Sub-Chapter VI

MISCELLANEOUS

28.43 - Colloidal precious metals; inorganic or organic compounds of precious metals, whether or not chemically defined; amalgams of precious metals.

2843.10 - Colloidal precious metals

- Silver compounds :

2843.21 - - Silver nitrate

2843.29 - - Other

2843.30 - Gold compounds

2843.90 - Other compounds; amalgams

(A) COLLOIDAL PRECIOUS METALS

This heading covers precious metals as listed in Chapter 71 (i.e., silver, gold, platinum, iridium, osmium, palladium, rhodium and ruthenium), provided they are in colloidal suspension.
These precious metals are obtained in this state either by dispersion or cathodic pulverisation, or by reducing one of their inorganic salts.

Colloidal silver occurs in small grains or flakes, bluish, brownish or greenish-grey, with a metallic glint. It is used in medicine as an antiseptic.

Colloidal gold may be red, violet, blue or green, and is used for the same purposes as colloidal silver.

Colloidal platinum is in small grey particles and has remarkable catalysing properties.

These colloidal metals (e.g., gold) remain classified in this heading when put up in colloidal solutions containing protective colloids (such as gelatin, casein, fish glue).

(B) INORGANIC OR ORGANIC COMPOUNDS OF PRECIOUS METALS, WHETHER OR NOT CHEMICALLY DEFINED

These are :

(I) **Oxides, peroxides and hydroxides of precious metals**, analogous to the compounds of sub-Chapter IV.

(II) **Inorganic salts of precious metals**, analogous to the compounds of sub-Chapter V.

(III) **Phosphides, carbides, hydrides, nitrides, silicides and borides**, analogous to the compounds of headings 28.48 to 28.50 (such as platinum phosphide, palladium hydride, silver nitride, platinum silicide).

(IV) **Organic compounds of precious metals**, analogous to the compounds of Chapter 29.

Compounds containing **both** precious metals and other metals (e.g., double salts of a base metal and a precious metal, complex esters containing precious metals) are also covered by this heading.

The most common compounds of each of the precious metals are listed below :

(1) **Silver compounds**.

(a) **Silver oxides**. Disilver oxide (Ag_2O) is a brownish-black powder slightly soluble in water, turning black on exposure to light.

Silver oxide (AgO) is a greyish-black powder.

Silver oxides are used, *inter alia*, in the manufacture of batteries.

(b) **Silver halides**. Silver chloride (AgCl) is a white mass or dense powder, insoluble in water, darkening when exposed to light; it is packed in dark-coloured opaque containers. Used in photography, in the manufacture of ceramics, in medicine and in silvering.

Cerargyrites (or horn silver), natural silver chlorides and iodides, are **excluded** (**heading 26.16**).

Silver bromide (yellowish), silver iodide (yellow), and silver fluoride are used for similar purposes to the chloride.

(c) **Silver sulphide**. Artificial silver sulphide (Ag_2S) is a heavy grey-black powder, insoluble in water, used for glass-making.

Natural silver sulphide (argentite), natural sulphide of silver and antimony (pyrargyrite, stephanite, polybasite) and natural sulphide of silver and arsenic (proustite) are **excluded** (**heading 26.16**).

(d) **Silver nitrate** ($AgNO_3$) white crystals, soluble in water, toxic, damages the skin. Used for silvering glass or metals; for dyeing silk or horn; in photography; for the manufacture of indelible ink; and as an antiseptic or a parasiticide. Sometimes called " lunar caustic ", though this name is also applied to silver nitrate melted with a small quantity of sodium or potassium nitrate, and sometimes with a little silver chloride, to form a cauteriser of **Chapter 30**.

(e) **Other salts and inorganic compounds**.

Silver sulphate (Ag_2SO_4) crystals.

Silver phosphate (Ag_3PO_4), yellowish crystals not very soluble in water; used in medicine, photography and optics.

Silver cyanide (AgCN), a white powder darkening on exposure to light, insoluble in water; used in medicine and for silver-plating. Silver thiocyanate (AgSCN) has a similar appearance and is used as an intensifier in photography.

Complex cyanide salts of silver and potassium ($KAg(CN)_2$) or silver and sodium ($NaAg(CN)_2$) are soluble white salts, used in electroplating.

Silver fulminate, white crystals, exploding at the slightest shock, dangerous to handle; used for the manufacture of detonating caps.

Silver dichromate ($Ag_2Cr_2O_7$) a crystalline ruby-red powder, slightly soluble in water; used for painting miniatures (silver red, purple red).

Silver permanganate, a crystalline deep violet powder, soluble in water; used in gas masks.

Silver azide, an explosive.

(f) **Organic compounds**. These include :

(i) Silver lactate (white powder) and silver citrate (yellowish powder); used in photography and as antiseptics.

(ii) Silver oxalate, which decomposes and explodes when heated.

(iii) Silver acetate, benzoate, butyrate, cinnamate, picrate, salicylate, tartrate and valerate.

(iv) Proteinates, nucleates, nucleinates, albuminates, peptonates, vitellinates and tannates of silver.

(2) **Gold compounds**.

(a) **Oxides**. Aurous oxide (Au_2O). An insoluble, dark violet powder. Auric oxide (Au_2O_3) (auric anhydride) is a brown powder; the corresponding acid is auric hydroxide or acid ($Au(OH)_3$), a black product, decomposed on exposure to light, from which alkali aurates are derived.

