

**CLASS 502, CATALYST, SOLID SORBENT, OR SUPPORT THEREFOR: PRODUCT OR PROCESS OF MAKING**

**SECTION I - CLASS DEFINITION**

This class provides for (1) a mixture of materials intended to catalyze a reaction or to sorb a component of a fluid or (2) certain single materials specifically structured to catalyze a reaction or sorb a component.

In this class, many subclasses are based on the groupings of elements in the periodic chart. Below are listed elements in the group as used in the class.

Group I metals: Lithium(Li), Sodium(Na), Potassium(K), Rubidium(Rb), Cesium(Cs), Francium(Fr), Copper(Cu), Silver(Ag), and Gold(Au)

Group II metals: Beryllium(Be), Magnesium(Mg), Calcium(Ca), Strontium(Sr), Barium(Ba), Radium(Ra), Zinc(Zn), Cadmium(Cd), and Mercury(Hg)

Group III: Scandium(Sc), Yttrium(Y), Aluminum(Al), Gallium(Ga), Indium(In), and Thallium(Tl)\*

Group IV: Titanium(Ti), Zirconium(Zr), Hafnium(Hf), Germanium(Ge), Tin(Sn), and Lead(Pd)

Group V metals: Vanadium(V), Niobium(Nb), Tantalum(Ta), Arsenic(As), Antimony(Sb), and Bismuth(Bi)

Group VI metals: Chromium(Cr), Molybdenum(Mo), Wolfram(W), Tungsten(T), and Polonium(Po)

Group VII metals: Manganese(Mn), Technetium(Tc), and Rhenium(Re)

Group VIII: Iron group metals, Iron(Fe), Cobalt(Co), Nickel(Ni), and the platinum group metals, Ruthenium(Ru), Rhodium(Rh), Palladium(Pd), Osmium(Os), Iridium(Ir), and Platinum(Pt)

Lanthanides: Elements with atomic numbers 57-71 inclusive, Lanthanum(La), Cerium(Ce), Praseodymium(Pr), Neodymium(Nd), Promethium(Pm), Samarium(Sm), Europium(Eu), Gadolinium(Gd), Terbium(Tb), Dysprosium(Dy), Holmium(Ho), Erbium(Er), Thulium(Th), Ytterbium(Yb), and Lutetium(Lu)

Alkaline earth metals: Calcium(Ca), Strontium(Sr), Barium(Ba), and Radium(Ra)

Alkali metals: Lithium(Li), Sodium(Na), Potassium(K), Rubidium(Rb), Cesium(Cs), and Francium(Fr)

Actinides: Elements with atomic numbers 89 and above inclusive, Actinium(Ac), Thorium(Th), Protactinium(Pa), Uranium(U), Neptunium(Np), Plutonium(Pu), Americium(Am), Curium(Cm), Berkelium(Bk), Californium(Cf), Einsteinium(Es), Fermium(Fm), Mendelevium(Md), Nobelium(No), Lawrencium(Lr)\*

Halogens: Fluorine(F), Chlorine(Cl), Bromine(Br), Iodine(I), and Astatine(At)

Lithium(Li), Sodium(Na), Potassium(K), Rubidium(Rb), Cesium(Cs), and Francium(Fr)

Rare earth: Scandium(Sc), Yttrium(Y), and Lanthanide group

\* La is grouped with the Lanthanides and Ac with the Actinides.

**SECTION II - NOTES TO THE CLASS DEFINITION**

- (1) Note. Except as indicated in the title and definition, the subclasses in this class provide for both a product and a process of making the product.

**SECTION III - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS**

**Lines Within This Class**

In this schedule some subclasses, namely 6, 8+, 104+ and 151 provide for methods only and a claim to a product must be classified in another subclass, while other subclasses, e.g., 11+, 20+, and 418+ although developed on a process theme, provide also for the products of the process. Except for those situations in which a subclass for a specific process is provided, a method of making a composition of this class is classified with the composition, per se.

