28.33 - Sulphates; alums; peroxosulphates (persulphates).

- Sodium sulphates :

2833.11 - - Disodium sulphate

2833.19 - - Other

- Other sulphates :

2833.21 - - Of magnesium

2833.22 - - Of aluminium

2833.24 - - Of nickel

2833.25 - - Of copper

2833.27 - - Of barium

2833.29 - - Other

2833.30 - Alums

2833.40 - Peroxosulphates (persulphates)

(A) **SULPHATES**

Subject to the **exclusions** mentioned in the introduction to this sub-Chapter, this heading covers the metal salts of sulphuric acid (H_2SO_4) (heading 28.07), but **excludes** mercury sulphates which fall in **heading 28.52,** ammonium sulphate which, even pure, falls in **heading 31.02** or **31.05** and potassium sulphate, which, whether or not pure, falls in **heading 31.04** or **31.05**.

(1) **Sodium sulphates** include :

(a) **Disodium sulphate** (neutral sulphate) (Na_2SO_4). Occurs in the anhydrous or hydrated state as a powder or in large transparent crystals, efflorescing in the air and dissolving in water with a fall in temperature. The decahydrate ($Na_2SO_4.10H_2O$) is known as Glauber's salt. Impure forms of disodium sulphate (90 - 99 % purity), generally obtained as by-products of various manufacturing processes, are often described as " salt cake " and are classified in this heading. Disodium sulphate is used as an adjuvant in dyeing; as a flux in glass-making to obtain vitrifiable mixtures (manufacture of bottle glass, crystal and optical glass); in tanning for preserving hides; in paper-making (preparation of certain chemical pulps); as a sizing material in the textile industry; in medicine as a purgative, etc.

Natural sodium sulphates (glauberite, bloedite, reussin, astrakhanite) are **excluded** (**heading 25.30**).

(b) **Sodium hydrogen sulphate** (acid sulphate) ($NaHSO_4$). This residual salt of the manufacture of nitric acid occurs in deliquescent fused, white masses. Used instead of sulphuric acid, in particular for pickling metal, regenerating rubber, in the metallurgy of antimony or tantalum and as a weed-killer.

(c) **Disodium disulphate** (sodium pyrosulphate) ($Na_2S_2O_7$).

(2) **Magnesium sulphate**. This heading covers artificial magnesium sulphate ($MgSO_4.7H_2O$) (Epsom salts, Seidlitz salts) obtained by purifying kieserite, or by the action of sulphuric acid on dolomite. Colourless crystals, slightly efflorescing in air, soluble in water. Used as a filler in sizing textiles, in tanning, for fire-proofing and as a purgative.

The heading **excludes** natural magnesium sulphate (kieserite) (**heading 25.30**).

(3) **Aluminium sulphate** ($Al_2(SO_4)_3$). Obtained by treating bauxite, or natural aluminium silicates, with sulphuric acid; the impurities are mainly iron compounds. In the hydrated state (with 18 H_2O) it appears in white crystals, soluble in water, which can either be crumbly and easily scratched with a fingernail or hard and brittle, according to the degree of concentration of the solution employed; on gentle heating it melts in its water of crystallisation, giving finally the anhydrous sulphate. Used in dyeing as a mordant; in tanning for preserving hides and for alum tanning; in paper-making as a size for paper pulp; in the dyestuffs industry for making lakes, methylene blue or other thiazode dyestuffs. Used also for clarifying tallow, purifying industrial water, in fire extinguishers, etc.

Basic aluminium sulphate, used in dyeing, is also classified here.

(4) **Chromium sulphates**. The best known is chromic sulphate ($Cr_2(SO_4)_3$), prepared from chromium nitrate and sulphuric acid. Crystalline powder, violet or green, in aqueous solution. Used as a mordant in dyeing (chrome mordanting) or in tanning (chrome tanning). The main products used for the latter purpose are rather unstable solutions of basic chromium sulphates derived from chromic sulphate or from chromous sulphate ($CrSO_4$). These sulphates are included here.

(5) **Nickel sulphates**. The most common of these sulphates has the formula $NiSO_4$. Anhydrous in yellow crystals, or hydrated in emerald green crystals (with 7 H_2O) or bluish crystals (with 6 H_2O); soluble in water. Used in electrolytic nickel-plating, as a mordant in dyeing, in the preparation of gas masks and as a catalyst.

