

**CPC****COOPERATIVE PATENT CLASSIFICATION****C01F****COMPOUNDS OF THE METALS BERYLLIUM, MAGNESIUM, ALUMINIUM, CALCIUM, STRONTIUM, BARIUM, RADIUM, THORIUM, OR OF THE RARE-EARTH METALS** (metal hydrides

{monoborane, diborane or addition complexes thereof} [C01B 6/00](#); salts of oxyacids of halogens [C01B 11/00](#); peroxides, salts of peroxyacids [C01B 15/00](#); sulfides or polysulfides of magnesium, calcium, strontium, or barium [C01B 17/42](#); thiosulfates, dithionites, polythionates [C01B 17/64](#); compounds containing selenium or tellurium [C01B 19/00](#); binary compounds of nitrogen with metals [C01B 21/06](#); azides [C01B 21/08](#); {compounds other than ammonia or cyanogen containing nitrogen and non-metals and optionally metals [C01B 21/082](#); amides or imides of silicon [C01B 21/087](#); metal {imides or} amides [C01B 21/092](#), {[C01B 21/0923](#)}; nitrites [C01B 21/50](#); {compounds of noble gases [C01B 23/0005](#)}; phosphides [C01B 25/08](#); salts of oxyacids of phosphorus [C01B 25/16](#); carbides [C01B 31/30](#); compounds containing silicon [C01B 33/00](#); compounds containing boron [C01B 35/00](#); compounds having molecular sieve properties but not having base-exchange properties [C01B 37/00](#); compounds having molecular sieve and base-exchange properties, e.g. crystalline zeolites, [C01B 39/00](#); cyanides [C01C 3/08](#); salts of cyanic acid [C01C 3/14](#); salts of cyanamide [C01C 3/16](#); thiocyanates [C01C 3/20](#); {double sulfates of magnesium with sodium or potassium [C01D 5/12](#); with other alkali metals [C01D 15/00](#), [C01D 17/00](#)}}

**C01F 1/00**

**Methods of preparing compounds of the metals beryllium, magnesium, aluminium, calcium, strontium, barium, radium, thorium, or the rare earths, in general**

**C01F 3/00****Compounds of beryllium****C01F 3/005**

- {Fluorides or double fluorides of beryllium with alkali metals or ammonium; Preparation of beryllium compounds therefrom}

**C01F 3/02**

- Oxides; Hydroxides

**C01F 5/00****Compounds of magnesium****C01F 5/02**

- Magnesia

**C01F 5/04**

- . by oxidation of metallic magnesium

**C01F 5/06**

- . by thermal decomposition of magnesium compounds (calcining magnesite or dolomite [C04B 2/10](#))

**C01F 5/08**

- . . by calcining magnesium hydroxide

**C01F 5/10**

- . . by thermal decomposition of magnesium chloride with water vapour

**C01F 5/12**

- . . by thermal decomposition of magnesium sulfate, with or without reduction

**C01F 5/14**

- Magnesium hydroxide

**C01F 5/145**

- . {Purification}

**C01F 5/16**

- . by treating magnesia, e.g. calcined dolomite, with water or solutions of salts not containing magnesium

**C01F 5/20**

- . by precipitation from solutions of magnesium salts with ammonia

- C01F 5/22
  - • from magnesium compounds with alkali hydroxides or alkaline- earth oxides or hydroxides
- C01F 5/24
  - Magnesium carbonates
- C01F 5/26
  - Magnesium halides
- C01F 5/28
  - • Fluorides
- C01F 5/30
  - • Chlorides
- C01F 5/305
  - • • {Dehydrating ammonium or alkali magnesium chlorides, e.g. carnalite}
- C01F 5/32
  - • • Preparation of anhydrous magnesium chloride by chlorinating magnesium compounds
- C01F 5/34
  - • • Dehydrating magnesium chloride containing water of crystallisation
- C01F 5/36
  - • Bromides
- C01F 5/38
  - Magnesium nitrates
- C01F 5/40
  - Magnesium sulfates (double sulfates of magnesium with sodium or potassium [C01D 5/12](#), with other alkali metals {[C01D 15/00](#)}, [C01D 17/00](#))
- C01F 5/42
  - Magnesium sulfites

