, 1,3-dichloro (*1,3-dichloropropylene) | x | x | | | x |
| 1-propene, 2,3-dichloro (*2,3-dichloropropylene) | x | x | | | |
| 1-propene, 2-methyl (*isobutylene) | | | | x | |
| 2-propenal (*acrolein) | | x | | x | x |
| 2-propenenitrile, homopolymer (*polyacrylonitrile) | | | | x | |
| 2-propenenitrile (*acrylonitrile) | | x | | x | x |
| 1-propene (*propylene) | | | | x | |
| 2-propenoic acid, ethyl ester (*ethyl acrylate) | | x | | x | x |
| 2-propenoic acid, 2-methyl, methyl ester (*methacrylic acid methyl ester) | | x | | x | x |

| | | | | | |
|---|---|---|---|---|---|
| 2-propenoic acid, methyl ester (*acrylic acid methyl ester) | | x | | x | x |
| 2-propenoic acid (*acrylic acid) | | x | | x | |
| Pyrene | | | x | | |
| 3(2)-pyridazinone, 5-amino-4-chloro-2-phenyl | x | | | | |
| Pyridine | | x | | x | x |
| 2-Pyrrolidinone, 1-methyl (*N-methyl-2-pyrrolidone) | | | | x | x |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **R** | | | | | |
| Rhodium | | | | x | |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **S** | | | | | |
| Selenium | | | x | x | x |
| Selenium hexafluoride (OC-6-11) (*selenium hexafluoride) | | | | | |
| Stannane, (acetyloxy)triphenyl (*fentin acetate) | x | x | | | |
| | x | x | | | |

| | | | | | |
|---|---|---|---|---|---|
| Stannane, chlorotriphenyl | | | | | |
| Stannane, dibutyldichloro (*di-n-butyltin dichloride) | x | x | | | |
| Stannane, dibutyloxo | x | x | | | |
| Stannane, hydroxytriphenyl | x | x | | | |
| Stannane, tetrabutyl (*tetrabutyltin) | x | x | | | |
| Stannane, tricyclohexylhydroxy (*cyhexatin) | x | x | | | |
| Sulphate anion | | | x | | |
| Sulphur dioxide | | x | | x | x |
| Sulphur trioxide | | x | | x | |
| Sulphuric acid, dimethyl ester (*dimethyl sulphate) | | | | x | x |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **T** | | | | | |
| Tellurium | | | | x | |
| Terphenyl, chlorinated | x | x | x | | |
| Tetraethyl lead | | x | | x | x |
| Tetramethyl lead | | x | | x | x |
| Thallium | | | x | x | x |

| | | | | | |
|---|---|---|---|---|---|
| Thiourea | | | x | | |
| Thiophosphoric acid, O-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl)-O,O-diethylester (*coumaphos) | x | | | | |
| Thiophosphoric acid, O,O-diethyl-O-[2-(ethylthio)ethyl]ester (*demeton-O) | x | | | | |
| Thiophosphoric acid, O,O-diethyl-O-(4-nitrophenyl)ester (*parathion) | x | x | | | x |
| Thiophosphoric acid, O,O-diethyl-O-(1-phenyl-1H-1,2,4-triazol-3-yl) ester (*triazophos) | x | | | | |
| Thiophosphoric acid, O,O-dimethyl, S-[2-(ethylsulphinyl)ethyl] ester (*oxydemeton-methyl) | x | | | | |
| Thiophosphoric acid, O,O-dimethyl-S-[2-(methylamino)-2-oxoethyl]ester (*omethoate) | x | x | | | |
| Thiophosphoric acid, O,O-dimethyl-O-[3-methyl-4-(methylthio)phenyl]ester (*fenthion) | x | | | | x |
| Thiophosphoric acid, O,O-dimethyl-O-(3-methyl-4-nitrophenyl) ester (*fenitrothion) | x | | | | |
| Thiophosphoric acid, O,O-dimethyl-O-(4-nitrophenyl)ester (*methylparathion) | x | x | | x | |
| Thiophosphoric acid, S-[2-(ethylthio)ethyl]-O,O-dimethylester (*demeton-S-methyl) | x | | | | |
| Tin | | | | x | x |
| Toxaphene (*camphechlor) | | | x | | x |
| | x | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 1,3,5-triazine, 2,4,6-trichloro (*cyanuric chloride) | x | | | | |
| 1,3,5-triazine, 2-chloro, 4-ethylamino, 6-isopropylamino (*atrazine) | | | | | |
| 1,3,5-triazine-2,4-diamine, 6-chloro-N,N’-diethyl (*simazine) | x | | | | |
| Triphenylene | | | x | | |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **U** | | | | | |
| Uranium | | | x | | x |
| Urea, N’-(4-chlorophenyl)-N-methoxy-N-methyl (*monolinuron) | x | x | | | |
| Urea, N’-(3,4-dichlorophenyl)-N-methoxy-N-methyl | x | x | | | |

| Name of substance | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **V** | | | | | |
| Vanadium | | | x | x | |
| Vanadium pentoxide | | | | | |

| Name of substance | | | | | |
|---|---|---|---|---|---|

| **Z** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|
| Zinc | | | x | | |

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### 5.4.2 Index to register of substances with most important common names and synonyms

| **Chemical names, synonyms, trade names** | **Registry name** |
|---|---|
| Acidum hydrofluorium | Hydrogen fluoride |
| Acrolein | Acrolein |
| Acrylaldehyde | Acrolein |
| Actinolite | Asbestos |
| Aerothene | 1,1,1-Trichloroethane |
| AHF | Hydrogen fluoride |

| | |
|---|---|
| Aldrex | Aldrin |
| Aldrin | Aldrin |
| Algylen | Trichloroethene |
| Allylaldehyde | Acrolein |
| alpha-Trichloroethane | 1,1,1-Trichloroethane |
| Alvit | Dieldrin |
| American Cyanamide 4049 | Malathion |
| Amosite | Asbestos |
| Amphibole asbestos | Asbestos |
| Anhydrous hydrofluoric acid | Hydrogen fluoride |
| Ankliostin | Tetrachloroethene |
| Annulene | Benzene |
| | DDT |

| | |
|---|---|
| Anofex | |
| Anthophyllite | Asbestos |
| Antimite | Naphthalene |
| Antimony | Antimony |
| Antimony hydride | Antimony |
| Antimony trioxide | Antimony |
| Antverruc | Formaldehyde |
| Aphisan | Malathion |
| Apirolio | Polychlorinated biphenyls |
| Armaclean | 1,1,1-Trichloroethane |
| Aroclor | Polychlorinated biphenyls |
| Arsenic | Arsenic |
| Arsenic trioxide | Arsenic |

| | |
|---|---|
| Asbestos | Asbestos |
| Ascarele | Polychlorinated biphenyls |
| Atoxan | Carbaryl |
| Atrazine | Atrazine |
| Aurora yellow | Cadmium |
| Azabenzene | Pyridine |
| Azine | Pyridine |
| Baltane | 1,1,1-Trichloroethane |
| BaP | Polycyclic aromatic hydrocarbons |
| BAP | Polycyclic aromatic hydrocarbons |
| Barium | Barium |
| Barium carbonate | Barium |
| Barium chloride | Barium |

| | |
|---|---|
| Benzene | Benzene |
| Benzene hexachloride | Lindane |
| Benzinol | Trichloroethene |
| Benzo[a]pyrene | Polycyclic aromatic hydrocarbons |
| Benzo[def]chrysene | Polycyclic aromatic hydrocarbons |
| Benzol | Benzene |
| 1,2-Benzpyrene | Polycyclic aromatic hydrocarbons |
| 3,4-Benzpyrene | Polycyclic aromatic hydrocarbons |
| Beosit | Endosulfan |
| Beryllium | Beryllium |
| BFV | Formaldehyde |
| Bicarburate of hydrogen | Benzene |
| Blue asbestos | Asbestos |

| | |
|---|---|
| Blue vitriol | Copper |
| Bluestone | Copper |
| Bromine | Bromine |
| Bromomethane | Methyl bromide |
| Caddy | Cadmium |
| Cadmium | Cadmium |
| Cadmium chloride | Cadmium |
| Cadmium dichloride | Cadmium |
| Cadmium orange | Cadmium |
| Cadmium oxide | Cadmium |
| Cadmium yellow | Cadmium |
| Calochlor | Mercury |

| | |
|---|---|
| Caprolin | Carbaryl |
| Carbaryl | Carbaryl |
| Carbolic acid | Phenol |
| Carbon monoxide | Carbon monoxide |
| Carbon oil | Benzene |
| Carbon oxide | Carbon monoxide |
| Carbon(II) oxide | Carbon monoxide |
| Carbophos | Malathion |
| Cecolin 2 | Tetrachloroethene |
| Cezarex | DDT |
| Champion Fluid | 1,1,1-Trichloroethane |
| Chlordane | Chlordane |
| Chlorinated naphthalenes | Chlorinated naphthalenes |

| | |
|---|---|
| Chlorine | Chlorine |
| 1-Chloro-2,3-epoxypropane | Epichlorohydrin |
| 2-Chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine | Atrazine |
| 2-Chloro-4-ethylamino-6-isopropylamino-s-triazine | Atrazine |
| 6-Chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine | Atrazine |
| Chloroethene | Vinyl chloride |
| Chloroform | Chloroform |
| Chloromethyloxirane | Epichlorohydrin |
| Chloronaphthalene | Chlorinated naphthalenes |
| Chloronaphthalene derivatives | Chlorinated naphthalenes |
| Chlorophenols | Chlorophenols |
| Chlorophenothane | DDT |
| 1,1-bis(4-Chlorophenyl)-2,2,2-trichloroethane | DDT |

| | |
|---|---|
| Chlorotene | 1,1,1-Trichloroethane |
| Chlorothane NU | 1,1,1-Trichloroethane |
| Chlorothene | 1,1,1-Trichloroethane |
| Chlorten | 1,1,1-Trichloroethane |
| Chlorum | Chlorine |
| Chlorylen | Trichloroethene |
| Chromic acid anhydride | Chromium |
| Chromium | Chromium |
| Chromium trioxide | Chromium |
| Chromium(VI) oxide | Chromium |
| Chrysotile | Asbestos |
| Circosolv | Trichloroethene |
| | Polychlorinated biphenyls |

| | |
|---|---|
| Clophen | Polychlorinated biphenyls |
| Coal naphtha | Benzene |
| Cobalt | Cobalt |
| Compound 269 | Endrin |
| Compound 497 | Dieldrin |
| Compound 7744 | Carbaryl |
| Copper | Copper |
| Copper oxide | Copper |
| Copper(I) oxide | Copper |
| Copper(II) sulphate pentahydrate | Copper |
| Cortilan | Lindane |
| 1,2-Cresol | Cresols |
| 1,3-Cresol | Cresols |

| | |
|---|---|
| 1,4-Cresol | Cresols |
| m-Cresol | Cresols |
| meta-Cresol | Cresols |
| o-Cresol | Cresols |
| ortho-Cresol | Cresols |
| p-Cresol | Cresols |
| para-Cresol | Cresols |
| Cresols | Cresols |
| Crocidolite | Asbestos |
| Cuprum | Copper |
| Cyclohexatriene | Benzene |
| 2,4-D | 2,4-Dichlorophenoxy acetic acid |
| | DDT |

| | |
|---|---|
| DDT | |
| p,p’-DDT | DDT |
| DDVP | Dichlorvos |
| Dekapir 2 | Tetrachloroethene |
| Delor | Polychlorinated biphenyls |
| Detal | Dinitro-o-cresol |
| Dextrone X | Paraquat |
| 2,2-Dichloroethenyl dimethyl phosphate | Dichlorvos |
| 2,4-Dichlorophenoxy acetic acid | 2,4-Dichlorophenoxy acetic acid |
| 2,2-Dichlorovinyl dimethyl phosphate | Dichlorvos |
| Dichlorvos | Dichlorvos |
| Dicophane | DDT |
| Didakene | Tetrachloroethene |

| | |
|---|---|
| Dieldrin | Dieldrin |
| O,O-Diethyl-O-4-nitrophenyl-phosphorothioate | Parathion |
| O,O-Diethyl-O-4-nitrophenyl-thiophosphate | Parathion |
| Digrisol | Tetrachloroethene |
| Dihydrogen sulphide | Hydrogen sulphide |
| O,O-Dimethyl O-(2,2-dichlorovinyl) phosphate | Dichlorvos |
| 1,1'-Dimethyl-(4,4'-bipyridinium) cation | Paraquat |
| 1,1'-Dimethyl-(4,4'-bipyridinium) [dichloride] | Paraquat |
| N,N'-Dimethyl-(4,4'-bipyridinium) chloride | Paraquat |
| O,O-Dimethyl-S-[1,2-bis(ethoxy-carbonyl)ethyl] dithiophosphate | Malathion |
| 4,6-Dinitro-o-cresol | Dinitro-o-cresol |
| Dinitro-o-cresol | Dinitro-o-cresol |
| Dinocide | DDT |

| | |
|---|---|
| Dioxin | Dioxins |
| Divanadium pentoxide | Vanadium |
| DNC | Dinitro-o-cresol |
| DNOC | Dinitro-o-cresol |
| Dow-Per | Tetrachloroethene |
| Dowclene WR | 1,1,1-Trichloroethane |
| Dowicide 7 | Chlorophenols |
| Dowicide G | Chlorophenols |
| Drivertan | 1,1,1-Trichloroethane |
| Drosol | Tetrachloroethene |
| Dynaper | Tetrachloroethene |
| E 605 | Parathion |
| ECH | Epichlorohydrin |