**Lines With Other Classes**

- (1) Classes directed to element or compound

Superiority is dependent on comprehensiveness. A patent claiming a new compound and a composition of

this class including such compound is placed here as an original and cross referenced to the compound class. A patent claiming a new compound or process of making it, and a composition of this class which is used in making the compound is placed in the compound class as an original and cross-referenced here.

## (2) Chemical Composition Placement

The rules for determining Class placement of the Original Reference (OR) for claimed chemical compositions are set forth in the Class Definition of Class 252 in the section **LINES WITH OTHER CLASSES AND WITHIN THIS CLASS**, subsection **COMPOSITION CLASS SUPERIORITY**, which includes a hierarchical **ORDER OF SUPERIORITY FOR COMPOSITION CLASSES**.

References to Other Classes, below, are directed to the following: Classes Providing for Related Matter; or Classes Which May Have Catalytic or Sorbent Functions.

## SECTION IV - REFERENCES TO OTHER CLASSES

### SEE OR SEARCH CLASS:

- 8, Bleaching and Dyeing; Fluid Treatment and Chemical Modification of Textiles and Fibers, for a process of dyeing, bleaching or cleaning a textile which may utilize a catalyst or sorbent. (Class Providing for Related Matter.)
- 44, Fuel and Related Compositions, for a composition designed to initiate or sustain a flame and which may include a catalyst or sorbent. (Class Providing for Related Matter.)
- 73, Measuring and Testing, subclasses 23.2+ for gas analysis by use of a sorbent. (Class Which May Have Catalytic or Sorbent Functions.)
- 95, Gas Separation: Processes, subclasses 90+ for processes of gas separation using solid sorbents. Class 95 will take the combination of gas separation using a solid sorbent and regenerating the solid sorbent. (Class Providing for Related Matter.)
- 96, Gas Separation: Apparatus, subclasses 108+ for solid sorbent apparatus for gas separation. Class 502 will take zeolite or other solid sorbent compositions having details of the physical characteristics of the composition itself (e.g., porosity, particle size, etc.). Class 502 will also take zeolite or other solid sorbent compositions that are layered, laminated, or

otherwise affixed to another zeolite or other solid sorbent composition or to a support material. Class 96 takes apparatus having (a) an inlet for the fluid mixture to be treated, (b) a means effective to cause separation into constituent parts, and (c) an outlet for at least one constituent separate and distinct from an outlet for another constituent or a single outlet used at different times to remove the separated constituents. The means causing separation into constituent parts confines the zeolite or other solid sorbent composition inside an enclosure that contains the fluid mixture being separated. Class 96 also takes filter elements having zeolite or other solid sorbent compositions held in an open structure or rim that encases, holds, or borders the zeolite or other solid sorbent composition or held on a skeletal structure. (Class Providing for Related Matter.)

- 119, Animal Husbandry, particularly subclasses 171+ for material used for absorbing moisture from an animal waste product, i.e., excrement or urine. (Class Providing for Related Matter.)
- 127, Sugar, Starch, and Carbohydrates, for a process using a sorbent in refining. (Class Providing for Related Matter.)
- 149, Explosive and Thermic Compositions or Charges, for a composition of that class which may include a catalyst or sorbent. (Class Providing for Related Matter.)
- 201, Distillation: Processes Thermolytic, for a process producing char or a carbon residue which may have catalytic or sorbent properties. (Class Providing for Related Matter.)
- 204, Chemistry: Electrical and Wave Energy, for an electrode of that class which may be catalytic or a process of treating an electrolyte of that class which may include sorbing. (Class Providing for Related Matter.)
- 206, Special Receptacles or Package, subclass 0.7 and 204 for a container of that class including a sorbent. (Class Which May Have Catalytic or Sorbent Functions.)
- 208, Mineral Oils: Processes and Products, for a process which may employ a catalyst or sorbent in treating petroleum. (Class Providing for Related Matter.)
- 210, Liquid Purification or Separation, for a process which may utilize a catalyst or sorbent in treating water or liquids in general. (Class Providing for Related Matter.)
- 252, Compositions, for a composition of general or of some specific utilities and the relative position of this class (502) with the various uses