**C01F 7/00****Compounds of aluminium**

- C01F 7/001
  - {Aluminium carbonate}
- C01F 7/002
  - {Compounds containing, besides aluminium, two or more other elements, with the exception of oxygen and hydrogen (compounds containing aluminium, fluorine and alkali or alkaline earth metals [C01F 7/54](#); compounds containing sulfur and other cations besides aluminium [C01F 7/68](#))}
- C01F 7/004
  - • {containing carbonate ions, e.g. dawsonite}
- C01F 7/005
  - • • {Hydrotalcite}
- C01F 7/007
  - • {containing, besides aluminium, only anions, e.g.  $\text{Al}(\text{OH})_x\text{CL}_y(\text{SO}_4)_z$  (mixed halides [C01F 7/48](#))}
- C01F 7/008
  - • {Ammonium aluminium fluorides}
- C01F 7/02
  - Aluminium oxide; Aluminium hydroxide; Aluminates
- C01F 7/021
  - • {After-treatment of oxides or hydroxides}
- C01F 7/022
  - • • {Classification}
- C01F 7/023
  - • • {Grinding, deagglomeration, disintegration}
- C01F 7/025
  - • • {Granulation, agglomeration}
- C01F 7/026
  - • • {Making or stabilising dispersions}
- C01F 7/027
  - • • {Treatment involving fusion or vaporisation}
- C01F 7/028
  - • {Beta-aluminas}
- C01F 7/04
  - • Preparation of alkali metal aluminates; Aluminium oxide or hydroxide therefrom {([C01F 7/028](#) takes precedence)}
- C01F 7/043
  - • • {Lithium aluminate}
- C01F 7/046
  - • • {Stabilisation of aluminates}
- C01F 7/06
  - • • by treating aluminous minerals {or waste-like raw materials} with alkali hydroxide, {e.g. leaching of bauxite according to the Bayer process (obtaining aluminium oxide or hydroxide from the resulting aluminate solution [C01F 7/14](#))}

C01F 7/0606	. . . . {Make-up of the alkali hydroxide solution from recycled spent liquor}
C01F 7/0613	. . . . {Pretreatment of the minerals, e.g. grinding}
C01F 7/062	. . . . {Digestion}
C01F 7/0626	. . . . . {Processes making use of tube digestion only}
C01F 7/0633	. . . . . {characterised by the use of additives}
C01F 7/064	. . . . . {Apparatus for digestion, e.g. digester vessels, heat exchangers}
C01F 7/0646	. . . . {Separation of the insoluble residue, e.g. red mud}
C01F 7/0653	. . . . . {characterised by the flocculant added to the slurry (final clarification of the aluminate solution <a href="#">C01F 7/47</a> )}
C01F 7/066	. . . . {Treatment of the separated residue}
C01F 7/0666	. . . . {Process control or regulation ( <a href="#">control per se G05</a> )}
C01F 7/0673	. . . . {from phosphate-containing minerals}
C01F 7/068	. . . . {from carbonate-containing minerals, e.g. dawsonite}
C01F 7/0686	. . . . {from sulfate-containing minerals, e.g. alunite}
C01F 7/0693	. . . . {from waste-like raw materials, e.g. fly ash, Bayer calcination dust}
C01F 7/08	. . . by treating aluminous minerals with sodium carbonate, {e.g. sinter processes ( <a href="#">C01F 7/0613</a> and <a href="#">C01F 7/066</a> take precedence)}
C01F 7/085	. . . . {according to the lime-sinter process}
C01F 7/10	. . . by treating aluminous minerals with alkali sulfates and reducing agents
C01F 7/12	. . . Alkali metal aluminates from alkaline-earth metal aluminates
C01F 7/14	. . . Aluminium oxide or hydroxide from alkali metal aluminates
C01F 7/141	. . . . {from aqueous aluminate solutions by neutralisation with an acidic agent}
C01F 7/142	. . . . . {with carbon dioxide}
C01F 7/144	. . . . {from aqueous aluminate solutions by precipitation due to cooling, e.g. as part of the Bayer process}
C01F 7/145	. . . . . {characterised by a crystal growth modifying agent other than aluminium hydroxide seed}
C01F 7/147	. . . . . {Apparatus for precipitation}
C01F 7/148	. . . . . {Separation of the obtained hydroxide, e.g. filtration, dewatering}
C01F 7/16	. . Preparation of alkaline-earth metal aluminates {or magnesium aluminate}; Aluminium oxide or hydroxide therefrom {( <a href="#">C01F 7/028</a> takes precedence)}
C01F 7/162	. . . {Magnesium aluminates}
C01F 7/164	. . . {Calcium aluminates}
C01F 7/166	. . . {Strontium aluminates}
C01F 7/168	. . . {Barium aluminates}
C01F 7/18	. . . Aluminium oxide or hydroxide from alkaline-earth metal aluminates
C01F 7/20	. . Preparation of aluminium oxide or hydroxide from aluminous ores with acids or salts
C01F 7/22	. . . with halides {or halogen acids}
C01F 7/24	. . . with nitric acid or nitrogen oxides
C01F 7/26	. . . with sulfuric acids or sulfates