| | |
|---|---|
| Eftol | Parathion |
| Endosulfan | Endosulfan |
| Endrin | Endrin |
| ENT 16,225 | Dieldrin |
| Epichlorohydrin | Epichlorohydrin |
| 2,3-Epoxypropyl chloride | Epichlorohydrin |
| Escothen | 1,1,1-Trichloroethane |
| Ethene monochloride | Vinyl chloride |
| Ethene trichloride | Trichloroethene |
| S-[1,2-bis-(Ethoxy-carbonyl)-ethyl]-O,O-dimethyl-dithiophosphate | Malathion |
| Ethyl fluid | Lead compounds - organic |
| Ethylene tetrachloride | Tetrachloroethene |
| | Tetrachloroethene |

| | |
|---|---|
| Etilin | |
| Etzel | Dinitro-o-cresol |
| Fannoform | Formaldehyde |
| Fenclor | Polychlorinated biphenyls |
| Fibre asbestos | Asbestos |
| FO 178 | 1,1,1-Trichloroethane |
| Folidol | Parathion |
| Formaldehyde | Formaldehyde |
| Formalin | Formaldehyde |
| Formalith | Formaldehyde |
| Formic acid aldehyde | Formaldehyde |
| Formol | Formaldehyde |
| Formyl hydrate | Formaldehyde |

| | |
|---|---|
| Formyl trichloride | Chloroform |
| Freon 1140 | Vinyl chloride |
| Fruit-tree carboline | Dinitro-o-cresol |
| gamma-BHC | Lindane |
| Gamonil | Carbaryl |
| Genklene | 1,1,1-Trichloroethane |
| Gesaprim | Atrazine |
| Gesarol | DDT |
| Glycinium | Beryllium |
| Gramoxon | Paraquat |
| Gramoxone | Paraquat |
| Grey arsenic | Arsenic |
| Guesapon | DDT |

| | |
|---|---|
| Guesard | DDT |
| Guesarol | DDT |
| Gyron | DDT |
| Haloform | Chloroform |
| Halowax | Chlorinated naphthalenes |
| HCB | Hexachlorobenzene |
| γ -HCH | Lindane |
| Heod | Dieldrin |
| 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-endo,exo -5,8-dimethano-naphthalene | Aldrin |
| 6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano -2,4,3-benzodioxathiepin-3-oxide | Endosulfan |
| 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro -1,4,5,8-dimethanonaphthalene | Dieldrin |
| 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,7,8,8a-octahydro -1,4-endo,endo-5,8-dimethanonaphthalene | Endrin |
| | Hexachlorobenzene |

| | |
|---|---|
| Hexachlorobenzene | Hexachlorobenzene |
| γ -Hexachlorocyclohexane | Lindane |
| Hexachlorodimethanonaphthalene | Aldrin |
| Hexadrin | Endrin |
| HHDN | Aldrin |
| Hortex | Lindane |
| Hydrofluoric acid | Hydrogen fluoride |
| Hydrogen fluoride | Hydrogen fluoride |
| Hydrogen fluoride (anhydrous) | Hydrogen fluoride |
| Hydrogen sulphide | Hydrogen sulphide |
| Hydroxybenzene | Phenol |
| Hydroxytoluene | Cresols |
| Inerteen | Polychlorinated biphenyls |

| | |
|---|---|
| Inhibisol | 1,1,1-Trichloroethane |
| Ivalon | Formaldehyde |
| Ixodex | DDT |
| Jacutin Fog | Lindane |
| K 31 | 1,1,1-Trichloroethane |
| Kanechlor | Polychlorinated biphenyls |
| Lanadin | Trichloroethene |
| Lead | Lead and its inorganic compounds |
| Lead chloride | Lead and its inorganic compounds |
| Lead dichloride | Lead and its inorganic compounds |
| Lead monoxide | Lead and its inorganic compounds |
| Lead tetraethyl | Lead compounds - organic |
| Lead tetramethyl | Lead compounds - organic |

| | |
|---|---|
| Lead(II) chloride | Lead and its inorganic compounds |
| Lead(II) oxide | Lead and its inorganic compounds |
| Lindane | Lindane |
| Litharge | Lead and its inorganic compounds |
| Lysoform | Formaldehyde |
| Malathion | Malathion |
| Malix | Endosulfan |
| Mecloran | 1,1,1-Trichloroethane |
| Mendrin | Endrin |
| Mercaptothion | Malathion |
| Mercuric chloride | Mercury |
| Mercuric oxide | Mercury |
| | Mercury |

| | |
|---|---|
| Mercury | |
| Mercury(II) chloride | Mercury |
| Mercury(II) oxide | Mercury |
| Metallic arsenic | Arsenic |
| Methacide | Toluene |
| Methanal | Formaldehyde |
| Methane trichloride | Chloroform |
| Methyl aldehyde | Formaldehyde |
| Methyl bromide | Methyl bromide |
| Methyl chloroform | 1,1,1-Trichloroethane |
| Methyl fluid | Lead compounds - organic |
| Methyl trichloride | Chloroform |
| 2-Methyl-4,6-dinitrophenol | Dinitro-o-cresol |
| | Toluene |

| | |
|---|---|
| Methylbenzene | Toluene |
| Methyleneoxide | Formaldehyde |
| Methylhydroxybenzene | Cresols |
| Methylphenol | Cresols |
| Methyltrichloromethane | 1,1,1-Trichloroethane |
| Methylviologen | Paraquat |
| Mineral naphtha | Benzene |
| Monochloroethene | Vinyl chloride |
| Monohydroxybenzene | Phenol |
| Morbicid | Formaldehyde |
| Motor benzol | Benzene |

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**Continued**

| | |
|---|---|
| N-oxides | Nitrogen oxides |
| Naphthalene | Naphthalene |
| 1-Naphthalenyl-methylcarbamate | Carbaryl |
| 1-Naphthyl-methylcarbamate | Carbaryl |
| NCI-CO4626 | 1,1,1-Trichloroethane |
| Nema | Tetrachloroethene |
| Neocid | DDT |
| Neocidol | DDT |
| Nickel | Nickel |
| | Nickel |

| | |
|---|---|
| Nickel catalyst | |
| Nickel tetracarbonyl | Nickel |
| Nickel(II) chloride (hexahydrate) | Nickel |
| Nitrate | Nitrate |
| Nitrogen dioxide | Nitrogen oxides |
| Nitrogen monoxide | Nitrogen oxides |
| Nitrogen oxide | Nitrogen oxides |
| Nitrogen oxides | Nitrogen oxides |
| Nitrogen peroxide | Nitrogen oxides |
| Nitrogen(II)oxide | Nitrogen oxides |
| Nitrogen(IV)oxide | Nitrogen oxides |
| Nitrous gases | Nitrogen oxides |
| NOx | Nitrogen oxides |

| | |
|---|---|
| Nuvan | Dichlorvos |
| 1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-tetrahydro-4,7-endo-methanoindane | Chlordane |
| Octalen | Aldrin |
| Octalox | Dieldrin |
| Oxirane | Epichlorohydrin |
| Oxomethane | Formaldehyde |
| Oxybenzene | Phenol |
| Oxymethylene | Formaldehyde |
| Ozone | Ozone |
| p,p’-Dichlorodiphenyltrichloroethane | DDT |
| PAH | Polycyclic aromatic hydrocarbons |
| Panam | Carbaryl |
| Paraquat | Paraquat |

| | |
|---|---|
| Parathion | Parathion |
| Parathion-ethyl | Parathion |
| PCB | Polychlorinated biphenyls |
| PCDD | Dioxins |
| PCDD/F | Dioxins |
| PCDF | Dioxins |
| PCN | Chlorinated naphthalenes |
| PCP | Chlorophenols |
| Penchlorol | Chlorophenols |
| Penta | Chlorophenols |
| 2,3,4,5,6-Pentachlorophenol | Chlorophenols |
| Pentachlorophenol | Chlorophenols |
| | Chlorophenols |

| | |
|---|---|
| Pentacon | Chlorophenols |
| Pentakil | Chlorophenols |
| PER | Tetrachloroethene |
| Peran | Tetrachloroethene |
| Perawin | Tetrachloroethene |
| Perc | Tetrachloroethene |
| Perchloroethene | Tetrachloroethene |
| Perclone | Tetrachloroethene |
| Perm-a-chlor | Trichloroethene |
| Phene | Benzene |
| Phenic acid | Phenol |
| Phenoclor | Polychlorinated biphenyls |
| Phenol | Phenol |

| | |
|---|---|
| Phenyl acid | Phenol |
| Phenyl hydrate acid | Phenol |
| Phenyl hydroxide | Phenol |
| Phenylmethane | Toluene |
| Plumbum | Lead and its inorganic compounds |
| Polychlorinated biphenyls | Polychlorinated biphenyls |
| Polychlorinated dibenzo-p-dioxins | Dioxins |
| Polychlorinated dibenzofurans | Dioxins |
| Polycyclic aromatic hydrocarbons | Polycyclic aromatic hydrocarbons |
| 2-Propenal | Acrolein |
| Propenal | Acrolein |
| Pyralene | Polychlorinated biphenyls |
| Pyranol | Polychlorinated biphenyls |

| | |
|---|---|
| Pyridine | Pyridine |
| Pyridinum | Pyridine |
| Pyroclor | Polychlorinated biphenyls |
| Quicksilver | Mercury |
| R20 | Chloroform |
| Raney nickel | Nickel |
| Sandovac | Formaldehyde |
| Santophen20 | Chlorophenols |
| Seedrin | Aldrin |
| Serpentine asbestos | Asbestos |
| Sevidol and many others | Carbaryl |
| Sevin | Carbaryl |
| | Tetrachloroethene |

| | |
|---|---|
| Sirius 2 | |
| Sodium dichromate (dihydrate) | Chromium |
| Solvethane | 1,1,1-Trichloroethane |
| Sontobrite | Chlorophenols |
| Sovtol | Polychlorinated biphenyls |
| Stibine | Antimony |
| Sulphur dioxide | Sulphur dioxide |
| Sulphur oxide | Sulphur dioxide |
| Sulphur(IV)oxide | Sulphur dioxide |
| Sulphuretted hydrogen | Hydrogen sulphide |
| Sulphurous acid anhydride | Sulphur dioxide |
| Sulphurous anhydride | Sulphur dioxide |
| Superslysoform | Formaldehyde |

| | |
|---|---|
| 2,4,5-T | 2,4,5-Trichlorophenoxy acetic acid |
| (T-4) Nickel carbonyl | Nickel |
| Tannosynt | Formaldehyde |
| Tar camphor | Naphthalene |
| 2,3,7,8-TCDD | Dioxins |
| TEL | Lead compounds - organic |
| Telclair X 31 | 1,1,1-Trichloroethane |
| Terabol | Methyl bromide |
| Terraklene | Paraquat |
| 2,3,7,8-Tetrachlorodibenzo-1,4-dioxin | Dioxins |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin | Dioxins |
| 1,1,2,2-Tetrachloroethene | Tetrachloroethene |
| Tetrachloroethene | Tetrachloroethene |

| | |
|---|---|
| Tetraethyl plumbum | Lead compounds - organic |
| Tetraethyllead | Lead compounds - organic |
| Tetralex | Tetrachloroethene |
| Tetralina | Tetrachloroethene |
| Tetramethyllead | Lead compounds - organic |
| Tetramethylplumbum | Lead compounds - organic |
| Thallium | Thallium |
| Thiodan | Endosulfan |
| Thiofor | Endosulfan |
| TML | Lead compounds - organic |
| Toluene | Toluene |
| Tremolite | Asbestos |
| | 1,1,1-Trichloroethane |

| | |
|---|---|
| 1,1,1-Tri | |
| Tri | Trichloroethene |
| Triasol | Trichloroethene |
| Trichloran | Trichloroethene |
| 1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane | DDT |
| 1,1,1-Trichloroethane | 1,1,1-Trichloroethane |
| Trichloroethene | Trichloroethene |
| Trichloromethane | Chloroform |
| 2,4,5-Trichlorophenoxy acetic acid | 2,4,5-Trichlorophenoxy acetic acid |
| Triclene | Trichloroethene |
| Tricresol | Cresols |
| Triethane | 1,1,1-Trichloroethane |
| Trimar | Trichloroethene |

| | |
|---|---|
| Trioxygen | Ozone |
| TT | 1,1,1-Trichloroethane |
| Vanadic acid anhydride | Vanadium |
| Vanadic anhydride | Vanadium |
| Vanadium pentaoxide | Vanadium |
| Vanadium pentoxide | Vanadium |
| Vanadium(V)oxide | Vanadium |
| Vapona | Dichlorvos |
| VC | Vinyl chloride |
| VCM | Vinyl chloride |
| Vinyl chloride | Vinyl chloride |
| Vitran | Trichloroethene |
| Vobaderin | Formaldehyde |

| | |
|---|---|
| Vythene C | 1,1,1-Trichloroethane |
| Wacker 3X1 | 1,1,1-Trichloroethane |
| Weedol | Paraquat |
| Weedone | Chlorophenols |
| White arsenic | Arsenic |
| Witherite | Barium |
| Zerdane | DDT |
| Zinc | Zinc |
| Zinc clippings | Zinc |
| Zinc dust | Zinc |
| Zinc folings | Zinc |
| Zinc powder | Zinc |

### 5.4.3 Explanatory notes (description of content of information sheets)

**SUBSTANCE DESIGNATION**

***CAS No.:*** **Chemical Abstract Service Registry number**

***Registry name:*** **Name according to common usage. Mainly for pesticides, these designations have become common practice.**

