Hawley's

CONDENSED CHEMICAL DICTIONARY

Fourteenth Edition

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bonding, so-called metal cluster compounds (C–H–M relationships), and electronic charge distributions.

diffraction, X-ray. A method of spectroscopic analysis involving the reflection or scattering of x-radiation by the atoms of a substance (lattice) as the rays pass through it. The rays are reflected by the atoms at an angle that is characteristic of the substance, yielding a spectrum that indicates its atomic or molecular structure. The spectra thus obtained are well defined and specific; from them the properties of elements and the structure of both crystalline and amorphous materials can be obtained. For example, unvulcanized rubber gives an amorphous pattern, while vulcanized rubber is crystalline; the cellulose macromolecule has alternating crystalline and amorphous areas. X-ray diffraction was one of the earliest and most successful methods of instrumental analysis; developed by Bragg and van Laue early in this century, it was used with dramatic effect by Moseley (1912) in establishing the location of several elements in the periodic system.
See lattice; crystal; x-radiation.

diffusion. The spontaneous mixing of one substance with another when in contact or separated by a permeable membrane or microporous barrier. The rate of diffusion is proportional to the concentration of the substances and increases with temperature. Diffusion occurs most readily in gases, less so in liquids, and least in solids. The theoretical principles are stated in Fick's laws. In gases, diffusion takes place counter to gravity, and the rate at which different gases diffuse into a particular gas (e.g., air) is inversely proportional to the square root of the density. For example, carbon dioxide and chlorine vapor will diffuse in air until a uniform mixture results. Diffusion occurs in the cell walls of plants and animals (osmosis). Many substances diffuse through a parchment membrane.
See dialysis; diffusion, gaseous; osmosis.

diffusion current. Limiting current reached by electrolytic migration of ions, in a solution, under the application of a potential difference to the electrodes.

diffusion, gaseous. A technique used for separating the light isotope of uranium (^{235} U) from the heavy isotope (^{238} U). The uranium is allowed to diffuse through a series of microporous barriers whose apertures are of molecular dimensions, in the form of the gas uranium hexafluoride; this is a mix of ^{238} UF^6 and ^{235} UF_6 in a ratio code of 140:1. Because of the vastly greater number of the heavier molecules and the extremely small difference in their masses, the mix must pass through a barrier a great many times to obtain a high concentration of the 235 isotope. Assuming that the diffusion rate of two gases through a porous barrier is inversely proportional to the square root of their molecular weights, the ideal separation factor is the square root of the product M 1 times M_2, where M_2 is the molecular weight of $^{238}UF_6$, and M_1 that of ^{235} UF_6. This method is still in use for uranium enrichment for nuclear fuel.

diffusion layer. The liquid layer around an electrode, within which the electrolyte concentration changes.

diffusion length. A property of materials used in reactors for moderators or reflectors. It is a measure of the distance a thermal neutron diffuses after it is thermalized until it is captured. It is related to the density of the material and to the scattering and absorption cross sections.

diflubenzuron. (*N*-((4-chlorophenyl)aminocarbonyl)-2,6-difluorobenzamide; 1-(4-chlorophenyl)-3-(2,6-difluorobenzoyl)urea).
CAS: 35367-38-5.
Use: Insecticide.

difluophosphoric acid. See difluorophosphoric acid.

2,4-difluoroaniline. $C_6H_5F_2N$.
Properties: Liquid. Bp 170C (753 mm Hg), fp −7.5C, density 10.7 lb/gal, flash p 158F (70C).
Use: Organic synthesis.

1,1,1-difluorochlorethane. See 1,1,1-chlorodifluoroethane.

difluorochloromethane. See chlorodifluoromethane.

difluorodiazine. FN:NF.
Properties: Gas. Can exist as *cis* and *trans* isomers.
Grade: All *trans* isomer, 95–99.8%.
Hazard: See fluorine.
Use: *trans* form: preparation of ionic fluorine compounds; *cis* form: polymerization initiator.

difluorodibromomethane. See dibromodifluoromethane.

difluorodichloromethane. See dichlorodifluoromethane.

difluorodiphenyltrichloroethane. See DFDT.

1,1-difluoroethane. (ethylidene fluoride).
CAS: 75-37-6. CH_3CHF_2.
Properties: Colorless, gas; odorless. Bp −24.7C, fp −117C, d 1.004 (−25C), refr index 1.255 (20C). Insoluble in water.
Derivation: By adding hydrogen fluoride to acetylene.
Grade: Technical, 98%.
Hazard: Flammable, dangerous fire risk. Flammable

lay-up. In the reinforced-plastics industry, a term used to refer to placement of the reinforcing material in the mold.

LC$_{50}$. (lethal concentration 50%). That quantity of a substance administered by inhalation that is necessary to kill 50% of test animals exposed to it within a specified time. The test applies not only to gases and vapors but to fumes, dusts, and other particulates suspended in air.