- C01F 7/28 . . . with sulfurous acid
- C01F 7/30 . . Preparation of aluminium oxide or hydroxide by thermal decomposition {or by hydrolysis or oxidation} of aluminium compounds
- C01F 7/302 . . . {Hydrolysis or oxidation of gaseous aluminium compounds in the gas phase}
- C01F 7/304 . . . . {of organic aluminium compounds}
- C01F 7/306 . . . {Thermal decomposition of hydrated chlorides, e.g. aluminium trichloride hexahydrate}
- C01F 7/308 . . . {Thermal decomposition of nitrates}
- C01F 7/32 . . . {Thermal decomposition} of sulfates {including complex sulfates, e.g. alums}
- C01F 7/34 . . Preparation of aluminium hydroxide by precipitation from solutions containing aluminium salts
- C01F 7/36 . . . from organic aluminium salts
- C01F 7/38 . . Preparation of aluminium oxide by thermal reduction of aluminous minerals
- C01F 7/40 . . . in the presence of aluminium sulfide
- C01F 7/42 . . Preparation of aluminium oxide or hydroxide from metallic aluminium, e.g. by oxidation
- C01F 7/422 . . . {by oxidation with a gaseous oxidator at a high temperature}
- C01F 7/424 . . . . {using a plasma}
- C01F 7/426 . . . {by applying mechanical energy to solid aluminium at a low temperature}
- C01F 7/428 . . . {by oxidation in an aqueous solution}
- C01F 7/44 . . Dehydration of aluminium {oxide or} hydroxide, {i.e. all conversions of one form into another involving a loss of water}
- C01F 7/441 . . . {by calcination}
- C01F 7/442 . . . . {in presence of a calcination additive}
- C01F 7/444 . . . . {Apparatus therefor}
- C01F 7/445 . . . . {making use of a fluidised bed}
- C01F 7/447 . . . {by wet processes}
- C01F 7/448 . . . . {using superatmospheric pressure, e.g. hydrothermal conversion of gibbsite into boehmite}
- C01F 7/46 . . Purification of aluminium oxide, aluminium hydroxide or aluminates {(C01F 7/028 takes precedence)}
- C01F 7/47 . . . of aluminates, {e.g. removal of compounds of Si, Fe, Ga or of organic compounds from Bayer process liquors}
- C01F 7/473 . . . . {Removal of organic compounds, e.g. sodium oxalate}
- C01F 7/476 . . . . . {by oxidation}
- C01F 7/48 . . Aluminium halides
- C01F 7/50 . . Fluorides
- C01F 7/52 . . . Double compounds containing both fluorine and other acid {halide} groups
- C01F 7/54 . . . Double compounds containing both aluminium and alkali metals or alkaline-earth metals

- C01F 7/56 . . Chlorides ([containing fluorine C01F 7/52](#))
- C01F 7/58 . . . Preparation of anhydrous aluminium chloride
- C01F 7/60 . . . . from oxygen-containing aluminium compounds
- C01F 7/62 . . . Purification
- C01F 7/64 . . Bromides ([containing fluorine C01F 7/52](#))
- C01F 7/66 . Aluminium nitrates ([containing fluorine {C01F 7/002}](#))
- C01F 7/68 . Aluminium compounds containing sulfur ([containing fluorine {C01F 7/002}](#))
- C01F 7/70 . . Sulfides
- C01F 7/72 . . Sulfites
- C01F 7/74 . . Sulfates
- C01F 7/741 . . . {Preparation from elemental aluminium or elemental aluminium containing materials, e.g. foil, dross}
- C01F 7/743 . . . {Preparation from silicoaluminous materials, e.g. clays, bauxite}
- C01F 7/745 . . . {Preparation from alums, e.g. alunite}
- C01F 7/746 . . . {After-treatment, e.g. dehydration, stabilisation}
- C01F 7/748 . . . . {Purification}
- C01F 7/76 . . . Double salts, {i.e. compounds containing, besides aluminium and sulfate ions, only other cations}, e.g. alums
- C01F 7/762 . . . . {Ammonium or alkali metal aluminium sulfates}
- C01F 7/765 . . . . . {Ammonium aluminium sulfates}
- C01F 7/767 . . . . {Alkaline earth metal aluminium sulfates}
  