***Chemical name:*** **Name according to chemical systematics (generally acc. to IUPAC)**

***Synonyms, Tradenames:*** **Additional common and chemical names which are used less frequently and names given by major manufacturers to their proprietary products.**

***Chemical name (German):*** **Generally the systematic name in German**

***Chemical name (French):*** **Generally the systematic name in French**

***Appearance:*** **Properties which may be perceived at first sight such as colour, physical state and odour**

**Basic chemical and physical data**

**This section contains an outline of the most important chemical and physical data of the treated substance. For groups of substances, data are given on typical compounds. The data refer to room temperature (20C / 293.15 K) and normal pressure (1.013 bar / 1.013 x $10^5$ Pa) if not indicated otherwise.**

**The following chemicophysical data are given for each of the treated substances:**

***Empirical formula / Chemical symbol:***

***Rel. molecular mass: / Rel. atomic weight:***
***Density:***
***Relative gas density:***
***Boiling point:***
***Melting point:***
***Vapour pressure:***
***Flash point:***
***Ignition temperature:***
***Explosion limits:***
***Odour threshold:***
***Solvolysis/solubility:***
***Conversions factors:***

**Temperature units:**

| | C | K | F |
|---|---|---|---|
| C | $T_C$ | $T_C$+273.15 | (9/5)$T_C$+32 |
| K | $T_K$-273.15 | $T_K$ | (9/5)$T_K$-459.67 |
| F | (5/9)($T_F$-32) | (5/9)($T_F$+459.67) | $T_F$ |

**Notes:**

**C Degree Celsius**
**$T_C$ Temperature in degree Celsius**

**K Degree Kelvin**
**$T_K$ Temperature in degree Kelvin**
**F Degree Fahrenheit**
**$T_F$ Temperature in degree Fahrenheit**

**Pressure units:**

| bar | Pa | N/mm$^2$ | kp/mm$^2$ | at | kp/m$^2$ | Torr | atm | lbf/in$^2$ | lbf/ft$^2$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | $10^5$ | 0.1 | 0.0102 | 1.0197 | 10197 | 750.06 | 0.9869 | 14.5037 | 20886 |

**Notes:**

**1 kP/m$^2$ = 1 mm water column**
**1 Torr = 1 mm Hg**

**Decimal parts and multiples of SI units:**

| Prefix | Pico | Nano | Micro | Milli | Centi | Deci | Deca | Hecto | Kilo | Mega | Giga |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Symbol | p | n | µ | m | c | d | da | h | k | M | G |
| Decimal power | -12 | -9 | -6 | -3 | -2 | -1 | 1 | 2 | 3 | 6 | 9 |

**ORIGIN AND USE**

**This information block contains**

- **Usage**
- **Origin and derivation**
- **Production and emissions**

**Whereas there is usually clear-cut information available on the first two items, this is not the case for the latter. Data on production and emissions are mostly estimates and computations.**

**Toxicity**

**The toxicity data are the results of various tests. Although both the methods and the boundary conditions of these tests may vary significantly, they are usually not specified in the pertinent literature. Thus, a comparison of the data is generally impossible. An assessment of the toxicity of a substance is rendered even more difficult as the tests have been carried out with various animals, concentrations, methodology and times of exposure.**

**The toxicological data provided have been selected from the numerous values available for certain substances with a view to achieve comparability.**

**Characteristic effects:**

**A brief description is given of important findings usually from the field of human medicine. In most cases they are the result of workplace exposure and not always epidemiological. The results of animal experiments are included for better understanding of the characteristic effects. Generally speaking, these are the only points of reference on the potential hazard of these substances to humans and other higher organisms.**

**ENVIRONMENTAL BEHAVIOUR**

**The occurrence of substances and the environmental behaviour are reported for the following environmental**

**components:**

- **Water**
- **Soil**
- **Air.**

**Because of the close links between the individual ecosystems, such a classification is merely formal. The brief description of the most important environmental media affected by a substance should not lead readers to ignore the exchange of substances between the various compartments. The data provided are intended to permit a rough estimate of the potential hazard of the substances in the respective areas. Certain variables such as accumulation and adsorption coefficients which are seldom incorporated into an environmental impact assessment, have deliberately not been included. If necessary, they can be taken from the literature cited.**

## ENVIRONMENTAL STANDARDS

| Medium/acceptor | Sector | Country/organ. | Status | Value | Cat. | Remarks | Source |
|---|---|---|---|---|---|---|---|

**In this section, a list of the substance-related laws, guidelines and recommendations is given from a wide range of countries, organisations and institutes. They have been arranged in tabular form according to environmental media and sectors in order to permit a direct comparison of identical or similar stipulations. In addition to the differences between the assessments of the chemical hazard, the special demands and prerequisites linked to individual regulations have to be considered.**

**Problems have frequently been encountered when assessing the status of laws and recommendations. Thus, five categories have been used:**

**L = Limit value set by law**

**(L) = Limit value suspected to be set by law**

**G = Guideline or recommendation from a government or non-governmental organisation**

**(G)**

**= Recommendation from a group of experts whose status has not been generally accepted as a national guideline yet**
**= There is no entry when the reported value cannot be assigned to any of the above categories.**

**Whenever there was any doubt on the status of a given value or its practical implementation, the next step down the scale was chosen. Thus, e.g. the American TWA/STEL values and the Russian PdK values are classed as (L). The column "Cat." (= Category) has only been filled in if it has been possible to clearly attribute the data to a comprehensive piece of legislation in the country concerned (TWA, PdK, MAK, MIK etc.). The column "Remarks" features a more detailed description of the reference to enhance comparability.**

**Comparison/reference values**

| **Medium/origin** | **Country** | **Value** | **Source** |
|---|---|---|---|

**The data listed are intended to facilitate evaluation by way of comparison of comprehensible factors or situations at known locations. Whenever possible, the selection also includes extreme values to give an impression of the spectrum of data found in the literature.**

**The source reference "acc." indicates a secondary source (e.g. acc. UBA).**

**Assessment/comments**

**A brief text outlines the aspects to be considered for risk assessment. In certain cases, reference is made to special properties to be observed when handling and using the substance. However, these comments should not be taken as a summary of the information sheet.**

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### 5.4.4 Information sheets arranged according to chemical substances and groups of substances - in alphabetical order

- Chlordane
- Chlorinated naphthalenes
- Chlorine
- Chloroform
- Chlorophenols
- Chromium
- Cobalt
- Copper
- Cresols
- DDT
- 2,4-Dichlorophenoxy acetic acid
- Dichlorvos
- Dieldrin
- Dinitro-o-cresol
- Dioxins
- Endosulfan
- Endrin
- Epichlorohydrin
- Formaldehyde
- Hexachlorobenzene
- Hydrogen fluoride
- Hydrogen sulphide
- Lead and its inorganic compounds
- Lead and its organic compounds
- Lindane
- Malathion
- Mercury

# Acrolein

## DESIGNATIONS

***CAS No.:*** **107-02-8**
***Registry name:*** **Acrolein**
***Chemical name:*** **2-Propenal**
***Synonyms, Trade names:*** **Propenal, acrylaldehyde, allylaldehyde**
***Chemical name (German):*** **Acrolein, 2-Propenal**
***Chemical name (French):*** **Acroline, 2-propnal**
***Appearance:*** **colourless or yellowish liquid with penetrating odour**

## BASIC CHEMICAL AND PHYSICAL DATA

***Empirical formula:*** $C_3H_4O$
***Rel. molecular mass:*** **56.06 g**
***Density:*** **0.84 g/cm$^3$**
***Relative gas density:*** **1.94**
***Boiling point:*** **52.5C**
***Melting point:*** **-87C**
***Vapour pressure:*** **29.3 x 10$^3$ Pa**
***Flash point:*** **-26C (closed cup)**
***Ignition temperature:*** **280C**
***Explosion limits:*** **2.8 - 31 vol.% (in air)**
***Odour threshold:*** **0.2-0.4 ppm**
***Solvolysis/solubility:***

**in water: 21.4 wt%**
**soluble in organic solvents**

***Conversion factors:***

**1 ppm = 2.33 $mg/m^3$**

**1 $mg/m^3$ = 0.43 ppm**

## ORIGIN AND USE

***Usage:***

**Acrolein is an important intermediate used mainly for the production of D,L-methionine (essential amino acid as an animal feed supplement) or acrylic acid (used to make acrylates). Furthermore, it is used as a very effective broad spectrum aquatic biocide e.g. to control the growth of aquatic weeds. On account of its low odour and irritation threshold, acrolein is added to other highly toxic substances as a warning agent.**

***Origin/derivation:***

**Acrolein is produced by heterogeneously catalyzed gas-phase oxidation of propene. Acrylic acid and carbon oxides are the by-products of this reaction.**

## Toxicity

| | | |
|---|---|---|
| *Humans:* | LCLo 153 ppm, inhalation (10 min) | acc. UBA, 1986 |
| | TCLo 1 ppm, inhalation | acc. UBA, 1986 |
| | TCLo 330 ppb, inhalation (child, 2 h) | acc. UBA, 1986 |

| | | |
|---|---|---|
| *Mammals:* | | |
| Rat: | LCLo 8 ppm, inhalation (4h) | acc. UBA, 1986 |
| | $LD_{50}$ 46 mg/kg, oral | acc. UBA, 1986 |
| | $LD_{50}$ 50 mg/kg, subcutaneous | acc. UBA, 1986 |
| Mouse: | $LC_{50}$ 66 ppm, inhalation (6 h) | acc. UBA, 1986 |
| | $LD_{50}$ 40 mg/kg, oral | acc. UBA, 1986 |
| | LDLo 2 mg/kg, intraperitoneal | acc. UBA, 1986 |
| *Aquatic organisms:* | | |
| Fish: | 1-5 ppm lethal | acc. UBA, 1986 |
| Aquatic plants: | 1.5-7.5 mg/l toxic | acc. UBA, 1986 |

| | | |
|---|---|---|
| Cold-blooded animals: | 0.05-5 mg/l toxic | acc. UBA, 1986 |

**Characteristic effects:**

***Humans/mammals:*** **Poisoning results in severe irritation of the eyes, the skin and the respiratory organs as well as the gastro-intestinal region. Slight exposure causes disorders of the central nervous system accompanied by dizziness, drowsiness and loss of consciousness. High concentrations cause severe burns as well as bronchitis, pneumonia and pulmonary oedemas. A mutagenic effect has only been observed to date amongst protozoons.**

## ENVIRONMENTAL BEHAVIOUR

**Acrolein is a poisonous, highly flammable and volatile liquid which is a hazard to all types of water and in particular to drinking water (water hazard class 2). Extremely small concentrations are sufficient (as a function of the pH) to have a toxic effect on aquatic organisms.**

**Acrolein is a constituent part of photochemical smog and - in addition to oxidation in air - is photolysed to form carbon monoxide, carbon dioxide and water as well as unsaturated hydrocarbons.**

**On the whole, acrolein is not very persistent, highly reactive and capable of being subjected to relatively rapid physical and chemical degradation. There is presumed to be no bioaccumulation (KOCH, 1989).**

## ENVIRONMENTAL STANDARDS

| Medium/ acceptor | Sector | Country/ organ. | Status | Value | Cat. | Remarks | Source |
|---|---|---|---|---|---|---|---|
| *Air:* | | D | L | 0.01 mg/m$^3$ | | Long-time value | acc. BAUM, 1988 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | D | L | 0.025 mg/m$^3$ | | Short-time value | acc. BAUM, 1988 |
| | Emiss. | D | L | 20 mg/m$^3$ | | mass flow > 0,1 kg/h | acc. TA Luft, 1986 |
| | | DDR | (L) | 0.02 mg/m$^3$ | | Short-time value | acc. HORN, 1989 |
| | | DDR | (L) | 0.01 mg/m$^3$ | | Long-time value | acc. HORN, 1989 |
| | | H | (L) | 0.1 mg/m$^3$ | | | acc. STERN, 1986 |
| | | IL | (L) | 0.1 mg/m$^3$ | | 24 h | acc. STERN, 1977 |
| | | IL | (L) | 0.25 mg/m$^3$ | | 30 min | acc. STERN, 1977 |
| | | SU | (L) | 0.03 mg/m$^3$ | | 24 h, 30 min | acc. STERN, 1977 |
| | Workp | D | L | 0.25 mg/m$^3$ | MAK | | DFG, 1989 |
| | Workp | DDR | (L) | 0.3 mg/m$^3$ | | Short-time value | acc. HORN, 1989 |
| | Workp | SU | (L) | 0.2 mg/m$^3$ | | | acc. SORBE, 1989 |
| | Workp | USA | (L) | 0.25 mg/m$^3$ | TWA | | ACGIH, 1986 |
| | Workp | USA | (L) | 0.8 mg/m$^3$ | STEL | | ACGIH, 1986 |

### Assessment/comments

**In view of the fact that acrolein is a considerable hazard to water, its use is to be avoided in the vicinity of water reclamation sites and groundwater recharge areas. A comprehensive assessment cannot yet be given on account of the lack of findings with regard to environmental behaviour and toxicity.**

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# Aldrin

## DESIGNATIONS

*CAS No.:* 309-00-2

*Registry name:* Aldrin

*Chemical name:* 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-endo,exo-5,8-dimethano-naphthalene

*Synonyms, Trade names:* Hexachlorodimethanonaphthalene, HHDN, Aldrex, Octalen, Seedrin