(b) **Chlorides**. Aurous chloride (AuCl), a yellowish or reddish crystalline powder. Gold trichloride ($AuC1_3$) (auric chloride, brown chloride), a reddish-brown powder or crystalline mass, very hygroscopic, often presented in sealed flasks or tubes. Tetrachloroauric (III) acid ($AuCl_3.HCl.4H_2O$) (yellow chloride) yellow crystals, hydrated, and alkali chloroaurates, reddish-yellow crystals, are also classified in this heading. These products are used in photography (preparation of toning baths), in the ceramic or glass industries and in medicine.

The heading **excludes** purple of Cassius, a mixture of stannic hydroxide and colloidal gold (**Chapter 32**); this is used in the manufacture of paints or varnishes, and especially for colouring porcelain.

(c) **Other compounds**. Gold sulphide (Au_2S_3) a blackish substance which, in combination with alkali sulphides, forms thioaurates.

Double sulphites of gold and sodium ($NaAu(SO_3)$) and of gold and ammonium ($NH_4Au(SO_3)$) marketed as colourless solutions, are used in electroplating.

Sodium aurothiosulphate is used in medicine.

Gold cyanide (AuCN), a crystalline yellow powder decomposable if exposed to heat, is used for electrolytic gilding and in medicine. Reacts with alkali cyanides to give cyanoaurates, such as potassium tetracyanoaurate ($KAu(CN)_4$), which is a soluble white salt used in electroplating.

Sodium aurothiocyanate, crystallising in orange-coloured needles; used in medicine and in photography (toning baths).

(3) **Ruthenium compounds**. Ruthenium dioxide (RuO_2) is a blue product, while ruthenium tetraoxide (RuO_4) is orange coloured. Ruthenium trichloride ($RuCl_3$) and ruthenium tetrachloride ($RuCl_4$), give double chlorides with alkali chlorides and ammino or nitroso complexes. There are also double nitrites of ruthenium or alkali metals.

(4) **Rhodium compounds**. The rhodium hydroxide ($Rh(OH)_3$), corresponds to rhodium oxide (Rh_2O_3) a black powder. The rhodium trichloride ($RhCl_3$), gives chlororhodites with alkali chlorides, and there are, a sulphate with its complex alums or phosphates, a nitrate and complex nitrites; also cyanorhodites and complex ammino or oxalic derivatives.

(5) **Palladium compounds**. The most stable oxide is palladous oxide (PdO), the only basic one. It is a black powder decomposed by heat.

Palladous chloride ($PdCl_2$), a brown deliquescent powder, soluble in water and crystallising with 2 H_2O, is used in the ceramic industry, in photography and in electroplating.

Potassium chloropalladite (K_2PdCl_4), a brown salt, fairly soluble, used as a detector of carbon monoxide, is also classified here. There also exist chloropalladates, ammino compounds (palladium diammines), thiopalladates, palladonitrites, cyanopalladites, pallado-oxalates and palladous sulphate.

(6) **Osmium compounds**. Osmium dioxide (OsO_2) is a dark brown powder. Osmium tetraoxide (OsO_4) is a volatile solid, crystallising in white needles; it attacks the eyes and lungs; used in histology and micrography. This tetraoxide gives osmates such as potassium osmate (red crystals), and, by treatment with ammonia and alkali hydroxides, osmiamates such as osmiamates of potassium or sodium, yellow crystals.

Osmium tetrachloride ($OsCl_4$) and trichloride ($OsCl_3$) give alkali chloro-osmates and chloro-osmites.

(7) **Iridium compounds**. In addition to iridium oxide there are an iridium tetrahydroxide ($Ir(OH)_4$), blue solid, a chloride, chloroiridates and chloroiridites, double sulphates and ammino compounds.

(8) **Platinum compounds**.

(a) **Oxides**. Platinous oxide (PtO) is a violet or blackish powder. Platinic oxide (PtO_2) forms several hydrates of which one, the tetrahydrate ($H_2Pt(OH)_6$) is a complex acid (hexahydroxyplatinic acid) to which correspond salts such as alkali hexahydroxyplatinates. There are also corresponding ammino complexes.

(b) **Other compounds**. Platinic chloride ($PtCl_4$) occurs in the form of a brown powder or a yellow solution; it is used as a reagent. Commercial platinum chloride (chloroplatinic acid) (H_2PtC1_6), deliquescent prisms, brownish-red in colour, soluble in water; used in photography (platinum toning), in platinum-plating, for ceramic glazing or for obtaining platinum sponge. There are corresponding platinum ammino complexes.

There are also ammino complexes corresponding to chloroplatinous acid (H_2PtCl_4), itself a red solid. Cyanoplatinites of potassium or barium are used for obtaining fluorescent screens for radiography.

(C) **AMALGAMS OF PRECIOUS METALS**

These are alloys of precious metals with mercury. Amalgams of gold or silver, which are the most common, are used as intermediate products for obtaining these precious metals.

The heading includes amalgams containing **both** precious metals and base metals (e.g., certain amalgams used in dentistry); but it **excludes** amalgams **wholly** of base metal (**heading 28.53**).

Mercury compounds, whether or not chemically defined, other than amalgams are **excluded (heading 28.52)**.