- and functions provided for in that class. (Class Providing for Related Matter.)
- 260, Chemistry of Carbon Compounds, (or the 520 and 530-570 series of classes incorporated therein) for either an organic compound which may be used as a catalyst or sorbent or a process using a catalyst or sorbent in making or purifying an organic compound. (Class Providing for Related Matter.)
- 420, Alloys or Metallic Compositions, subclass 900 for an alloy which may sorb hydrogen. (Class Which May Have Catalytic or Sorbent Functions.)
- 422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing, particularly subclass 30, 69+, 88+, 122, 177+, 190+, 211+, and 312 for a process using, or apparatus including, a catalyst or sorbent. (Class Which May Have Catalytic or Sorbent Functions.)
- 423, Chemistry of Inorganic Compounds, Digest 13 and 16 for specific techniques which may be useful in using or regenerating a catalyst or sorbent. (Class Which May Have Catalytic or Sorbent Functions.)
- 423, Chemistry of Inorganic Compounds, for either an inorganic compound which may be used as a catalyst or sorbent and especially subclasses 700+ for a zeolite or a process using a catalyst to make an inorganic compound. (Class Providing for Related Matter.)
- 426, Food or Edible Material: Processes, Compositions, and Products, for a food which may include a sorbent. (Class Providing for Related Matter.)
- 430, Radiation Imagery Chemistry: Process, Compositions, or Product Thereof, for a light sensitive composition which may include a catalyst. (Class Providing for Related Matter.)
- 435, Chemistry Molecular Biology and Microbiology, for an enzyme or a method using an enzyme. (Class Providing for Related Matter.)
- 436, Chemistry: Analytical and Immunological Testing, appropriate subclasses for chemical analysis or testing processes involving the use of a sorbent. (Class Which May Have Catalytic or Sorbent Functions.)
- 506, Combinatorial Chemistry Technology: Method, Library, Apparatus, for a catalyst library or a method of making said library.
- 518, Chemistry: Fischer-Tropsch Processes; or Purification or Recovery of Products Thereof, for a process of that class using a catalyst and see especially subclass 701, 707, 709, 713, to 721 and subclass 722 for a process using a sorbent. (Class Providing for Related Matter.)
- 585, Chemistry of Hydrocarbon Compounds, for a process in which a catalyst or sorbent may be used to produce a hydrocarbon. (Class Providing for Related Matter.)

## SECTION V - GLOSSARY

### SYNONYMS OF THE ELEMENTS

Alabamine = astatine, Aldebaranium = ytterbium

Argentum = silver, Aurum = gold

Austrium = impure gallium, Cassiopeium = lutecium

Celtium = lutecium, Columbium = niobium

Demonium = dysprosium, Deuterium = hydrogen

Didymium = neodymium and praseodymium

Dwi-manganese = rheniu, Eka-aluminum = gallium

Eka-boron = scandium, Eka-caesium = virginium

Eka-iodine = alabamine, Eka-manganese = masurium

Eka-silicon = germanium, Eka-tantalum = protactinium

Erythronium = vanadium, Ferrum = iron

Florentium = illinium, Glucinum = beryllium

Hydrargyrum = mercury, Illinium = promethium

Kalium = potassium, Masurium = technetium

Natrium = sodium, Neoytterbium = ytterbium

Niobium = Columbium, Niton = radon

Plumbum = lead, Radium emanation = radon

Stannum = tin, Stibium = antimony

Tritiumum = hydrogen, Virginium = francium

Wolfram = tungsten

The meaning to be given to the various "art" terms appearing in this class, but which have not been included in the glossary below, is the same as that generally accepted or in common usage. However, certain terms employed in this class, which are included below, have been assigned definitions tailored to meet the needs of this class and therefore those may be more restricted or less limited or even altogether different from those in common usage.