*Chemical name (German):* Aldrin, 1,2,3,4,10,10-Hexachlor-1,4,4a,5,8,8a-hexahydro-1,4-endo,exo-5,8-dimethano-naphthalin

***Chemical name (French):*** **Aldrin, hexachloro-1,2,3,4,10,10-hexahydro-1,4,4a,5,8,8a-exodimthano-1,4,5,8-naphthalne**

***Appearance:*** **white, odourless, crystalline solid; technical product is dark brown**

## BASIC CHEMICAL AND PHYSICAL DATA

***Empirical formula:*** $C_{12}H_8Cl_6$
***Rel. molecular mass:*** **364.91 g**
***Density:*** **1.70 g/cm$^3$**
***Relative gas density:*** **12.6**
***Boiling point:*** **145C**
***Melting point:*** **104-105.5C, technical product: 49-60C**
***Vapour pressure:*** **3.07 x 10$^{-3}$ Pa**
***Solvolysis/solubility:*** **in water: < 50 mg/l soluble in petroleum, acetone, benzene and xylene; extremely soluble in fat**
***Conversion factors:***

**1 ppm = 15.2 mg/m$^3$**
**1 mg/m$^3$ = 0.07 ppm**

## ORIGIN AND USE

***Usage:***
**Aldrin is a broad-spectrum insecticide used in particular to combat soil and cotton pests as well as locusts.**

***Origin/derivation:***

**Technically, aldrin is produced from cyclopentadiene by stepwise Diels-Alder reaction with acetylene and hexachlorocyclopentadiene. In the environment, aldrin is produced by decomposition of dieldrin; it is converted to dieldrin in organisms. Refer also to "dieldrin".**

**Toxicity**

| | | |
|---|---|---|
| *Mammals:* | | |
| Rat: | $LD_{50}$ 67 mg/kg, oral | acc. VERSCHUEREN, 1983 |
| | $LD_{50}$ 98-200 mg/kg, dermal | acc. VERSCHUEREN, 1983 |
| Mouse: | $LD_{50}$ 44 mg/kg, oral | acc. MERCIER, 1981 |
| Dog: | $LD_{50}$ 65-95 mg/kg, oral | acc. MERCIER, 1981 |
| *Aquatic organisms:* | | |
| Cyprinodont | $LC_{50}$ 4-8 ppb (96 h) | acc. VERSCHUEREN, 1983 |
| Mugilidae | $LC_{50}$ 100 ppb (96 h) | acc. VERSCHUEREN, 1983 |
| American minnow | $LC_{50}$ 28 g/l (96 h) | acc. VERSCHUEREN, |

| | | |
|---|---|---|
| | | 1983 |
| Blue perch | LC$_{50}$ 13 g/l (96 h) | acc. VERSCHUEREN, 1983 |
| Rainbow trout | LC$_{50}$ 10-17.7 g/l (96 h) | acc. VERSCHUEREN, 1983 |
| Water flea | LC$_{50}$ 30 g/l (24 h) | acc. VERSCHUEREN, 1983 |
| | LC$_{50}$ 28 g/l (48 h) | acc. VERSCHUEREN, 1983 |

**Characteristic effects:**

***Humans/mammals:*** **Aldrin damages the central nervous system and the liver. Typical symptoms of acute poisoning are agitation, convulsions and paralysis. Aldrin is readily absorbed in the organism and transformed to dieldrin within 12-24 hours. A carcinogenic effect has been found to date in animal experiments with various species.**

## ENVIRONMENTAL BEHAVIOUR

***Water:***
**Due to its considerable toxicity to aquatic organisms and its high level of persistence in water aldrin is assigned in Germany to water hazard class 3 (highly hazardous).**

***Air:***
**Photochemical transformation of aldrin readily takes place in the atmosphere.**

***Soil:***

**Accumulation is found in soil on account of the high persistence of the substance.**

***Half-life:***

**In river water with an initial concentration of 10 μ g/l kept in a sealed glass jar in sunlight and under artificial fluorescent light, there was hardly any degradation after 1 week. After 4 weeks 60%, after 8 weeks 80% had been degraded to dieldrin. Between 0 and 25 % of a given quantity can still be found in soil after 1 - 6 years.**

***Degradation, decomposition products:***

**Under oceanic conditions, aldrin is metabolised either directly or by transformation to dieldrin to form aldrindiol. In the atmosphere, aldrin decomposes to form photoaldrin or photodieldrin by transformation to dieldrin. Photooxidation due to UV-light decomposes some 75% of a given quantity (at 90 - 95C) in water to form carbon dioxide, hydrogen chloride and water after more than 100 hours (VERSCHUEREN, 1983).**

***Food chain:***

**The presence of aldrin has been detected in mother's milk (MERCIER, 1981).**

## ENVIRONMENTAL STANDARDS

| **Medium/acceptor** | **Sector** | **Country/organ.** | **Status** | **Value** | **Cat.** | **Remarks** | **Source** |
|---|---|---|---|---|---|---|---|
| *Water:* | Drinkw | USA | G | 0.001 mg/l | | Illinois state | acc. WAITE, 1984 |
| | Waste water | EC | L | 5 mg/l | | Seawater | acc. LEROY, 1985 |
| | Waste water | EC | L | 5 mg/l | | Freshwater | acc. LEROY, 1985 |
| *Air:* | Workp | D | L | 0.25 mg/m$^3$ | MAK | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Workp | D | L | 0.25 mg/m$^3$ | MAK | | DFG, 1989 |
| | Workp | SU | (L) | 0.01 mg/m$^3$ | PDK | Skin | acc. KETTNER, 1979 |
| | Workp | USA | (L) | 0.25 mg/m$^3$ | TWA | Skin | ACGIH, 1986 |
| | Workp | USA | (L) | 0.75 mg/m$^3$ | STEL | | ACGIH, 1986 |
| *Foodstuffs:* | | WHO | G | 0.0001 mg/(kg d) | ADI | Aldrin + Dieldrin | acc. VETTORAZZI, 1979 |
| | | WHO | G | 0.03-0.3 mg/kg | | Residue tolerance limit | acc. VERSCHUEREN, 1983 |

***Note:* The Order Governing the Use of Pesticides has provided for a complete ban since 1988.**

**Comparison/reference values**

| **Medium/origin** | **Country** | **Value** | **Source** |
|---|---|---|---|
| Areas of water | | | |
| Northern Mississippi | USA | 0.01-0.49 ng/l | acc. VERSCHUEREN, 1983 |
| Hawaii (sediment) | USA | 5.5-11.02 µ g/kg | acc. VERSCHUEREN, 1983 |
| Anchovies, Mediterranean, 1976/77 | | 0.1-0.8 µ g/kg fresh wt. (n=12) | acc. VERSCHUEREN, 1983 |

| | | | |
|---|---|---|---|
| Tuna, Mediterranean, 1976/77 | | 0.1-0.2 µ g/kg fresh wt. (n=5) | acc. VERSCHUEREN, 1983 |

**Assessment/comments**

**(refer to "dieldrin" information sheet)**

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# Antimony

## DESIGNATIONS

***CAS No.:* 7440-36-0**
***Registry name:* Antimony**
***Chemical name:* Antimony**
***Synonyms, Trade names:***
***Chemical name (German):* Antimon**
***Chemical name (French):* Antimoine**
***Appearance:* brittle grey metal with silvery white sheen**

## BASIC CHEMICAL AND PHYSICAL DATA

| | |
|---|---|
| *Chemical Symbol:* | Sb |
| *Rel. atomic mass:* | 121.75 g |
| *Density:* | 6.68 g/$cm^3$ |
| *Boiling point:* | 1,380C |
| *Melting point:* | 630C |
| *Solvolysis/solubility:* | in water: insoluble |

**BASIC DATA ON SELECTED COMPOUNDS**

| | | |
|---|---|---|
| *CAS No:* | 7803-52-3 | 1309-64-4 |
| *Chemical name* | Antimony hydride | Antimony trioxide |
| *Synonyms, Trade names* | Stibine | |
| *Chemical name (German):* | Antimonwasserstoff | Antimontrioxid |
| *Chemical name (French):* | Hydrure d’antimoine | Trioxyde d’antimoine |
| *Appearance*: | colourless, foul smelling gas | white crystalline powder |
| *Empirical formula:* | $SbH_3$ | $Sb_2O_3$ |
| *Rel. molecular mass:* | 124.8 g | 291.5 g |

| | | |
|---|---|---|
| *Density*: | 5.68 g/l | 5.2-5.8 g/cm$^3$ |
| *Relative gas density* | 4.3 | |
| *Boiling point* | -18C | 1456C |
| *Melting point:* | -88C | 656C |
| *Solvolysis/solubility:* | in water: 200 ml/l | in water: 0.014 g/l |
| *Conversion factors:* | 1 ppm = 5.19 mg/m$^3$<br>1 mg/m$^3$ = 0.19 ppm | |

**ORIGIN AND USE**

***Usage:***
**Metallic antimony is mainly used in alloys with lead or tin; its compounds have a wide range of industrial uses e.g. in the manufacture of fireproof fabrics, rubber and synthetics, glass and ceramics, matches, explosives and pyrotechnic materials as well as medicines.**

***Origin/derivation:***
**Antimony is an element which makes up 0.001 % of the Earth's crust.**

***Production figures:***
**World production of primary antimony in tons of metal (1986):**

| | |
|---|---|
| China | 14,000 |

| | |
|---|---|
| Bolivia | 10,243 |
| South Africa | 7,024 |
| USSR | 6,000 |
| World | 55,533 |

**(figures taken from FISCHER WELTALMANACH, 1989)**

**Toxicity**

| *Mammals:* | | |
|---|---|---|
| Rat | $LD_{50}$ 4,480 mg/kg, oral (antimony acetate) | acc. DVGW, 1985 |
| | $LD_{50}$ 115 mg/kg, oral (antimony potassium tartrate) | acc. DVGW, 1985 |
| | $LD_{50}$ 20,000 mg/kg, oral (antimony(III)oxide) | acc. DVGW, 1985 |
| Mouse | $LD_{50}$ 600 mg/kg, oral (antimony potassium tartrate) | acc. DVGW, 1985 |

| | | |
|---|---|---|
| *Aquatic organisms:* | | |
| Fish | LCLo 10-100 ppm (96h), (antimony compounds) | acc. UBA, 1986 |

**Characteristic effects:**

***Human/mammals:*** **The toxicity of antimony compounds is comparable to that of arsenic, but as antimony compounds are hardly absorbed in the gastrointestinal tract, there is less hazard of acute poisoning. In addition, antimony compounds often cause vomiting thus being removed from the organism. Chronic poisoning may result in damage to the liver, the kidneys and even the heart and the circulatory system. The symptoms differ among the compounds. Stibine accumulates in fatty tissue.**

## ENVIRONMENTAL BEHAVIOUR

**The background impact of antimony is 0.0005 - 1.1 mg/kg in soils and 0.04 - 3 μ g/l in surface and groundwater (DVGW, 1985). Antimony entering the soil by way of precipitation has been found to impair fertility. Antimony emissions are transported over great distances in the atmosphere.**

## ENVIRONMENTAL STANDARDS

| **Medium/acceptor** | **Sector** | **Country/organ.** | **Status** | **Value** | **Cat.** | **Remarks** | **Source** |
|---|---|---|---|---|---|---|---|
| *Water:* | Drinkw | EC | G | 0.01 mg/l | | | acc. DVGW, 1985 |
| *Soil:* | | D | G | 5 mg/kg | | In cultivated soil | acc. KLOKE, 1988 |

*Air:*

| | | | | | | |
|---|---|---|---|---|---|---|
| **Emiss.** | **D** | **L** | **20 mg/m$^3$** | | **mass flow > 25 g/h2)** | **acc. TA Luft, 1986** |
| Workp | AUS | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| Workp | B | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| Workp | CH | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| Workp | D | L | 0.5 mg/m$^3$ | MAK | | DFG, 1989 |
| Workp | DDR | L | 0.5 mg/m$^3$ | 'MAK' | | acc. MERIAN, 1984 |
| Workp | I | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| Workp | NL | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| Workp | PL | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| Workp | RO | (L) | 0.5 mg/m$^3$ | | Short-time value | acc. MERIAN, 1984 |
| Workp | RO | (L) | 0.2 mg/m$^3$ | | Long-time value | acc. MERIAN, 1984 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Workp | S | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| | Workp | SF | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| | Workp | SU | (L) | 0.5 mg/m$^3$ | | Short-time value1) | acc. Kettner, 1979 |
| | Workp | SU | (L) | 0.2 mg/m$^3$ | | Long-time value1) | acc. KETTNER, 1979 |
| | Workp | USA | (L) | 0.5 mg/m$^3$ | STEL | | ACGIH, 1986 |
| | Workp | YU | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |

***Note:***

***1)*** **The Soviet Union has produced a list of limit values ranging between 0.3 and 1 mg/m$^3$ for antimony compounds.**

**2) dustlike Sb and its compounds, stated as Sb**

**Comparison/reference values**

| Medium/origin | Country | Value | Source |
|---|---|---|---|
| Areas of water | | | |
| | D | 0.13 g/l | acc. DVGW, 1985 |

| | | | |
|---|---|---|---|
| Lake Constance (1982) | | | |
| Main (Hochheim, 1975) | D | 1.21 g/l | acc. DVGW, 1985 |
| Fulda (Fulda, 1975) | D | 0.062 g/l | acc. DVGW, 1985 |
| Rhine (Ludwigshafen, 1975) | D | 0.62 g/l | acc. DVGW, 1985 |