LCL. Abbreviation for "less than carload lot," used by shippers, traffic managers, railroads, etc.

LD$_{50}$. (lethal dose 50%). That quantity of a substance necessary to kill 50% of exposed animals in laboratory tests within a specified time. A substance having an oral LD$_{50}$ of less than 400 mg/kg of body weight is considered to be highly toxic.

LDPE. Abbreviation for low-density polyethylene.

leaching. See solvent extraction.

lead. (from Latin plumbum).
CAS: 7439-92-1. Pb. Metallic element of atomic number 82, group IVA of the periodic table, aw 207.2, valences = 2,4, four stable isotopes. The isotopes are the end products of the disintegration of three series of natural radioactive elements uranium (206), thorium (208), and actinium (207).
Properties: Heavy, ductile, soft, gray solid. D 11.35, mp 327.4C, bp 1755C. Soluble in dilute nitric acid; insoluble in water but dissolves slowly in water containing a weak acid. Resists corrosion; relatively impenetrable to radiation. Poor electrical conductor, good sound and vibration absorber. Noncombustible.
Occurrence: U.S., Mexico, Canada, South America, Australia, Africa, Europe.
Derivation: Roasting and reduction of galena (lead sulfide), anglesite (lead sulfate), and cerussite (lead carbonate). Also from scrap.
Method of purification: Desilvering (Parkes process), electrolytic refining (Betts process), pyrometallurgical refining (Harris process). Bismuth is removed by Betterton-Kroll process.
Grade: High purity (less than 10 ppm impurity), pure (99.9+%), powdered (99% pure), pig lead, paste.
Available Forms: Ingots, sheet, pipe, shot, buckles or straps, grids, rod, wire, etc.; paste; powder; single crystals.
Hazard: Toxic by ingestion and inhalation of dust or fume. TLV: (fumes and dusts and inorganic compounds) 0.15 mg (Pb)/m^3. For ambient air the EPA standard is 1.5 μg/m^3. A cumulative poison. FDA regulations require zero lead content in foods and less than 0.05% in house paints.
Use: Storage batteries, tetraethyllead (gasoline additive), radiation shielding, cable covering, ammunition, chemical reaction equipment (piping, tank linings, etc.), solder and fusible alloys, type metal, vibration damping in heavy construction, foil, Babbitt and other bearing alloys.

lead acetate. (sugar of lead).
CAS: 301-04-2. $Pb(C_2H_3O_2)_2 \cdot 3H_2O$.
Properties: White crystals or flakes (commercial grades are frequently brown or gray lumps); sweetish taste. D 2.50, mp loses water at 75C, at 200C decomposes, bp (anhydrous) 280C. Absorbs carbon dioxide when exposed to air, becoming insoluble in water. Soluble in water; slightly soluble in alcohol; freely soluble in glycerol. Combustible.
Derivation: By the action of acetic acid on litharge or thin lead plates.
Grade: Powdered, granular, crystals, flakes, CP.
Hazard: Toxic by ingestion, inhalation, and skin absorption; use may be restricted.
Use: Dyeing of textiles, waterproofing, varnishes, lead driers, chrome pigments, gold cyanidation process, insecticide, antifouling paints, analytical reagent, hair dye.

lead alkyl, mixed. A mixture containing various methyl and ethyl derivatives of tetraethyl lead and tetramethyl lead. Thus, methyl triethyl lead, dimethyl diethyl lead, and ethyl trimethyl lead may all be present with or without tetraethyl and tetramethyl lead.
Hazard: Toxic by ingestion and skin absorption.
Use: Antiknock agents in aviation gasoline.

lead antimonate. (Naples yellow; antimony yellow). $Pb_3(SbO_4)_2$.
Properties: Orange-yellow powder; insoluble in water. D 6.58 (20C). Noncombustible.
Derivation: Interaction of solutions of lead nitrate and potassium antimonate, concentration, and crystallization.
Hazard: Toxic by inhalation. TLV: 0.15 mg(Pb)/m^3.
Use: Staining glass, crockery, and porcelain.

lead arsenate. (lead orthoarsenate).
CAS: 7784-40-9. $Pb_3(AsO_4)_2$.
Properties: White crystals. D 5.8, mp 1042C (decomposes). Soluble in nitric acid; insoluble in water.
Derivation: By the action of a soluble lead salt on a solution of sodium arsenate, concentration, and crystallization.
Hazard: Highly toxic. TLV: 0.15 mg/m^3; a carcinogen.
Use: Insecticide, herbicide.

lead arsenite.
CAS: 10031-13-7. $Pb(AsO_2)_2$.
Properties: White powder. D 5.85. Soluble in nitric acid; insoluble in water.
Hazard: Highly toxic.
Use: Insecticide.