(6) **Copper sulphates**.

(a) **Cuprous sulphate** (Cu_2SO_4). Catalyst used in the preparation of synthetic ethanol.

(b) **Cupric sulphate** ($CuSO_4.5H_2O$). By-product of electrolytic copper refining; also obtained by treating copper waste or scrap with a weak solution of sulphuric acid. Blue crystals or crystalline powder, soluble in water. It turns into a white anhydrous sulphate when calcinated, which absorbs water with avidity. Used as a fungicide in agriculture (see Explanatory Note to heading 38.08); for preparing spraying mixtures; to prepare cuprous oxide or inorganic copper colours; in dyeworks (for dyeing silk or wool black, purple or lilac); in electrolytic copper refining or copper-plating; as a flotation regulator (for restoring the natural buoyancy of ores); as an antiseptic, etc.

Natural hydrated copper sulphate (brochantite) is **excluded** (**heading 26.03**).

(7) **Zinc sulphate** ($ZnSO_4.7H_2O$). Obtained by the action of dilute sulphuric acid on zinc, zinc oxide, zinc carbonate or roasted blende. White vitreous masses or in needle-shaped crystals. Used for lessening the natural buoyancy of ores in flotation processes; as a mordant in dyeing; for zinc-plating by electrolysis; as an antiseptic; for preserving wood; in the manufacture of driers, of lithopone (**heading 32.06**), luminophores (zinc sulphate activated by copper) (**heading 32.06**) and of various other zinc compounds.

(8) **Barium sulphate**. This heading covers artificial or precipitated barium sulphate ($BaSO_4$) obtained by precipitating a solution of barium chloride with sulphuric acid or an alkali sulphate. Occurs as a white powder, very heavy (specific gravity about 4.4) and insoluble in water, or in a thick paste. Used as a white pigment, as a filler for sizing textiles and in the preparation of rubber, coated paper, paperboard, lutings, lakes, colours, etc. It is impervious to X-rays and is therefore used (pure) in radiography.

Natural barium sulphate (barytes, heavy spar) is **excluded** (**heading 25.11**).

(9) **Iron sulphates**.

(a) **Ferrous sulphate** ($FeSO_4$). Obtained by treating iron shavings with dilute sulphuric acid or as a by-product from the manufacture of titanium dioxide; it often contains impurities such as copper and ferric sulphates and arsenic. Very soluble in water; occurs mainly in the hydrated state (generally with 7 H_2O) in light green crystals and turns brown on exposure to air; the action of heat transforms them into white anhydrous sulphate. Aqueous solutions are green but turn brownish on exposure to air. Ferrous sulphate is used for preparing inks (iron inks), colours (Prussian blue), and the mixture (with slaked lime and sawdust) used for purifying coal gas; in dyeing; as a disinfectant, an antiseptic and a herbicide.

(b) **Ferric sulphate** ($Fe_2(SO_4)_3$). Prepared from ferrous sulphate. Powder or as brownish slabs. Very soluble in water, with which it forms a white hydrate (with 9 H_2O). Used for purifying natural waters or sewage, for coagulating blood in slaughterhouses, in iron-tanning and as a fungicide. As it lessens the buoyancy of ores, it is used as a flotation regulator. Used also as a mordant in dyeing and in the electrolytic production of copper or zinc.

(10) **Cobalt sulphate** ($CoSO_4.7H_2O$). Prepared from cobaltous oxide and sulphuric acid; red crystals soluble in water. Used for electrolytic cobalt-plating, as a ceramic colour, as a catalyst and for preparing precipitated cobalt resinates (driers).

(11) **Strontium sulphate**. Artificial strontium sulphate ($SrSO_4$) precipitated from chloride solution, is a white powder, sparingly soluble in water. Used in pyrotechnics, ceramics and the preparation of various strontium salts.

Native strontium sulphate (celestine) is **excluded** (**heading 25.30**).

(12) **Cadmium sulphate** ($CdSO_4$). Colourless crystals, soluble in water, either anhydrous or in the hydrated state (with 8 H_2O). Used in the manufacture of cadmium yellow (cadmium sulphide) or other colouring matters, and of medicinal products; in standard electric cells (Weston cells); in electroplating and in dyeing.