### ASSESSMENT/COMMENTS

**Antimony compounds are poisonous and exhibit a toxicological behaviour similar to that of arsenic. Little is known to date about the environmental risks involved. Water pollution seldom occurs because of the low solubility of most compounds. Extreme caution should be taken when coming into direct contact with antimony compounds.**

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# Arsenic

### DESIGNATIONS

***CAS No.:* 7440-38-2**
***Registry name:* Arsenic**
***Chemical name:* Arsenic**
***Synonyms, Trade names:* Grey arsenic, metallic arsenic**
***Chemical name (German):* Arsen**
***Chemical name (French):* Arsenic**
***Appearance:* bright silver-grey metal, brittle and of average hardness; other modifications: yellow (unstable), black**

## BASIC CHEMICAL AND PHYSICAL DATA

| | |
|---|---|
| *Chemical symbol:* | As |
| *Rel. atomic mass:* | 74.92 g |
| *Density:* | 5.72 g/cm$^3$ |
| *Boiling point:* | 613C (subl.) |
| *Melting point:* | 817C (at 3.7 MPa) |
| *Vapour pressure:* | 0 Pa |
| *Solvolysis/solubility:* | in water: very low |

## BASIC DATA ON SELECTED COMPOUNDS

| *CAS No:* | 1327-53-3 | 7784-42-1 |
|---|---|---|
| | | |

| | | |
|---|---|---|
| *Chemical name:* | Arsenic trioxide | Arsine |
| *Synonyms, Trade names:* | White arsenic | |
| *Chemical name (German):* | Arsentrioxid, Weiarsenik, Arsenik | Arsin, Arsenwasserstoff |
| *Chemical name (French):* | Arsenic | Arsine, hydrure d'arsenic |
| *Appearance:* | white powder or small white pieces, odourless | colourless gas with garlic-like odour |
| *Empirical formula:* | $As_2O_3$ | $AsH_3$ |
| *Rel. molecular mass:* | 197.82 g | 77.95 g |
| *Density:* | 3.7-3.87 g/cm$^3$ | 3.48 g/l |
| *Relative gas density:* | | 2.7 |
| *Boiling point:* | | -55C |
| *Melting point:* | 200C (subl.) | -117C |
| *Solvolysis/solubility:* | in water: 18 g/l | in water: 20 vol.% |
| *Conversion factors:* | 1 ppm = 0.12 mg/m$^3$<br>1 mg/m$^3$ = 8.22 ppm | 1 ppm = 0.31 mg/m$^3$<br>1 mg/m$^3$ = 3.24 ppm |

## ORIGIN AND USE

### *Usage:*

**The demand for metallic arsenic is limited. Arsenic is used in nonferrous alloys (e.g. to enhance the temper of lead-alloys) and highly pure arsenic is needed to produce GaAs- and InAs-semiconductors.**
**With the introduction of antibiotics, pharmaceutical products containing arsenic have become less important. Moreover, arsenic compounds have been used as pesticides (prohibited in Germany) and in the production of pigments.**

***Origin/derivation:***

**Arsenic is an element. The average arsenic content of the earth's crust has been estimated at $5 \times 10^{-4}$ %· It is mainly obtained from complex ores. France, the former USSR, Sweden and Mexico are the main arsenic producing countries.**

***Production figures:***
**Arsenic production in tons of $As_2O_3$ content per year (1978)**

| | |
|---|---|
| France | 7280 |
| USSR | 7640 |
| Sweden | 6706 |
| Mexico | 6263 |
| World | 40283 |

**(figures taken from ULLMANN 1985)**

**Toxicity**

| | | |
|---|---|---|
| *Humans:* | LDLo 1 mg/kg, oral (arsenic trioxide) | acc. Koch 1989 |
| | TCLo 0.5 ppm, inhalation (arsine) | acc. Koch 1989 |
| | LD 50 mg/m$^{3,}$ inhalation (arsine) | acc. Koch 1989 |
| *Mammals:* | | |
| Rat | $LD_{50}$ 4.5 mg/kg, oral ( arsenic trioxide) | acc. Koch 1989 |
| Mouse | $LD_{50}$ 43 mg/kg, oral ( arsenic trioxide) | acc. Koch 1989 |
| Rabbit | LDLo 4.5 mg/kg, oral ( arsenic trioxide) | acc. Koch 1989 |
| *Aquatic organisms:* | | |
| Fish | $LC_{50}$ 10-100 mg/l (96h), arsenic trioxide | acc. Koch 1989 |

**Characteristic effects:**

***Humans/mammals:* Pure arsenic is not toxic, but contaminations of technical arsenic (e.g. with $As_2O_3$) have to be considered. Acute poisoning mostly occurs by ingestion and inhalation of inorganic trivalent compounds such as $As_2O_3$. Symptoms are strong gastrointestinal disturbances, cramps and circulatory collapse. Airborne dusts often result in irritation of exposed skin and mucous membranes. Chronic poisoning can be caused by the intake of food and water with arsenicals or by inhalation of airborne dusts during long-term occupational exposure. Symptoms may appear even after many years of latency. Chronic poisoning results in damage to bone marrow, blood, liver,**

**respiratory tract and central nervous system.**

**Acute poisoning with arsine results in retarded but rapid hemolytic anemia.**

## ENVIRONMENTAL BEHAVIOUR

**In aquatic systems, arsenic mainly exists in the form of arsenides and arsenates. In sediments and soils, arsenates are readily absorbed at iron or aluminium hydroxides thus reducing their percolative abilities and speed as well as their availability for biological systems. In aquatic phases, arsenic forms insoluble precipitates with a number of compounds (Ca,S,Ba,Al,Fe) resulting in the elimination of arsenic compounds from the water. In microorganisms, plants and animals, methylation and reduction of arsenic compounds take place. Thus, a number of chemophysically and biologically stable arsenic compounds are produced [KOCH 1989].**

***Half-life:***
**The average biological half-life is about 60 days (rats/rabbits) due to the accumulation of arsenic in the erythrocytes. For humans, half-life is shorter because of a fast excretion of arsenic [KOCH 1989].**

## ENVIRONMENTAL STANDARDS

| Medium/ acceptor | Sector | Country/ organ. | Status | Value | Cat. | Remarks | Source |
|---|---|---|---|---|---|---|---|
| *Air:* | **Emiss.** | **D** | **L** | **0.2 mg/m$^3$** | | **mass flow > 5 g/h$^{2)}$** | **acc. TA Luft, 1986** |
| | Workp | D | L | 0.1 mg/m$^3$ | TRK | oxides, acids and their salts | acc. AUER Technikum 1988 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Workp | D | L | 0.2 mg/m$^3$ | MAK | arsine | acc. AUER Technikum 1988 |
| | Workp | USA | (L) | 1) | TWA | oxides | acc. AUER Technikum 1988 |
| | Workp | USA | (L) | 0.2 mg/m$^3$ | TWA | arsine | acc. AUER Technikum 1988 |
| | Workp | SU | (L) | 0.3 mg/m$^3$ | | oxides | acc. AUER Technikum 1988 |
| | Workp | SU | (L) | 0.3 mg/m$^3$ | | arsine | acc. AUER Technikum 1988 |

[1)] **suspected human carcinogens**

[2)] **dustlike As and its compounds, stated as As**

## ASSESSMENT/COMMENTS

**The toxicity of arsenic compounds differs significantly. Anorganic compounds are generally more toxic than organic ones. Some arsenic compounds are even carcinogenic. It is particularly significant as a workplace poison.**

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# Asbestos

## DESIGNATIONS

*CAS No.:* **1332-21-4**

*Registry name:* Asbestos

*Chemical name:* Asbestos

*Synonyms, Trade names: S*erpentine asbestos, amphibole asbestos, fibre asbestos, blue asbestos

*Chemical name (German):* Asbest

*Chemical name (French):* Amiante

*Appearance:* fibrous, impure minerals whose colour varies between pure white and green, brown or grey depending on the iron-oxide content; crocidolite is blue (blue asbestos); the fibres are between 20 and 25 nm long; asbestos fibres are smooth and greasy to the touch.

## BASIC CHEMICAL AND PHYSICAL DATA

Asbestos is not a chemical element, but rather an umbrella term for two groups of minerals (serpentine and amphibole asbestos)

| | Serpentine | Amphibole | | | | |
|---|---|---|---|---|---|---|
| | Chrysotile | Crocidolite | Amosite | Anthophyllite | Tremolite | Actinolite |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Empirical formula:* | $Mg_3 Si_20_5(OH)_4$ | $Na_2Fe_2(Fe,Mg)_3 Si_8O_{22} (OH)_2$ | $(Fe,Mg)_7 Si_8O_{22}(OH)_2$ | $Mg_7 Si_8O_{22}(OH)_2$ | $Ca_2Mg_5 Si_8O_{22}(OH)_2$ | $Ca_2(Mg,Fe)_5 Si_8O_{22}(OH)_2$ |
| *Rel. molecul. mass:* | 277.13 g | 1,008.82 g | 1,171.83 g | 780.88 g | 812.42 g | 1,091.67 g |
| *Density:* | 2.2-2.6 g/cm$^3$ | 2.8-3.6 g/cm$^3$ | 2.9-3.3 g/cm$^3$ | 2.8-3.2 g/cm$^3$ | 2.9-3.2 g/cm$^3$ | 3.0-3.21 g/cm$^3$ |
| *Melting point:* | 1,500C | 1,200C | 1,400C | 1,450C | 1,315C | 1,400C |

***Flash point:* asbestos is non-combustible, resistant to heat and features a low conductivity in water: insoluble**

## ORIGIN AND USE

***Usage:***
**Because of its heat-resistance and suppleness and its capacity for being incorporated into inorganic and organic binders, asbestos is used in industry for thermal insulation, fireproofing and sealing in addition to acting as a filler in the production of countless composites (more than 3000). Economic exploitation is centred on chrysotile asbestos from the serpentine group (95 %). 5 % of amphibole asbestos is used for asbestos-fibre production.**

**Spun asbestos is used for fireproof, chemical-resistant clothing. When mixed with cement, asbestos is cast to form panels and pipes (70 - 90 % of the world production is used in the construction industry in Western Europe; acc. WHO, 1987). Asbestos has also been used as a filter material in the drinks and pharmaceutical industry and for the manufacture of brake and clutch linings for motor vehicles.**

***Origin/derivation:***

**Asbestos is extremely widespread in nature. The most important deposits are to be found in the former Soviet Union, Canada and South Africa. Natural emissions are produced for example by the weathering of serpentine rocks.**

***Production figures:***
**Worldwide production in 1983 was in excess of 4 million tons (WHO, 1987). The main producers are as follows (WHO, 1986):**

| | | |
|---|---|---|
| USSR | 1983: | 2,250,000 t/a |
| Canada | 1983: | 820,000 t/a |
| South Africa | 1983: | 221,111 t/a |
| Brazil | 1983: | 158,855 t/a |
| Zimbabwe | 1983: | 153,221 t/a |
| Italy | 1983: | 139,054 t/a |
| China | 1983: | 110,000 t/a |

**Toxicity**

| | | |
|---|---|---|
| *Humans:* | TCLo 2.8 fibres/cm$^3$/5 years | acc. UBA, 1986 |
| | | |

| | | |
|---|---|---|
| | TCLo 1.2 fibres/$cm^3$/19 years without interruption | acc. UBA, 1986 |
| *Mammals:* | | |
| Rat | TDLo 100 mg/kg, intrapleural | acc. UBA, 1986 |

**As yet there are no known characteristic toxicology data (DVGW, 1988).**

**Characteristic effects:**

***Humans/mammals:*** **Various asbestos-induced illnesses are known from the industrial-medicine sector in which the size of the fibres plays a crucial role. Generally speaking, fibres with a diameter of less than 2 μ m and a length of more than 5 μ m are considered to be hazardous to health (diameter : length = 1 : 3). Such a fibre size is capable of entering the lungs, gathering there and becoming encapsulated. Fibres have also been found to have a certain migration capability in the organism and the cell metabolism. Accumulation in the lungs causes sclerosis of the pulmonary alveoli and thus impairs the oxygen exchange.**

**The inhalation of large quantities of fibre can cause asbestosis which increases the risk of bronchial cancer. In particular, dusts < 200 μ m are highly toxic and suspected of being a direct cause of tumours.**

**Exposure to asbestos irritates the eyes and the respiratory tract. Direct penetration into damaged skin produces excessive hornification. Fibres in the lungs bring about chronic bronchitis, irritation of the pleura and pleurisy. Distension of the lungs can result in lung cancer. Workplace exposure may produce periods of latency in the gastro-intestinal tract lasting up to 40 years.**

## ENVIRONMENTAL BEHAVIOUR

***Water:***

**Asbestos fibres cause water to become turbid, but are not soluble in water.**

*Air:*

**The dwell time in the atmosphere is dependent on the fibre size. Asbestos fibres can be transported over hundreds of kilometres in the atmosphere. Weathering produces short and thin asbestos fibres from the coarse dust.**

*Soil:*

**If asbestos fibres get into the soil, they accumulate on the surface and may be scattered again at any time. Particles in excess of 2 μ m are not washed into the soil pores. In the soil itself and in sediments, asbestos is considered to be harmless (DVGW, 1988). Asbestos dusts in refuse or on dumps must be covered or moistened during transportation to stop them ingressing into the air. Soils and sediments in general are considered as accumulation sites.**

*Half-life:*

**The half-life of fibres on mucous membranes is a matter of minutes - hours or days - years after penetration into the tissue (HORN, 1989).**