#### ACTIVATED

The state or condition of a material which has been treated or acted upon to enable it to function as intended. In general a change is effected which is discernible often only in the ability to perform such function. For instance, activated charcoal.

#### ACTIVE CARBON

Sorbent form compressing carbon with either additive or porous structure enhancing sorbability.

#### ANIMAL CHARCOAL

See Bone Black

#### BONE BLACK

Solid residue from chafing bones - @10%carbon, 80%  $\text{Ca}_3(\text{PO}_4)_2$ , used particularly in decolorizing sugar solutions.

#### CATALYST

An agent which affects or effects a chemical reaction by its presence in the reaction mass (other than by dissolving or dispersing the reactants) generally being recoverable from the products as if it did not enter into the reaction and merely provided the impetus for reaction of other materials. While it was originally thought that a catalyst did not enter the reaction and instead provided sites at which the reactants, per se, interacted, it is understood now that at least some transitory intermediates may involve the catalyst. The catalyst, however does not contribute substance to the desired final product even though it may remain inseparable from such product.

#### CATALYZE

Affecting, effecting, promoting, or initiating a reaction by being present-generally by presenting a contact surface and usually recoverable from the product in essentially unchanged form and operating other than by merely acting as a solvent. The strict classical concept of a catalyst is not rigidly adhered to now and the catalyst may disappear, change or be included as an incidental moiety in the final product. A catalyst may inhibit one reaction while promoting or allowing another reaction but an agent strictly preventing or retarding a reaction is a preservative for Class 252 Compositions, subclasses 380+. Examples of these retardants or inhibitors are anti-oxidant and anti-knock compositions. An agent that encourages a reaction by dispersing the reactants such as a more effective solvent is not a catalyst. A catalyst may be gaseous, liquid or solid.

#### CHAR

Carbonaceous residue from pyrolysis of organic material generally of a hard burned pitch appearance.

#### CLAY

A naturally occurring hydrated aluminum silicate originally derived from the earth, having physical properties due at least in part to the size and distribution of colloidal particles, and properties including plasticity. Thirty or more percent of the particles are under 0.002 mm in diameter.

- (1) Note. The use of the term clay in a document is considered to meet the above definition.
- (2) Note. Terms recognized as clay: attapulgite, bentonite, fuller's earth, halloysite, illite kaolin, montmorillonite, mullite.
- (3) Note. Some earthy silicon compounds that are not clay or zeolite include Asbestos, Diaspore, Diatomaceous earth, Diatomite, Feldspar, Guhr, Kieselgahr, Mica, Quartz, Sand, and Silica.

#### METAL

An element that is not designated a nonmetal as listed infra. Nonmetals are H, B, C, Si, N, P, O, S, Se, Te, Halogens (F, Cl, Br, I, At,) and noble gases (He, Ne, Ar, Kr, Xe, Rn). The various types or groups of metals are as set out at the beginning of the schedule.

## ORGANIC

A compound in which carbon is bonded to (1) a second carbon; (2) at least one atom of hydrogen or halogen; or (3) nitrogen by a single or double bond; except cyanic and (HOCN) cyanogen (NCCN), cyanamide (H<sub>2</sub>NCN), cyanogen halide (HalCN), hydrocyanic acid (HCN) isocyanic acid (HNCO) fulminic acid (HCNO) and metal carbides (MeCCMe). See class definition of Class 260.

## SORB

The attracting and holding of a constituent of a contacting fluid, on the surface, within pores, or throughout its mass by a material of solid character. The sorbing is often selective, preferentially attracting a component and not attracting another but it may apply to a complete fluid. The sorbent may comprise a solid impregnated with a normally liquid material in which the mixture has a solid property but does not encompass a solution of a solid in a liquid.