(13) **Lead sulphates**.

(a) **Artificial lead sulphate** ($PbSO_4$). Obtained from lead nitrate or acetate by precipitation with sulphuric acid; white powder or crystals, insoluble in water. Used in the manufacture of lead salts.

(b) **Basic lead sulphate**. Prepared as greyish powder by heating together litharge, sodium chloride and sulphuric acid. May also be obtained by a metallurgical process, in which case it takes the form of a white powder. Used in the preparation of pigments, mastics and mixtures for the rubber industry.

Natural lead sulphate (anglesite) is **excluded** (**heading 26.07**).

(B) ALUMS

Alums are hydrated double sulphates containing a sulphate of a trivalent metal (aluminium, chromium, manganese, iron or indium) and a sulphate of a monovalent metal (alkali sulphate or ammonium sulphate). Used in dyeing, as antiseptics and in the preparation of chemicals, although there is a tendency to replace them by simple sulphates.

(1) **Aluminium alums**.

(a) **Aluminium potassium sulphate** (ordinary alum or potassium alum) ($Al_2(SO_4)_3.K_2SO_4.24H_2O$). Obtained from natural alunite (alum stone) (heading 25.30), (i.e., basic aluminium-potassium sulphate mixed with aluminium hydroxide). Alum is also prepared from the two constituent sulphates. White crystalline solid, soluble in water. On calcination it gives a light white powder, anhydrous and crystalline (calcined alum). Used for the same purposes as aluminium sulphate, in particular in the preparation of lakes, in dyeing and in tanning (alum-tanning). Used also in photography, toilet preparations, etc.

(b) **Aluminium ammonium sulphate** (ammonium alum) ($Al_2(SO_4)_3.(NH_4)_2SO_4.24H_2O$). Colourless crystals, soluble in water especially when hot. Used in the preparation of pure aluminium oxide and in medicine.

(c) **Aluminium sodium sulphate** (sodium alum) ($Al_2(SO_4)_3.Na_2SO_4.24H_2O$). Similar to potassium alum, occurs in efflorescent crystals, soluble in water. Used as a mordant in dyeing.

(2) **Chromium alums**.

(a) **Chromium potassium sulphate** (chrome alum) ($Cr_2(SO_4)_3.K_2SO_4.24H_2O$). Obtained by reducing a solution of potassium dichromate in sulphuric acid with sulphur dioxide. Forms purplish-red crystals, soluble in water and efflorescing in the air. Used in dyeing as a mordant, in tanning (chrome-tanning), in photography, etc.

(b) **Ammonium chromium sulphate** (chrome ammonium alum). Crystalline blue powder, used in tanning and in ceramics.

(3) **Iron alums. Ammonium iron bis (sulphate)** ($(NH_4)_2SO_4.Fe_2(SO_4)_3.24H_2O$), in purple crystals dehydrating and turning white in the air; **iron (III) potassium sulphate** also in purple crystals. Both are used in dyeing.

(C) **PEROXOSULPHATES (PERSULPHATES)**

The name peroxosulphates (persulphates) is reserved for the salts of the peroxosulphuric (persulphuric) acids of heading 28.11. They are fairly stable in the dry state but in aqueous solution they are decomposed on heating. Powerful oxidising agents.

(1) **Diammonium peroxodisulphate** ($(NH_4)_2S_2O_8$). Prepared by electrolysing concentrated solutions of ammonium sulphate and sulphuric acid; colourless crystals, soluble in water, decomposed by moisture and heat. Used in photography; in textile bleaching or dyeing processes; in the preparation of soluble starches; in the preparation of other peroxodisulphates and of certain electrolytic baths; in organic synthesis, etc.

(2) **Disodium peroxodisulphate** ($Na_2S_2O_8$). Colourless crystals, very soluble in water. Used as a disinfectant, in bleaching, as a depolarising agent (batteries) and for engraving copper alloys.

(3) **Dipotassium peroxodisulphate** ($K_2S_2O_8$). Colourless crystals, very soluble in water. Used for bleaching, in soap-making, in photography, as an antiseptic, etc.

Natural calcium sulphates (gypsum, anhydrite, karstenite) are **excluded** (**heading 25.20**).