*Food chain:*

**Asbestos fibres penetrate into organisms via drinking water. The pollution of drinking water is caused by fibres in asbestos-cement pipes. The impact is a function of the calcium-carbonate saturation of the water and depends on the number of iron-oxide deposits in the pipes. There is as yet no proof of oral asbestos intake causing cancer.**

## ENVIRONMENTAL STANDARDS

| **Medium/ acceptor** | **Sector** | **Country/ organ.** | **Status** | **Value** | **Cat.** | **Remarks** | **Source** |
|---|---|---|---|---|---|---|---|
| *Air:* | Workp | A | L | | | | acc. Albracht, |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | 250,000 f/m$^3$ | | chrysotile [1991] | 1991 |
| Workp | B | L | 150,000 f/m$^3$ | | crocidolite [1987] | acc. Albracht, 1991 |
| Workp | B | L | 1,000,000 f/m$^3$ | | other asbestos [1987] | acc. Albracht, 1991 |
| Workp | CH | L | 1,000,000 f/m$^3$ | | dusts [1988] | acc. Albracht, 1991 |
| Workp | DK | L | 300,000 f/m$^3$ | | crocidolite, ceiling value (15min) [1988] | acc. Albracht, 1991 |
| Workp | DK | L | 300,000 f/m$^3$ | | other asbestos [1988] | acc. Albracht, 1991 |
| Workp | F | L | 500,000 f/m$^3$ | | crocidolite [1987] | acc. Albracht, 1991 |
| Workp | F | L | 1,000,000 f/m$^3$ | | other asbestos [1987] | acc. Albracht, 1991 |
| Workp | D | L | 250,000 f/m$^3$ | TRK | chrysotile [1990] | acc. Albracht, 1991 |
| Workp | D | G | 50,000 f/m$^3$ | TRK | crocidolite, remediation [1990] | acc. Albracht, 1991 |
| | | | | | crocidolite, 4h | acc. Albracht, |

| | | | | | | |
|---|---|---|---|---|---|---|
| Workp | GB | L | 200,000 f/m$^3$ | | [1984] | 1991 |
| Workp | GB | L | 500,000 f/m$^3$ | | other asbestos, 4h, [1984] | acc. Albracht, 1991 |
| Workp | DDR | L | 1,000,000 f/m$^3$ | | dusts [1983] | acc. Albracht, 1991 |
| Workp | DDR | L | 2,000,000 f/m$^3$ | | short time value (30 min) [1983] | acc. Albracht, 1991 |
| Workp | GR | L | 500,000 f/m$^3$ | | crocidolite [1988] | acc. Albracht, 1991 |
| Workp | GR | L | 1,000,000 f/m$^3$ | | other asbestos [1988] | acc. Albracht, 1991 |
| Workp | IRL | L | 500,000 f/m$^3$ | | crocidolite [1989] | acc. Albracht, 1991 |
| Workp | IRL | L | 1,000,000 f/m$^3$ | | other asbestos [1989] | acc. Albracht, 1991 |
| Workp | NL | L | 200,000 f/m$^3$ | | crocidolite, ceiling value (10 min) [1989] | acc. Albracht, 1991 |
| Workp | NL | L | 2,000,000 f/m$^3$ | | Other asbestos, 4h [1989] | acc. Albracht, 1991 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Workp | S | L | 200,000 $f/m^3$ | | asbestos (except chrysotile) [1987] | acc. Albracht, 1991 |
| | Workp | USA | L | 200,000 $f/m^3$ | | asbestos [1986] | acc. Albracht, 1991 |
| | Workp | USA | G | 200,000 $f/m^3$ | | amosite | ACGIH, 1988 |
| | Workp | USA | G | 500,000 $f/m^3$ | | crocidolite | ACGIH, 1988 |
| | Workp | USA | G | 2,000,000 $f/m^3$ | | chrysotile, other asbestos | ACGIH, 1988 |
| | Air | F | (L) | 0.1 $mg/m^3$ | | Emission (dust) | acc. MEEK et al, 1985 |
| | Emiss. | D | L | 0.1 mg/m3 | TA-L | fine dust, mass flow 0.5g/h | acc. TA Luft, 1986 |
| | | DDR | L | 0.005 mg/m3 | $MIK_k$ | | acc. HORN, 1989 |
| *Foodstuffs:* | Drinkw | USA | L | 7,100 $fibres/lx10^3$ | | Average and long fibres | acc. DVGW, 1988 |

***Note:* There is virtually a complete ban in Denmark on materials containing asbestos for production, import and utilization. Norway, Sweden and Holland control the asbestos content of insulating materials and consumer goods in supplementary legislation.**

### Comparison/reference values

| Medium/origin | Country | Value | Source |
|---|---|---|---|
| Surface water: | | | |
| Northern Lake Constance (1981) | D | < 5 fibres/l x $10^3$ 1) | acc. DVGW, 1988 |
| Southern Lake Constance (1981) | D | 10-20 fibres/l x $10^3$ 1) | acc. DVGW, 1988 |
| Franconian Forest (1981) | D | 10-50 fibres/l x $10^3$ 1) | acc. DVGW, 1988 |
| Bavarian Forest (1981) | D | < 5-30 fibres/l x $10^3$ 1) | acc. DVGW, 1988 |
| *Groundwater:* | | | |
| Northern Germany (1981) | D | 4-100 fibres/l x $10^3$ 1) | acc. DVGW, 1988 |
| Franconian Forest (1981) | D | < 5-60 fibres/l x $10^3$ 1) | acc. DVGW, 1988 |
| *Drinking water:* | | | |
| 10 utility companies (1981) | D | 5-1,000 fibres/l x $10^3$ 2) | acc. DVGW, 1988 |
| Montreal (1971) | CDN | 2,000-9,500 fibres/l x $10^3$ | acc. DVGW, 1988 |
| Toronto (1974) | CDN | 700-4,100 fibres/l x $10^3$ | acc. DVGW, 1988 |
| Duluth (1974) | USA | 20,000-75,000 fibres/l x $10^3$ | acc. DVGW, 1988 |

| | | | |
|---|---|---|---|
| Chicago (1977) | USA | 80-2,300 fibres/l x $10^3$ | acc. DVGW, 1988 |

**Note:**

**1) Asbestos fibres more than 5 μ m long**

**2) Utility companies with asbestos-cement pipes and a negative saturation index > 0.2 at tapping point**

**Assessment/comments**

**Asbestos fibres are released into the environment by natural and anthropogenic processes. The liberation of asbestos during the manufacture and processing of materials containing asbestos must be significantly reduced especially in confined areas and at workplaces because of the great hazard to the respiratory organs and in particular the lungs. There is increasing speculation that the oral intake of asbestos can cause tumours. Therefore, there is no justification for the further use of asbestos cement in drinking water pipes. Numerous products containing substitute materials are now making it possible to dispense with the use of substances containing asbestos.**

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# Atrazine

## DESIGNATIONS

***CAS No.:* 1912-24-9**
***Registry name:* Atrazine**
***Chemical name:* 2-Chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine**
***Synonyms, Trade names:* 6-Chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazin-2,4-diamine, 2-chloro-4-ethylamino-6-isopropylamino-s-triazin, Gesaprim**
***Chemical name (German):* Atrazin, 2-Chlor-4-ethylamino-6-isopropylamino-1,3,5-triazin**
***Chemical name (French):* Atrazine**
***Appearance:* colourless, crystalline solid**

## BASIC CHEMICAL AND PHYSICAL DATA

| | |
|---|---|
| *Empirical formula:* | $C_8H_{14}ClN_5$ |
| *Rel. molecular mass:* | 215.69 g |
| *Density:* | 1.2 g/$cm^3$ |
| *Boiling point:* | not distillable |
| *Melting point:* | 173-175C |
| *Vapour pressure:* | 4 x $10^{-5}$ Pa |
| *Solvolysis/solubility:* | in water: approx. 70 mg/l; in ether: 12 g/l (20C); in methanol: 18 g/l (at 27C); in n-pentane: 36 mg/l (27C); in chloroform: 52 g/l (27C) |

## ORIGIN AND USE

***Usage:***

**Atrazine is used as a selective herbicide e.g. for weed control in corn and asparagus, in the culture of sugarcane and pineapple and in winegrowing (also in combination with e.g. mecoprop). Additionally, it is used as a total herbicide on roads and public places as well as on uncultivated ground in combination with amitrol, bromacil, dalapon and growth promoters. Atrazine inhibits photosynthesis and other metabolic processes in plants.**

***Origin/derivation:***

**There are no natural sources of atrazine. It is produced from cyanuric acid chloride with ethylamine and isopropylamine. The reaction takes place successively in tetrachloromethane. All the atrazine produced is released into the environment.**

***Production figures:***

| | | |
|---|---|---|
| World | 90,000 t | (1976) |
| USA | 40,000 t | (1976) |
| EU | 750 t | (1978/79) |
| D | < 1,000 t | (1985) |
| | 1,164 t | (1987) |

## Toxicity

| | | |
|---|---|---|
| *Mammals:* | | |
| Rat | $LD_{50}$ 3080 mg/kg, oral | acc. PERKOW, 1985 |
| | $LD_{50}$ >5600 mg/kg, dermal | acc. RIPPEN, 1992 |
| | $LC_{50}$ > 710 mg/m$^3$ (1h), inhalation | acc. PERKOW, 1985 |
| Mouse | $LD_{50}$ 1750 mg/kg, oral | acc. PERKOW, 1985 |
| Rabbit | $LD_{50}$ 750 mg/kg, oral | acc. PERKOW, 1985 |
| | $LD_{50}$ 7500 mg/kg, dermal | acc. PERKOW, 1985 |
| Hamster | $LD_{50}$ 1000 mg/kg, oral | acc. RIPPEN, 1992 |
| *Aquatic organisms:* | | |
| Rainbow trout | $LC_{50}$ 8.8 mg/l (96h) | acc. PERKOW, 1985 |
| Perch | $LC_{50}$ 16 mg/l (96h) | acc. PERKOW, 1985 |
| Carp | $LC_{50}$ 76 mg/l (96h) | acc. PERKOW, 1985 |
| Green algae | $EC_{50}$ 0.055 mg/l (inhibition of growth) | acc. RIPPEN, 1992 |

| | | |
|---|---|---|
| | $EC_0$ 0.030 mg/l (inhibition of cell division) | acc. RIPPEN, 1992 |
| *Plants:* | | |
| Corn | >70% effect at 4.5 kg/ha | acc. RIPPEN, 1992 |
| Lettuce | >70% effect at 0.5 kg/ha | acc. RIPPEN, 1992 |
| Millet | 35-70% effect at 1.6 mg/l | acc. RIPPEN, 1992 |
| Soybean | 35-70% effect at 1.1 mg/l | acc. RIPPEN, 1992 |
| Wheat | 35-70% effect at 4.3 mg/l | acc. RIPPEN, 1992 |

**Characteristic effects:**

***Humans/mammals:* The acute toxicity of atrazine for mammals is very low. In addition, there is hardly any resorption via the skin due to its low solubility. Atrazine does not irritate the skin or the eyes. It is easily resorbed after oral intake and within 24 hours, more than 50% is excreted via urine. During the passage, atrazine is completely metabolised mainly by way of oxidative dealkylation of the amino group and reaction of the chlorine atom with endogenic thiolic reagents. In animal experiments, mutagenic or teratogenic effects have not been discovered. Thus, in Germany, the substance is not classed as toxic.**

## ENVIRONMENTAL BEHAVIOUR

***Soil:***

**The substance is characterised by a relatively high resistance to physical and chemical transformation. In addition, the low solubility in water and the low vapour pressure indicate a reduced mobility. Atrazine may be chemically**

**hydrolysed forming the inactive hydroxyatrazine which in turn may be microbiologically decomposed. The half-life for hydrolysis is strongly dependent on the pH of the soil. In a neutral, slightly alkaline or slightly acid environment, atrazine is stable (half-life at pH 7-9: 10,000 days). Hydrolysis mainly takes place under alkaline or acid conditions (half-life at pH 3 or pH 11 3 months) [acc. KOCH, 1989].**

***Water:***

**Although atrazine is very stable and only slightly soluble in water, the contamination of groundwater has to be considered. In Germany, atrazine is classified in water hazard class 2.**

## ENVIRONMENTAL STANDARDS

| **Medium/ acceptor** | **Sector** | **Country/organ.** | **Status** | **Value** | **Cat.** | **Remarks** | **Source** |
|---|---|---|---|---|---|---|---|
| *Soil:* | | NL | G | 0.05 μ g/kg | | Reference | acc. TERRA TECH, 6/94 |
| | | NL | L | 6 mg/kg | | Intervention | acc. TERRA TECH, 6/94 |
| *Water:* | Drinkw | D | L | 0.1 g/l | | single substance | acc. KOCH, 1989 |
| | Drinkw | D | L | 0.5 g/l | | sum of pesticides | acc. KOCH, 1989 |
| | Drinkw | EC | L | 0.1 g/l | | single substance | |
| | Groundw | NL | G | | | Reference | acc. TERRA TECH, |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 0.0075 g/l | | | 6/94 |
| | Groundw | NL | L | 150 g /l | | Intervention | acc. TERRA TECH, 6/94 |
| *Air*: | Workp | D | L | 2 mg/m$^3$ | MAK | | acc. RIPPEN, 1992 |
| | Workp | SU | (L) | 2 mg/m$^3$ | PDK | | acc. AUER TECHNIKUM, 1988 |
| | Workp | USA | (L) | 5 mg/m$^3$ | TWA | | acc. RIPPEN, 1992 |
| *Foodstuffs:* | | | | | | | |
| Mushrooms | | D | L | 10 mg/kg | | | acc. PERKOW, 1985 |
| Vegetable Corn | | D | L | 1 mg/kg | | | acc. PERKOW, 1985 |
| Corn | | D | L | 0.5 mg/kg | | | acc. PERKOW, 1985 |
| Vegetables | | D | L | 0.1 mg/kg | | | acc. PERKOW, 1985 |
| Asparagus | | CH | L | 1 mg/kg | | | acc. PERKOW, 1985 |
| Corn | | CH | L | 0.1 mg/kg | | | acc. PERKOW, 1985 |