## SPECIFICALLY STRUCTURED

Having shape or size designed or calculated to increase the catalysis or sorbency of a material, generally by presenting a greater surface area per unit volume or a pore size of critical dimensions. Examples of specifically structured single materials are Raney nickel and activated carbon. Since porosity and specific pore size are inherent in zeolites, critical dimensions of the pores of a Zeolite alone are not considered to constitute specific structure.

## ZEOLITE

A hydrous alumino silicate characterized by a three dimensional framework of SiO<sub>4</sub> and AlO<sub>4</sub> tetrahedra, cross-linked by the sharing of oxygen atoms being chemically balanced by a cation, usually sodium or calcium and of crystalline structure such that openings or pores allow access to a relatively large absorption area inside the crystal. The cation may be ion exchanged for other metal ions, ammonia, an amine or hydrogen. Zeolites may be activated for sorption by driving off the water of hydration.

- (1) Note. Terms Recognized as being Zeolite include Analcite, Cancrinite, Chabazite, Clinotilolite, Cordierite, Edingtonite, Eri-onite, Faujasite, Ferrierite, Gmelinite, Heu-landite, Laumontite, Levynite, Mesolite,

Mordenite, Natrolite, Offretite, Paulingite, Phillipsite, Ptilolite, Scolecite, Thomsonite, ZSM, and ZK.

- (2) Note. See the list in (3) Note of the defini-tion of Clay, supra, for some silicon com-pounds not treated as clays or zeolites in this class (502).

## SUBCLASSES

### 1 HAVING FOREIGN OR DIVERSE FUNC-TION (E.G., PREVENT CORROSION, ETC.):

This subclass is indented under the class defini-tion. Composition having utility in addition to catalysis or sorbency.

- (1) Note. The diverse function may compre-hend myriad uses, e.g., impart color, etc., but a claimed function provided for in Class 252, Compositions in the schedule higher than subclass 478 is superior and will govern classification.
- (2) Note. Some wick compositions may be classified here on the basis of a heat con-ductivity in addition to sorbency, but the bulk of wick compositions are classified in subclasses 400+.
- (3) Note. A composition intended to func-tion as an ignitor by catalytic and incan-descing action is proper for this subclass.

## SEE OR SEARCH CLASS:

252, Compositions, subclass 1 for a generi-cally claimed composition having several disclosed uses and the appro-priate subclass for a composition hav-ing a claimed utility provided for in that class schedule down to subclass 194, inclusive. The rules for deter-mining Class placement of the Original Reference (OR) for claimed chemical compositions are set forth in the Class Definition of Class 252 in the section LINES WITH OTHER CLASSES AND WITHIN THIS CLASS, sub-section COMPOSITION CLASS SUPERIORITY, which includes a hierarchical ORDER OF SUPERIOR-ITY FOR COMPOSITION CLASSES.

**2 With structure having utility in addition to support or carrier:**

This subclass is indented under subclass 1. Composition having a shape or dimension serving a purpose other than as a carrier for or to enhance the surface contact area of catalytic or sorbent material.

- (1) Note. This subclass provides for a nominally claimed (a) self cleaning oven wall or (b) exhaust muffler with catalytic activity.
- (2) Note. The foreign or diverse function is usually provided by the physical form of the composition in this subclass, while the other function in subclass 1 is usually due to the chemical nature of the composition.

**3 TO BE USED AS A MELT:**

This subclass is indented under the class definition. Composition intended to function in the liquid phase, and which at standard temperature and pressure would be solid.

- (1) Note. To be classified here, a patent must include a claim reciting the liquid phase, or molten feature.
- (2) Note. A sorbent which would normally be solid at room temperature but is claimed as a liquid or melt is classifiable here.

**4 IN FORM OF A MEMBRANE:**

This subclass is indented under the class definition. Composition claimed in terms designating a relatively thin, flexible film.

**SEE OR SEARCH CLASS:**

210, Liquid Purification or Separation, subclass 500.21 for a membrane for treating liquids, in general, and water, in particular, by selective diffusion therethrough of components of the liquid.