lead azide.
CAS: 13424-46-9. $Pb(N_3)_2$.

solvent. A substance capable of dissolving another substance (solute) to form a uniformly dispersed mixture (solution) at the molecular or ionic size level. Solvents are either polar (high dielectric constant) or nonpolar (low dielectric constant). Water, the most common of all solvents, is strongly polar (dielectric constant 81), but hydrocarbon solvents are nonpolar. Aromatic hydrocarbons have higher solvent power than aliphatics (alcohols). Other organic solvent groups are esters, ethers, ketones, amines, and nitrated and chlorinated hydrocarbons. The chief uses of organic solvents are in the coatings field (paints, varnishes and lacquers), industrial cleaners, printing inks, extractive processes, and pharmaceuticals. Since many solvents are flammable and toxic to varying degrees, they contribute to air pollution and fire hazards. For this reason their use in coatings and cleaners has declined in recent years. See individual compounds.

solvent, aprotic. A solvent that cannot act as a proton acceptor or donor, i.e., as an acid or base.

solvent drying. Removal of water from metal surfaces by means of a solvent that displaces it preferentially, as on precision equipment, electronic components, etc. Examples of solvents used are acetone, 1,1,2-trichloro-1,2,2-trifluorethane, 1,1,1-trichloroethane.

solvent dye. See dye, solvent.

solvent extraction. A separation operation that may involve three types of mixture: (1) a mixture composed of two or more solids, such as a metallic ore; (2) a mixture composed of a solid and a liquid; (3) a mixture of two or more liquids. One or more components of such mixture are removed (extracted) by exposing the mixture to the action of a solvent in which the component to be removed is soluble. If the mixture consists of two or more solids, extraction is performed by percolation of an appropriate solvent through it. This procedure is also called leaching, especially if the solvent is water; coffee making is an example. Synthetic fuels can be made from coal by extraction with a coal-derived solvent followed by hydrogenation.

In liquid-liquid extraction one or more components are removed from a liquid mixture by intimate contact with a second liquid that is itself nearly insoluble in the first liquid and dissolves the impurities and not the substance that is to be purified. In other cases the second liquid may dissolve, i.e., extract from the first liquid, the component that is to be purified, and leave associated impurities in the first liquid. Liquid-liquid extraction may be carried out by simply mixing the two liquids with agitation and then allowing them to separate by standing. It is often economical to use counter-current extraction, in which the two immiscible liquids are caused to flow past or through one another in opposite directions. Thus fine droplets of heavier liquid can be caused to pass downward through the lighter liquid in a vertical tube or tower.

The solvents used vary with the nature of the products involved. Widely used are water, hexane, acetone, isopropyl alcohol, furfural, xylene, liquid sulfur dioxide, and tributyl phosphate. Solvent extraction is an important method of both producing and purifying such products as lubricating and vegetable oils, pharmaceuticals, and nonferrous metals.

solvent, latent. (cosolvent). An organic liquid that will dissolve nitrocellulose in combination with an active solvent. Latent solvents are usually alcohols and are used widely in nitrocellulose lacquers in a ratio of 1 part alcohol to 2 parts active solvent.

solvent naphtha. See naphtha (2b).

Solvent Red 73. See 4′,5′-diiodofluorescein.

solvent refining. See solvent extraction.

Solvent Yellow 3. See *o*-aminoazotoluene.

solvolysis. A reaction involving substances in solvent, in which the solvent reacts with the dissolved substance (solute) to form a new substance. Intermediate compounds are usually formed in this process.

See hydrolysis.

soman. (methylphosphonofluoridic acid-1,2,2-trimethylpropylester).

CAS: 96-64-0. $(CH_3)_3CCH(CH_3)OPF(O)CH_3$. A nerve gas.

Properties: Colorless liquid. Evolves odorless gas. Bp 167C, fp −70C, d 1.026 (20C).

Hazard: Highly toxic by ingestion, inhalation, and skin absorption; may be fatal on short exposure; cholinesterase inhibitor; military nerve gas; fatal dose (man) 0.01 mg/kg.

somatotropic hormone. (STH; somatotropin).

CAS: 9002-72-6. Hormone secreted by the anterior lobe of the pituitary. It causes an increase in general body growth and also affects carbohydrate and lipid metabolism.

Sommelet-Hauser rearrangement. Rearrangement of benzyl quaternary ammonium salts to *ortho*-substituted benzyldialkylamines on treatment with alkali metal amides.

Sommelet reaction. Preparation of aldehydes from aralkyl or alkyl halides by reaction with hexamethylenetetramine followed by mild hydrolysis of the formed quaternary salt.

Sonn-Muller method. Preparation of aromatic aldehydes from anilides by conversion of an acid anilide with phosphorus pentachloride to an imido