- C01F 11/00** **Compounds of calcium, strontium, or barium ([C01F 7/00](#) takes precedence)**
- C01F 11/005 . {Preparation involving liquid-liquid extraction, absorption or ion-exchange}
- C01F 11/02 . Oxides or hydroxides ([production of lime C04B 2/00](#))
- C01F 11/04 . . by thermal decomposition
- C01F 11/06 . . . of carbonates
- C01F 11/08 . . by reduction of sulfates
- C01F 11/10 . . from sulfides
- C01F 11/12 . . from silicates
- C01F 11/16 . . Purification
- C01F 11/18 . Carbonates
- C01F 11/181 . . {Preparation of calcium carbonate by carbonation of aqueous solutions and characterised by control of the carbonation conditions}
- C01F 11/182 . . {Preparation of calcium carbonate by carbonation of aqueous solutions and characterised by an additive other than CaCO<sub>3</sub>-seeds}
- C01F 11/183 . . . {the additive being an organic compound}
- C01F 11/184 . . {Preparation of calcium carbonate by carbonation of solutions based on non-aqueous solvents}
- C01F 11/185 . . {After-treatment, e.g. grinding, purification, conversion of crystal morphology}
- C01F 11/186 . . {Strontium or barium carbonate}
- C01F 11/187 . . . {Strontium carbonate}

C01F 11/188	. . . {Barium carbonate}
C01F 11/20	. Halides
C01F 11/22	. . Fluorides
C01F 11/24	. . Chlorides
C01F 11/26	. . . from sulfides
C01F 11/28	. . . by chlorination of alkaline-earth metal compounds
C01F 11/30	. . . Concentrating; Dehydrating; Preventing the adsorption of moisture or caking
C01F 11/32	. . . Purification
C01F 11/34	. . Bromides
C01F 11/36	. Nitrates
C01F 11/38	. . Preparation with nitric acid or nitrogen oxides
C01F 11/40	. . Preparation by double decomposition with nitrates
C01F 11/42	. . Double salts (with magnesium C01F 5/38)
C01F 11/44	. . Concentrating; Crystallising; Dehydrating; Preventing the absorption of moisture or caking
C01F 11/46	. Sulfates (dehydration of gypsum {for the production of calcium sulfate cements} C04B 11/02)
C01F 11/462	. . {Sulfates of Sr or Ba}
C01F 11/464	. . {Sulfates of Ca from gases containing sulfur oxides}
C01F 11/466	. . {Conversion of one form of calcium sulfate to another}
C01F 11/468	. . {Purification of calcium sulfates}
C01F 11/48	. Sulfites
<b>C01F 13/00</b>	<b>Compounds of radium</b>
<b>C01F 15/00</b>	<b>Compounds of thorium</b>
<b>C01F 17/00</b>	<b>Compounds of the rare earth metals, i.e. scandium, yttrium, lanthanum, or the group of the lanthanides</b>
	<b><u>NOTE</u></b>
	In this group "rare earth metals" means one single element or a combination of elements taken from the group as specified above
C01F 17/0006	. {Preparation involving a liquid-liquid extraction, an adsorption or an ion exchange}
C01F 17/0012	. {Compounds containing besides rare earth metals two or more other element with the exception of oxygen or hydrogen, e.g. La <sub>4</sub> S <sub>3</sub> Br <sub>6</sub> or ternary oxides or hydroxides, e.g. NaCeO <sub>2</sub> }
C01F 17/0018	. . {Oxygen being the only anion}
C01F 17/0025	. . . {Aluminates}
C01F 17/0031	. . {Halogen being the only anion (compounds containing besides rare earth metals only different halogens, e.g. Sc C01F 17/0056)}
C01F 17/0037	. . {Sulfur being the only anion}

- C01F 17/0043
  - {Oxides or hydroxides (ternary oxides or hydroxides, e.g.  $\text{NaCeO}_2$  [C01F 17/0018](#))}
- C01F 17/005
  - {Carbonates}
- C01F 17/0056
  - {Halides}
- C01F 17/0062
  - . {Fluorides}
- C01F 17/0068
  - . {Chlorides}
- C01F 17/0075
  - {Nitrates}
- C01F 17/0081
  - {Sulfates}
- C01F 17/0087
  - {Sulfides}
- C01F 17/0093
  - . {Oxysulfides}