**5 IRRADIATION BY, OR APPLICATION OF, ELECTRICAL, MAGNETIC OR WAVE ENERGY:**

This subclass is indented under the class definition. Process of preparing or perfecting a composition under the ... by subjecting it to a flow or current of electrons, a sonic, magnetic, or electromotive field, or bombardment by sub atomic particles or radiant energy (e.g., ion implantation, ultra sonic vibration, actinic light, X-rays, etc.).

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

522, for a cross-reference art collection of compositions of this class, activated for use, by radiant energy.

**6 CONTROL RESPONSIVE TO SENSED CONDITION:**

This subclass is indented under the class definition. Processes involving a process control which is responsive to a sensed condition, (e.g., temperature, pressure, etc.).

- (1) Note. A process of regenerating a composition of this class with automatic control of temperature is classifiable here.

**7 BIOSPECIFIC MATERIAL, OR PRODUCED BY ENZYME OR MICROORGANISM:**

This subclass is indented under the class definition. Composition peculiarly adapted to affect or bind a unique or very narrow spectrum of biological material, or produced by a living plant or animal of a size normally visible only through a microscope.

- (1) Note. Microorganism includes bacterium, yeast, fungus, virus and unicellular alga.
- (2) Note. A composition in which a catalytic function is supplied only by an enzyme is classifiable in Class 435, Chemistry: Molecular Biology and Microbiology.

**SEE OR SEARCH CLASS:**

435, Chemistry: Molecular Biology and Microbiology, appropriate subclasses especially 183+, for an enzyme (also known as a biological catalyst), per

se, or a process using an enzyme, and see the definition of that class (435) for lines with other classes involving enzymes, and subclass 815 for a cross-reference art collection for a process of separating enzymes.

**8 FORMING OR TREATING A SPHERE, PROCESS ONLY:**

This subclass is indented under the class definition. Method in which catalytic, sorbent, or carrier material is shaped as an orb or ball, or such material so shaped, is processed to perfect it for a utility of this class.

- (1) Note. The material may be a catalyst precursor or a carrier, per se, claimed or disclosed solely for use in a composition of this class.
- (2) Note. This and the indented subclass provide for process only, and a claim to a sphere of a composition of this class must be classified in this schedule on some other basis, generally being crossed down to the appropriate class providing for the composition.

**9 Forming other than by liquid immersion:**

This subclass is indented under subclass 8. Method in which the spherical shape is imparted by solid or gaseous means.

- (1) Note. Some examples of methods provided for in this subclass are cutting, rolling, spraying, or atomizing, shot tower dropping, etc.

**10 Treating preformed sphere only:**

This subclass is indented under subclass 8. Process in which a previously made sphere is subjected to the action of an agent which perfects it for use as a catalyst or sorbent.

- (1) Note. The agent may be chemical or physical.

**11 INCLUDING ION EXCHANGING, EXCEPT ZEOLITES OR PRODUCT THEREOF:**

This subclass is indented under the class definition. Process in which a dissociably charged chemical moiety is released by the composition and a different charged moiety of the same

polarity is captured, effecting a reversible chemical replacement reaction.

- (1) Note. While an ion exchange process for a zeolite for this class is not classifiable here, such a process involving a clay is classifiable here.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 60+, for a process of making a catalytic or sorbent zeolite composition which may include an ion exchange step.

SEE OR SEARCH CLASS:

- 252, Compositions, subclass 179 and 184 for an ion exchanging composition.  
521, Synthetic Resins or Natural Rubbers, subclass 25 for an ion exchange synthetic resin.

**12 For regenerating or rehabilitating catalyst or sorbent:**

This subclass is indented under subclass 11. Process, , of treating a composition which has been in use, to restore it to a state of intended function.