**Assessment/comments**

**Because of its persistence and the hazard of contamination of groundwater and drinking water, the use of atrazine should be restricted as far as possible.**

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# Barium

## DESIGNATIONS

*CAS No.:* 7440-39-3
*Registry name:* Barium
*Chemical name:* Barium
*Synonyms, Trade names:* Barium
*Chemical name (German):* Barium
*Chemical name (French):* Baryum
*Appearance:* soft, silvery white metal

## BASIC CHEMICAL AND PHYSICAL DATA

*Chemical symbol:* Ba
*Rel. atomic mass.:* 137.34 g
*Density:* 3.51 g/cm$^3$ at 20C
*Boiling point:* 1,640C
*Melting point:* 725C
*Vapour pressure:* 0.13 Pa at 547C

***Flash point:*** **flammable and highly reactive solid. Contact with water (e.g. humidity) causes a strong reaction forming explosive mixtures of hydrogen gas and air. On heating, it readily reacts with oxygen and nitrogen.**

***Solvolysis/solubility:*** **in water (at 20C): reaction to barium hydroxide 32.8 g/l, barium sulphate 0.02 g/l**

## BASIC DATA OF SELECTED COMPOUNDS

| | | |
|---|---|---|
| *CAS No:* | 513-77-9 | 10361-37-2 |
| *Chemical name:* | Barium carbonate | Barium chloride |
| *Synonyms, Trade names:* | Witherite | |
| *Chemical name (German):* | Bariumcarbonat | Bariumchlorid |
| *Chemical name (French):* | Carbonate de baryum | Chlorure de baryum |
| *Appearance:* | white, fine crystalline powder | colourless crystals |
| *Empirical formula:* | $BaCO_3$ | $BaCl_2$ |
| *Rel. molecular mass:* | 197.35 g | 208.25 g |
| *Density:* | 4.29 g/cm$^3$ | 3.91 g/cm$^3$ |
| *Melting point:* | 1360C (loss of $CO_2$) | 962C |
| *Solvolysis/solubility:* | in water: 2 x 10$^{-3}$ wt% at 20C | in water: 26.3 wt% at 20C<br>36.6 wt% at 100C |

## ORIGIN AND USE

*Usage:*

Metallic Ba and Ba/Al-alloys are mainly used as scavengers to remove the last traces of unwanted gases from vacuum tubes. Roughly 80 % of barium sulphate is used to increase the density of drilling fluids when drilling for oil. The remaining 20 % is used as fillers for paints and paper, as heavy concrete additives and X-ray contrast medium as well as for fireworks or explosives. Barium carbonate is used in the ceramics and glass industry as well as to combat rodents in agriculture. A further important application is the electrolysis of alkali-metal chlorides.

*Origin/derivation:*

Ba is an element which is found as a mineral component (heavy spa: barium sulphate) and makes up 0.04-0.05 % of the Earth's crust.

*Production figures:*

The consumption of barium sulphate in the Federal Republic of Germany in 1975 was about 370,000 t (DVGW, 1985).

Estimated production of $BaSO_4$ (in 1,000 tons, 1982):

| | |
|---|---|
| USA | 1,800 |
| Western Europe | 1,030 |
| Mid/Far East | 1,890 |

| | |
|---|---|
| South Africa | 800 |
| Comecon | 820 |
| World | 7,250 |

**Toxicity**

| *Mammals:* | | |
|---|---|---|
| Rat: | LD 500 mg/kg, oral (barium acetate) | acc. DVGW, 1985 |
| | LD 630 mg/kg, oral (barium carbonate) | acc. DVGW, 1985 |
| | $LD_{50}$ 150 mg/kg, oral (barium chloride) | acc. DVGW, 1985 |
| | $LD_{50}$ 355 mg/kg, oral (barium nitrate) | acc. DVGW, 1985 |
| Mouse: | $LD_{50}$ 800 mg/kg, oral (barium carbonate) | acc. DVGW, 1985 |
| | LD 7-14 mg/kg, oral (barium chloride) | acc. DVGW, 1985 |
| Rabbit: | LD 236 mg/kg, oral (barium acetate) | acc. DVGW, 1985 |
| | LD 170-300 mg/kg, oral (barium carbonate) | acc. DVGW, 1985 |
| *Aquatic organisms:* | | |

| | | |
|---|---|---|
| Water flea: | 83 mg/l critical level | acc. DVGW, 1985 |
| Eel: | LD 2,000 mg/l (36 h) | acc. DVGW, 1985 |
| Goldfish | LD 9,400 mg/l (14.5 h) | acc. DVGW, 1985 |

**Characteristic effects:**

***Humans/mammals:*** **All soluble barium compounds are poisonous and readily resorbed in the gastro-intestinal tract and subsequently accumulated in the bones. The intake of between 2 and 4 g of barium chloride can prove fatal; barium ions paralyse the heart.**

**Acute poisoning results in nausea and diarrhoea, cardiac problems and muscular spasms as well as cardiac arrest or apnoea.**

**Whereas barium hydroxide is highly caustic since it forms soluble barium hydroxide in water, barium sulphate is not hazardous on account of the fact that it is virtually insoluble in water.**

## ENVIRONMENTAL BEHAVIOUR

**Barium compounds mostly impact the environment as a result of industrial waste water. As little as 0.1 mg/l of barium is sufficient to damage micro-organisms; the self-purification capability of surface and groundwater is inhibited from 1 g/l.**

## ENVIRONMENTAL STANDARDS

| Medium/acceptor | Sector | Country/organ. | Status | Value | Cat. | Remarks | Source |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Water:* | Surface | EC | (L) | 0.1 mg/l | | 1) | acc. DVGW, 1985 |
| | Surface | EC | (L) | 1 mg/l | | 2) | acc. DVGW, 1985 |
| | Drinkw | AUS | | 1 mg/l | | 1973 | acc. MERIAN, 1984 |
| | Drinkw | CDN | | 1 mg/l | | 1978 | acc. DVGW, 1985 |
| | Drinkw | EC | (G) | 0.1 mg/l | | Approx. figure | acc. DVGW, 1985 |
| | Drinkw | SU | | 4 mg/l | | 1970 | acc. MERIAN, 1984 |
| | Drinkw | USA | L | 1 mg/l | | | acc. DVGW, 1985 |
| | Groundw | NL | G | 50 g/l | | Reference | acc. TERRA TECH, 6/94 |
| | Groundw | NL | L | 625 g/l | | Intervention | acc. TERRA TECH, 6/94 |
| | Trough | USA | (L) | 1 mg/l | | 1968 | acc. DVGW, 1985 |
| *Soil:* | | NL | G | 200 mg/kg | | Reference | acc. TERRA TECH, 6/94 |
| | | NL | L | 625 mg/kg | | Intervention | acc. TERRA TECH, 6/94 |
| *Air:* | Workp | AUS | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| | | | (L) | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Workp | B | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| | Workp | CH | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| | Workp | D | L | 0.5 mg/m$^3$ | MAK | | DFG, 1989 |
| | Workp | DDR | (L) | 0.5 mg/m$^3$ | MAK | | acc. MERIAN, 1984 |
| | Workp | NL | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| | Workp | PL | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| | Workp | RO | (L) | 0.5 mg/m$^3$ | | Short-time value | acc. MERIAN, 1984 |
| | Workp | SF | (L) | 0.5 mg/m$^3$ | | | acc. MERIAN, 1984 |
| | Workp | USA | (L) | 0.5 mg/m$^3$ | TWA | | ACGIH, 1986 |
| | Emiss. | D | L | 0,1 mg/m$^3$ | | find dust mass flow > 0.5 g/h | acc. TA Luft, 1986 |
| *Foodstuffs:* | | D | G | 0.5-3 mg/kg.d | ADI | | acc. DVGW, 1985 |
| | Drinkw | D | L | 1 mg/l | | | acc. DVGW, 1985 |

***Note:***

**There is almost a total ban in the Federal Republic of Germany on the use of barium in cosmetics.**

**1) Mandatory value for simple physical treatment and sterilisation**

**2) Mandatory value for normal physical and chemical treatment and sterilisation; mandatory value for physical and refined chemical treatment, oxidation, adsorption and sterilisation**

**3) With mass flow of 1 kg/h and more**

**Comparison/reference values**

| | | | |
|---|---|---|---|
| Surface water | | | |
| Lake Constance (1983) | D | 23.5 g/l | acc. DVGW, 1985 |
| Ruhr (Duisburg, 1983) | D | 41 g/l | acc. DVGW, 1985 |
| Denver (1966) | USA | 16-56 g/l | acc. DVGW, 1985 |
| Drinking water | | | |
| 100 communities | USA | 2-380 g/l | acc. DVGW, 1985 |

**Assessment/comments**

**Barium compounds are poisonous and highly toxic particularly to aquatic organisms. There is no possibility of comprehensive assessment since there are scarcely any data available regarding the environmental behaviour of such compounds.**

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# Benzene

## DESIGNATIONS

***CAS No.:*** **71-43-2**
***Registry name:*** **Benzene**
***Chemical name:*** **Benzene**
***Synonyms,Tradenames:*** **Benzol, bicarburate of hydrogen, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, motor benzol, phene, phenyl hydride**
***Chemical name (German):*** **Benzol, Benzen**
***Chemical name (French):*** **Benzne**
***Appearance:*** **colourless, highly volatile liquid with aromatic odour**

## BASIC CHEMICAL AND PHYSICAL DATA

| | |
|---|---|
| *Empirical formula:* | $C_6H_6$ |
| *Rel. molecular mass:* | 78.12 g |
| *Density:* | 0.879 g/cm$^3$ |
| *Relative gas density:* | 2.7 |

| | |
|---|---|
| *Boiling point:* | 80.1C |
| *Melting point:* | 5.5C |
| *Vapour pressure:* | 102 hPa |
| *Flash point:* | -11C |
| *Ignition temperature:* | 555C |
| *Solvolysis/solubility:* | in water: 1.79 g/l (25C)<br>soluble in fats<br>miscible with acetone, ether, alcohol, chloroform |
| *Conversions factors:* | 1 ppm = 3.26 mg/m$^3$ at 20C<br>1 mg/m$^3$ = 0.31 ppm |

## ORIGIN AND USE

***Usage:***
**In the chemical industry pure benzene forms the most important basis for aromatic intermediate products as well as for the group of cycloaliphatic compounds. Plastics, synthetic rubber, dyes, paints, varnishes, resins, detergent raw materials and pesticides are all produced on the basis of benzene.**

***Origin/derivation:***
**Benzene is found in small quantities and at low concentrations in nature. It is a component part of crude oil (max.**

**0.4 g/l). Benzene is produced and processed on a large scale as pure benzene. It is normally obtained from crude oil. Standard grade petrol contains between 12 and 16 g/l, premium petrol up to 24 g/l of benzene. Emission sources apart from motor vehicles are coking plants, furnaces, refineries and the chemical industry in addition to the storage and distribution of petrol.**

***Production figures:***

**The estimated figures for overall worldwide annual production vary. They are estimated at more than 15 million tons of pure benzene and some 10 million tons in fuels. Production of pure benzene:**

| | | | |
|---|---|---|---|
| D (1983): | 1.34 mio t | EC (1978/79): | 4.4 mio t |
| F (1983) | 1.37 mio t | USA (1983) | 4.28 mio t |
| Japan (1983) | 1.75 mio t | USSR (1977) | 1.54 mio t |

***Emission figures (estimated):***

**Worldwide 100,000-1,000,000 t/a; USA into atmosphere 110,000-224,000 t/a (of which 40,000-80,000 t/a from fuels); USA into surface/groundwater 3-14 t/a; D 55,000-70,000 t/a (of which 50,000-60,000 t/a from fuels)**

**Toxicity**

| | |
|---|---|
| *Humans:* | $TLC_0$ 0.68 mg/l, inhalation 1) |
| *Mammals:* | |
| Rat (male) | $LD_{50}$ 3.8-6.5 g/kg, oral |

| | |
|---|---|
| Rat (male) | $LD_{50}$ 17.6 g/kg, dermal |
| Rat (male) | $LC_{50}$ 18 mg/l, inhalation (4 h) |
| Rat (female) | $LD_{50}$ 6.2-7.2 g/kg, oral |
| Rat (female) | $LD_{50}$ 19.4 g/kg, dermal |
| Rat (female) | $LC_{50}$ 23 mg/l, inhalation (4 h) |
| *Insects:* | |
| Weevil | $LC_{50}$ 210 mg/l |
| *Aquatic organisms:* | |
| Golden orfe | $LC_0$ 31 +/- 25 mg/l (96 h) (ringtest, 11 laboratories) |
| Goldfish | $LC_0$ 36 mg/l (24 h) |
| Trout | $LC_{50}$ 22 mg/l (96 h) |
| Herring | $EC_0$ <0.8 mg/l (reproduction) |
| Water flea (Daphnia magna) | $LC_{50}$ 200 mg/l (48 h) |

| | |
|---|---|
| Water flea (Daphnia magna) | $LC_{50}$ 15 mg/l (96 h) |
| Blue algae | $EC_0$ >1400 mg/l (inhibition of cell reproduction) |
| Green algae | $EC_0$ >1400 mg/l (inhibition of cell reproduction) |
| Green algae | $EC_{50}$ 310-460 mg/l (reduced photosynthesis) |
| Marine algae | $EC_0$ approx. 1400 mg/l (reduced productivity) |
| *Other organisms:* | |
| Earthworm | $LC_{50}$ 100-1000 g/cm$^2$ (48 h) |

