Sub-Chapter V

ALDEHYDE-FUNCTION COMPOUNDS

29.12 - Aldehydes, whether or not with other oxygen function; cyclic polymers of aldehydes; paraformaldehyde.

- Acyclic aldehydes without other oxygen function :

2912.11 - - Methanal (formaldehyde)

2912.12 - - Ethanal (acetaldehyde)

2912.19 - - Other

- Cyclic aldehydes without other oxygen function :

2912.21 - - Benzaldehyde

2912.29 - - Other

- Aldehyde-alcohols, aldehyde-ethers, aldehyde-phenols and aldehydes with other oxygen function :

2912.41 - - Vanillin (4-hydroxy-3-methoxybenzaldehyde)

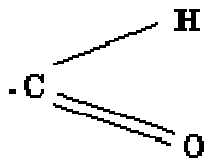
2912.42 - - Ethylvanillin (3-ethoxy-4-hydroxybenzaldehyde)

2912.49 - - Other

2912.50 - Cyclic polymers of aldehydes

2912.60 - Paraformaldehyde

These are compounds formed by oxidising primary alcohols; they contain the characteristic group :



They are generally colourless liquids with a strong, penetrating odour; many aromatic aldehydes readily oxidise on contact with air, being converted into acids.

The term " aldehydes, with other oxygen function " means aldehydes which contain also one or more of the oxygen functions referred to in previous sub-Chapters (alcohol, phenol, ether, etc., functions).

(A) **ALDEHYDES**

(I) **Saturated acyclic aldehydes**.

(1) **Methanal** (formaldehyde) (HCHO). Obtained by catalytic oxidation of methanol. Colourless gas with a penetrating odour, highly soluble in water. Its aqueous solutions at about 40 % are known as formalin or formol, a colourless liquid with a penetrating and suffocating odour. These solutions may contain methanol as a stabiliser.

Methanal has many applications; in organic synthesis (dyestuffs, explosives, pharmaceutical products, synthetic tanning agents, plastics, etc.), as an antiseptic, deodorant and reducing agent.

(2) **Ethanal** (acetaldehyde) (CH_3CHO). Obtained by oxidation of ethanol or from acetylene. Mobile, colourless liquid with a pungent, fruity odour; caustic; very volatile, inflammable; miscible with water, alcohol and ether. Used in organic synthesis to make plastics, varnishes, or in medicine as an antiseptic.

(3) **Butanal** (butyraldehyde, normal isomer) ($CH_3CH_2CH_2CHO$). Colourless liquid, miscible with water, alcohol and ether; used for the preparation of plastics, perfumes and accelerators for vulcanising rubber.

(4) **Heptanal** (heptaldehyde, oenanthol) ($CH_3(CH_2)_5CHO$). Obtained by distilling castor oil; a colourless liquid with a penetrating odour.

(5) **Octanal** (caprylaldehyde) ($C_8H_{16}O$); **nonanal** (pelargonaldehyde) ($C_9H_{18}O$); **decanal** (capraldehyde) ($C_{10}H_{20}O$); **undecanal** (undecylic aldehyde) ($C_{11}H_{22}O$); **dodecanal** (lauraldehyde) ($C_{12}H_{24}O$), etc. These are used as raw materials in the perfumery industry.

(II) **Unsaturated acyclic aldehydes**.

(1) **Propenal** (acrylaldehyde, acraldehyde, acrolein) ($CH_2{=}CHCHO$). Formed when fatty matter is burned; a liquid with a characteristic bitter and irritating odour; used in organic synthesis.

(2) **2-Butenal** (crotonaldehyde) ($CH_3CH{=}CHCHO$). Found in the first distillation products of crude alcohol; a colourless liquid with a penetrating odour.

(3) **Citral**. Liquid with an agreeable odour, found in essential oil of tangerine, of citron, of lemons and, more especially, in lemon grass oil.

(4) **Citronellaldehyde**. Found in citron oil.

(III) **Cyclanic, cyclenic and cycloterpenic aldehydes**.

(1) **Phellandral** or tetrahydrocuminaldehyde. Found in fennel and eucalyptus oils.

(2) **Cyclocitrals A and B**. Obtained from citral.