SEE OR SEARCH CLASS:

- 34, Drying and Gas or Vapor Contact With Solids, for processes of regenerating catalysts or adsorbents by drying only.  
201, Distillation: Processes, Thermolytic, appropriate subclasses for a process of carbonizing by thermolytic distillation.  
202, Distillation: Apparatus, for apparatus for making or reactivating bone black and other carbonaceous adsorbents by destructive distillation.  
208, Mineral Oils: Processes and Products, for processes of converting or refining mineral oils which also includes the steps of reactivating the catalyst or adsorbent used in the process.

**20 REGENERATING OR REHABILITATING CATALYST OR SORBENT:**

This subclass is indented under the class definition. Process of treating a composition, which has been in use, to restore it to a state of intended function by (a) removing accumulated extraneous material, (b) replacing a lost essen-

tial or perfecting component, (c) rearranging disturbed elements into a former functionally useful configuration, or (d) subjecting spent material to a force or environment serving to make it again active for its intended function.

- (1) Note. A steam treatment which is claimed to activate spent carbon sorbent is provided for in this or an indented subclass even though there is no disclosure of removal of contaminant or addition of material.
- (2) Note. Combinations of regeneration or reactivation of an adsorbent and the recovery of the adsorbed material are classified on the basis of the material recovered.

**SEE OR SEARCH CLASS:**

- 34, Drying and Gas Vapor Contact With Solids, for processes of regenerating catalysts or adsorbents by drying only.
- 201, Distillation: Processes, Thermolytic, appropriate subclasses for a process of carbonizing by thermolytic distillation.
- 202, Distillation: Apparatus, for apparatus for making or reactivating bone black and other carbonaceous adsorbents by destructive distillation.
- 208, Mineral oils: Processes and Products, for processes of converting or refining mineral oils which also includes the steps of reactivating the catalyst or adsorbent used in the process.

**21 Including segregation of diverse particles:**  
This subclass is indented under subclass 20. Process wherein components of the catalyst or sorbent are separated on the basis of specific gravity, density, size, shape, or other property of differing discrete small bodies of the composition.

- (1) Note. This subclass includes abrasion with segregation of the catalyst or sorbent from abraded particles. It also includes segregation of catalyst and foreign particles such as dust.
- (2) Note. Flotation separation is an example of a process classifiable here.

**SEE OR SEARCH CLASS:**

- 209, Classifying, Separating, and Assorting Solids, for methods of segregation of particles of general utility.

**22 Treating with a liquid or treating in a liquid phase, including dissolved or suspended:**

This subclass is indented under subclass 20. Process in which the catalyst or sorbent is contacted with a liquid or wherein treatment is effected in a liquid medium.

- (1) Note. In a liquid medium includes either dissolved or suspended catalyst or sorbents.
- (2) Note. The treating reagent is itself a liquid, is dissolved or suspended in a liquid or is added to a catalyst or sorbent which is dissolved or suspended in a liquid carrier, or is itself a liquid, including molten.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 3, for a catalyst which functions in a molten state.

**23 "Wet air combustion" oxidation of material submerged in liquid:**

This subclass is indented under subclass 22. Process in which the catalyst or sorbent is subjected to dissolved oxygen under pressure and heat, below the critical temperature, such that autogenic oxidation is effected.

- (1) Note. Generally undesired extraneous carbonaceous material is converted to water and carbon oxides.
- (2) Note. The process is also known by several terms such as "flameless combustion", "submerged combustion", etc.

**SEE OR SEARCH CLASS:**

- 210, Liquid Purification or Separation, subclass 761 for a similar process in which liquid is treated by oxidation of components in the liquid phase.