***Note:*** **1) All data as per RIPPEN, 1989**

**Characteristic effects:**
***Humans/mammals:*** **The inhalation of benzene vapours may affect the central nervous system depending on the concentration and the duration of exposure. The symptoms of acute poisoning are dizziness, headaches, nausea, drowsiness and disturbance of consciousness with states of agitation and spasms, finally resulting in loss of consciousness and paralysis of the respiratory centre. Liquid benzene irritates the skin and mucous membranes and may be resorbed through the skin.**

**Chronic exposure causes damage to bone marrow. Benzene is a blood toxin: chromosomal changes in blood**

**corpuscles of workers subjected to exposure and in blood corpuscles and bone cells of rats subjected to exposure have been found.**

**Proven carcinogenity in humans; carcinogenic tumours in rats and mice;**

***Plants:* High atmospheric concentrations (>50 mg/m$^3$, 30 min.) have a lethal effect. In water used for watering plants, small benzene concentrations stimulate plant growth and root formation. On the other hand, high concentrations close to the saturated solution inhibit growth.**

***Note:* A detailed list of the investigations performed to establish the characteristic effects of benzene can be found in OAK RIDGE NATIONAL LABORATORY, 1987 and BUA, 1988.**

## ENVIRONMENTAL BEHAVIOUR

***Water:***

**Benzene is highly volatile: evaporation half-life 2.7-5 hours (4.8 h in 1m deep body of water at 25C).**

***Air:***

**Benzene is a moderate source of smog. It readily reacts with OH radicals, whose concentration governs the dwell time in the atmosphere (between several hours and several days). Wash-out effects merely result in short-term extraction from the atmosphere since benzene readily evaporates again from the surface of water or soil.**

***Soil:***

**Benzene is highly volatile and thus considerable losses from the topsoil into the atmosphere take place. In deeper soil layers, the substance is relatively mobile. Thus, elution into groundwater may result. Benzene accumulates in sewage sludge.**

***Degradation, decomposition products, half-life:***

**Degradation in the atmosphere primarily takes place by indirect phototransformation; no photolysis at wavelengths >290nm. In the troposphere the half-life is between 7 and 22 days with a mean value of 13 days. In the lower troposphere (up to an altitude of approx. 1-2 km), the average values for the half-life of benzene are between 3 and 10 days.**

**Degradation in surface water, groundwater and in soil is mainly by way of biodegradation (aerobic more readily than anaerobic). Microbial metabolites: 1,2-dihydroxy-1,2-dihydrobenzene, pyrocatechol. Metabolites in mammals: Phenols and related compounds (e.g. hydroquinone, pyrocatechol). 33% aerobic degradation in sewage treatment plants after 12h; aerobic degradation is slight compared to volatilisation. Thermal decomposition takes place at 600C in the vapour phase; hydrolysis is unlikely under normal conditions.**

## ENVIRONMENTAL STANDARDS

| Medium/acceptor | Sector | Country/organ. | Status | Value | Cat. | Remarks | Source |
|---|---|---|---|---|---|---|---|
| *Water:* | | D | G | 3 | WGK | | acc. RIPPEN, 1989 |
| | Drinkw | A | L | 10 g/l | | | acc. RIPPEN, 1989 |
| | Drinkw | SU | G | 500 g/l | | Tox. tolerance value | acc. RIPPEN, 1989 |
| | Drinkw | USA | G | 13 g/l (7d) | | Nat. Acad. Science | acc. RIPPEN, 1989 |
| | Drinkw | USA | G | 0.35 g/l (7d) | | U.S.EPA | acc. RIPPEN, 1989 |
| | Drinkw | USA | G | 0.67 g/l | | Chron. exposure | acc. RIPPEN, 1989 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Drinkw | USA | (L) | 5 g/l | MCL | | |
| Drinkw | WHO | G | 10 g/l | | Risk of leukaemia | WHO, 1984 |
| Waste water | USA | G | 125 g/l | | Direct introduction | acc. RIPPEN, 1989 |
| Waste water | USA | G | 75 g/l (average, 4d) | | Direct introduction | acc. RIPPEN, 1989 |
| Groundw | D(HH) | G | 1 g/l | | Closer investigation | acc. LAU-BW1), 1989 |
| Groundw | D(HH) | G | 5 g/l | | Rehabilitation investigation | acc. LAU-BW1), 1989 |
| Groundw | NL | G | 0.2 g/l | | Reference | acc. TERRA TECH 6/94 |
| Groundw | NL | L | 30 g/l | | Intervention | acc. TERRA TECH 6/94 |
| Groundw | USA | L | 1 g/l | | Florida | acc. ORNL2), 1987 |
| Surface | USA | G | 3.1 mg/l (1 d, average) | | Protect. of freshwater | acc. RIPPEN, 1989 |
| Surface | USA | G | 7 mg/l (max.) | | Protect. of freshwater | acc. RIPPEN, 1989 |
| Surface | USA | G | 0.92 mg/l (1 d, | | Protect. of | acc. RIPPEN, 1989 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | average) | | saltwater | |
| | Surface | USA | G | 2.1 mg/l (max.) | | Protect. of saltwater | acc. RIPPEN, 1989 |
| *Soil:* | | NL | G | 0.05 mg/kg DM | | Reference | acc. TERRA TECH 6/94 |
| | | NL | L | 1 mg/kg DM | | Intervention | acc. TERRA TECH 6/94 |
| *Air:* | Emiss. | D | L | 5 $mg/m^3$ | | mass flow > 25 g/h | acc. TA Luft, 1986 |
| | | D | L | 10 $mg/m^3$ | MIK | Short-time value | acc. RIPPEN, 1989 |
| | | D | L | 3 $mg/m^3$ | MIK | Long-time value | acc. RIPPEN, 1989 |
| | | DDR | (L) | 0.3 $mg/m^3$ | (MIK) | Short-time value | acc. HORN et al., 1989 |
| | | DDR | (L) | 0.1 $mg/m^3$ | (MIK) | Long-time value | acc. HORN et al., 1989 |
| | | H | (L) | 0.8 $mg/m^3$ | | 30 min average3) | acc. STERN, 1986 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | H | (L) | 1 mg/m$^3$ | | 30 min average$^{4)}$ | acc. STERN, 1986 |
| | H | (L) | 0.3 mg/m$^3$ | | 24 h average$^{4)}$ | acc. STERN, 1986 |
| | IL | (L) | 4.8 mg/m$^3$ | | 30 min average | acc. STERN, 1986 |
| | IL | (L) | 1.6 mg/m$^3$ | | 24 h average | acc. STERN, 1986 |
| | PL | (L) | 0.2 mg/m$^3$ | | 30 min average$^{3)}$ | acc. STERN, 1986 |
| | PL | (L) | 1 mg/m$^3$ | | 30 min average$^{4)}$ | acc. STERN, 1986 |
| | PL | (L) | 0.1 mg/m$^3$ | | 24 h average$^{3)}$ | acc. STERN, 1986 |
| | PL | (L) | 0.3 mg/m$^3$ | | 24 h average$^{4)}$ | acc. STERN, 1986 |
| | PL | (L) | 0.025 mg/m$^3$ | | a-average$^{3)}$ | acc. STERN, 1986 |
| | | | 0.043 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | PL | (L) | mg/$m^3$ | | a-average4) | acc. STERN, 1986 |
| | RO | (L) | 2.4 mg/$m^3$ | | 30 min average | acc. STERN, 1986 |
| | RO | (L) | 0.8 mg/$m^3$ | | 24 h average | acc. STERN, 1986 |
| | SU | (L) | 1 mg/$m^3$ | | 30 min average4) | acc. STERN, 1986 |
| | SU | (L) | 0.3 mg/$m^3$ | | 24 h average4) | acc. STERN, 1986 |
| Workp | CS | (L) | 16 ppm | | from 1969 | acc. ACGIH, 1982 |
| Workp | D | L | 16 mg/$m^3$ | TRK5) | | DFG, 1989 |
| Workp | D | L | 5 ml/$m^3$ | TRK6) | | DFG, 1989 |
| Workp | DDR | (L) | 5 mg/$m^3$ | | | acc. HORN et al, 1988 |
| Workp | S | (L) | 10 ppm | | from 1975 | acc. ACGIH, 1982 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Workp | SU | (L) | 5 mg/m$^3$ | | | acc. RIPPEN, 1989 |
| | Workp | USA | (L) | 10 ppm | TWA | | acc. AUER TECHNIKUM 1988 |

***Note:***

**1) Baden-Wrttemberg Regional Environment Office**
**2) Oak Ridge National Laboratory**
**3) Specially protected areas**
**4) Protected areas**
**5) Dusts**
**6) Gases and vapours**

**Further benzene-specific legislation in the Federal Republic of Germany can be found in:**
**the *Gefahrstoffverordnung* (Ordinance on Hazardous Substances), the *Bundesimmissionsschutzverordnung* (Federal Immission Control Ordinance); the *Strfallverordnung* (Hazardous Incident Ordinance), the *Gefahrgutverordnungen* (ordinances governing hazardous materials), the *Abfallgesetz-Sonderabfall* (Waste Avoidance and Waste Management Act - Special Waste), the *Benzinqualittsangabeverordnung* (ordinance on the indication of fuel grade), the *Kosmetikverordnung* (ordinance on cosmetics), the *Verordnung ber die Einschrnkung und Verbote fr bestimmte Stoffe in Spielwaren und Scherzartikeln* (ordinance on the restriction and banning of certain substances in toys and joke-shop articles).**

**Comparison/reference values**

| **Medium/origin** | **Country** | **Value** |
|---|---|---|
| *Water* | | |
| Rhine (Basle, 1976) | CH | 0.2 g/l |
| Rhine (Cologne, 1976) | D | 0.3 g/l |
| Rhine (Duisburg, 1976) | D | 0.8 g/l |
| Tees River Estuary (1984) | GB | 0.1-200 g/l |
| Groundwater (not contaminated) | NL | <0.01-0.03 g/l (n=8) |
| Groundwater (contaminated) | NL | 100 g/l |
| Groundwater (contaminated) | USA | 1.0-470 g/l (n=9 of 13) |
| Dump seepage water | USA | 17-540 g/l (n=6) |
| Drinking water | USA | <0.5-15 g/l (n=945; 11 >=0.5 g/l) |
| Rainwater | GB | 87 g/l |
| *Soil/sediment:* | | |
| Sewage sludge | USA | 0.05-11.3 mg/kg (n=11 of 13) |
| Tees River Estuary (1986) | GB | 1.5-3.9 g/kg (n=4) |
| *Air:* | | |
| Clean air, Southern hemisphere 1980-1983 | | <5-80 pptv (average values) |

| | | |
|---|---|---|
| Clean air, Northern hemisphere 1980-1983 | | 100-260 pptv (average values) |
| Arctic (July 1982) | | 66 pptv (n=8; average value) |
| Arctic (spring 1983) | | 307 pptv (n=10; average value) |
| Deuselbach ('clean air', 1983) | D | 0.10-0.12 ppbv (average values) |
| Various (background impact) | Brazil | 0.31-0.72 ppbv (n=8) |
| Various | Kenya | 0.07-0.85 ppbv (n=13) |
| Various (desert) | Egypt | 0.19 ppbv (n=5; average value) |
| Berlin (1976/77) | D | 0.6-60 ppbv (n>200; 24 h values) |
| 7 cities (1980/81) | USA | 1.4-5.8 ppbv (average values) |
| Leningrad (1977-79) | SU | 5.4-204 ppbv (n=30; 20-50 min values) |
| *Respiratory air:* | | |
| At petrol stations (1970-80) | | 100-10,000 g/ m$^3$ (n>130; 2-14 h values) |
| Petrol-tanker drivers | | 30-100,000 g/m$^3$ |
| Petrol-tanker drivers | | 540 g/m$^3$ (8 h average value) |
| Tanker crew | | 2,400-170,000 g/m$^3$ |

| | | |
|---|---|---|
| Tanker crew | | 4200 g/m$^3$ (8 h average value) |
| *Foodstuffs:* | | |
| Various fish (Los Angeles Bay, 1980/81) | | <1-52 g/kg FS (n=4) |
| Eggs | | 0.5-1.9 mg/kg |
| Beef | | 2-19 g/kg |
| Rum | | 0.12 g/kg |

***Note:* 1) All data as per RIPPEN, 1989**

**Assessment/comments**

**In view of the fact that benzene readily ingresses into the atmosphere on account of its physical properties, it can be transported over long distances despite relatively short transformation reactions. The advantages of relatively rapid benzene degradation are offset by numerous toxic degradation products. In addition to workplace exposure, humans are threatened above all by the intake of benzene caused by smoking and traffic emissions. The limit values and guide values vary in the atmospheric sector and particularly in the drinking water sector. The values recommended by the WHO are 15 - 30 times in excess of the proposals made by the U.S. EPA which should be used for orientation at least in those instances where drinking water is primarily used for human consumption.**

**Further information on benzene is to be found in RIPPEN (1989), OAK RIDGE NATIONAL LABORATORY (1987) and BUA, 1988.**

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