(3) **Perillaldehyde**. Found in essential oils of the *Perilla mankinensis*.

(4) **Safranal**.

(IV) **Aromatic aldehydes**.

(1) **Benzaldehyde** (C_6H_5CHO). Highly refractive, colourless liquid with a characteristic odour of bitter almonds; used in organic synthesis, in medicine, etc.

(2) **Cinnamaldehyde** ($C_6H_5CH{=}CHCHO$). Oily yellowish liquid with a strong odour of cinnamon; used in perfumery.

(3) α-**Amylcinnamaldehyde**.

(4) **3-*p*-Cumenyl-2-methylpropionaldehyde**.

(5) **Phenylacetaldehyde** ($C_6H_5CH_2CHO$). Liquid with a pronounced odour of hyacinths; used in perfumery.

(B) ALDEHYDE-ALCOHOLS, ALDEHYDE-ETHERS, ALDEHYDE-PHENOLS AND ALDEHYDES WITH OTHER OXYGEN FUNCTION

Aldehyde-alcohohols are compounds which contain both the aldehyde function and the alcohol function.

Aldehyde-ethers are ethers which contain also the aldehyde group (-CHO).

Aldehyde-phenols are compounds which contain both the phenolic hydroxyl group (C_6H_5OH) and the aldehyde group (-CHO).

The most important aldehyde-alcohols, aldehyde-phenols and aldehyde-ethers are :

(1) **Aldol** ($CH_3CH(OH)CH_2CHO$). Obtained by aldol condensation of acetaldehyde; colourless liquid which, when left undisturbed, polymerises to a crystalline mass (paraldol). Used in organic synthesis, for the manufacture of plastics, and in the flotation of ores.

(2) **Hydroxycitronellaldehyde** ($C_{10}H_{20}O_2$). Colourless, slightly syrupy liquid with a very pronounced odour of lily of the valley; used as a fixative in perfumery.

(3) **Glycollaldehyde** ($HOCH_2CHO$). Crystallises in colourless crystals.

(4) **Vanillin** (4-hydroxy-3-methoxybenzaldehyde). The methyl ether of 3,4-dihydroxy-benzaldehyde (protocatechualdehyde); found in vanilla. Brilliant needles or crystalline white powder.

(5) **Ethylvanillin** (3-ethoxy-4-hydroxybenzaldehyde). Fine white crystals.

(6) **Salicylaldehyde** (*o*-hydroxybenzaldehyde) (HOC_6H_4CHO). Colourless oily liquid with a characteristic odour of bitter almonds; used for the manufacture of synthetic perfumes.

(7) **3,4-Dihydroxybenzaldehyde** (protocatechualdehyde) ($(HO)_2C_6H_3CHO$). Brilliant colourless crystals.

(8) **Anisaldehyde** ($CH_3OC_6H_4CHO$) (*p*-methoxybenzaldehyde). Found in aniseed and fennel oils; colourless liquid. Used in perfumery under the name of "hawthorn essence (aubepine)".

(C) CYCLIC POLYMERS OF ALDEHYDES

(1) **Trioxan** (trioxymethylene). A solid polymer of formaldehyde; white crystalline substance, soluble in water, alcohol or ether.

(2) **Paraldehyde**. A polymer of ethanal; colourless liquid with an agreeable ether-like odour, highly inflammable. Used in organic synthesis, as a soporific and disinfectant in medicine, etc.

(3) **Metaldehyde**. Also a polymer of ethanal; crystalline white powder, insoluble in water. This heading covers **only** metaldehyde in the form of crystals or powders.

Metaldehyde put up in forms (for example, tablets, sticks or similar forms) for use as fuels is **excluded** (**heading 36.06**) (see Note 2 (a) to Chapter 36).

(D) PARAFORMALDEHYDE

This polymer ($HO(CH_2O)_nH$) is obtained by evaporating aqueous solutions of formaldehyde. A solid, white, flaky or powdered substance with a pronounced odour of formaldehyde. It is used to prepare plastics, waterproof glues and pharmaceutical products, and also as a disinfectant and a preserving agent.

This heading **excludes** aldehyde-bisulphite compounds which are classified as sulphonated derivatives of alcohols (**headings 29.05 to 29.11**).