- 24 Including intended dissolution or precipitation of a substantial amount of an ingredient of the ultimate composition:**  
This subclass is indented under subclass 22. Process in which an essential component of the composition is (1) dissolved in a solvent or by reaction, or (2) caused to come out of solution in a solid phase, permitting separation from reaction products and/or extraneous material or providing such component in an effective form.
- (1) Note. The subject matter of this subclass requires an intentional dissolution of a component of the composition and does not include incidental etching of an active material during an acid treating to clean the metal surface.
- (2) Note. A process in which additional active material may be added by precipitation is not proper for this subclass. The material precipitated must have been present in the original catalyst composition, though possibly in a different form.
- 25 Using salt or alkaline substance:**  
This subclass is indented under subclass 22. Process in which the material utilized is capable of supplying a nonprotonic positive ion.
- (1) Note. The treating material of the subclass generally gives a basic or neutral pH, but may include soaps (salts of carboxylic acids) and acid salts (e.g.,  $\text{NaHSO}_4$ ,  $\text{CaHPO}_4$ ).
- (2) Note. The use of a base to neutralize a previous acid treatment is provided for in this subclass.
- 26 Ammonia or derivative thereof:**  
This subclass is indented under subclass 25. Process in which the alkaline material or salt comprises  $\text{NH}_3$  or a derivative thereof e.g., amine, amide, or quaternary ammonium salt.
- 27 Using acid:**  
This subclass is indented under subclass 22. Process in which a proton donor is utilized.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
35, for a process using a halogen acid in the gaseous state.
- 28 Organic:**  
This subclass is indented under subclass 27. Process in which the acid contains carbon as set out in the term "organic" in the glossary.
- 29 Organic liquid:**  
This subclass is indented under subclass 22. Process in which the treating agent is a liquid carbon compound as set out in the term organic in the glossary.
- (1) Note. The bulk of the disclosures in this subclass are directed to solvent washing or extracting.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
21, for a flotation separating of particles process which may include an organic liquid.
- 30 And gas addition thereto:**  
This subclass is indented under subclass 29. Process which includes the step of subjecting the composition to the action of a gas.
- (1) Note. The gas treatment may be concurrent with the liquid treatment.
- 31 Hydrocarbon:**  
This subclass is indented under subclass 29. Process in which the liquid used comprises a compound composed of only hydrogen and carbon.
- 32 Halogen containing:**  
This subclass is indented under subclass 29. Process in which the organic material contains a nonmetallic element from GP. VII.
- 33 Oxygen containing:**  
This subclass is indented under subclass 29. Process in which the organic material contains element number 8.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
28, for a process utilizing an organic acid which may contain oxygen.
- 34 Gas or vapor treating:**  
This subclass is indented under subclass 20. Process in which the treating material is a readily diffusive fluid, tending to expand indefinitely and with molecules in free movement.
- (1) Note. This subclass provides for the use of normally liquid material which becomes gaseous under the prevailing conditions (e.g., temperature above its boiling point).
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
30, for the use of a gas in conjunction with an organic liquid to regenerate a catalyst or sorbent.
- 35 Using halogen containing substance including liquids vaporizable upon contacting spent catalyst or sorbent:**  
This subclass is indented under subclass 34. Process in which the treating material includes a nonmetallic element of GP. VII, free or in a compound, in gaseous form or as a liquid vaporizable upon contacting the spent material being regenerated.
- SEE OR SEARCH CLASS:  
208, Mineral Oils: Processes and Products, for a catalytic or sorbent process of that class which may include regeneration of the catalyst or sorbent and see especially subclass 140.
- 36 Fluorine containing:**  
This subclass is indented under subclass 35. Process in which the halogen is element number 9.
- 37 Simultaneously or subsequently adding free oxygen or use of oxyhalogen compound:**  
This subclass is indented under subclass 35. Process in which uncombined element number 8 is introduced with or after the halogen material, or a halogen compound including element number 8 is a treating agent.
- 38 Treating with free oxygen containing gas:**  
This subclass is indented under subclass 34. Process in which the gas includes uncombined element number 8.
- 39 And forming useful by-product:**  
This subclass is indented under subclass 38. Process in which a second material or energy of value, apart from the catalyst or sorbent composition is obtained.
- (1) Note. The by-product forming does not include recovering or separating of a reaction product or a sorbed component resulting from the process in which the composition of this class became spent. See (2) Note of subclass 20. The by-product includes e.g., collected carbon oxide gas from combustion of carbonaceous material fouling a catalyst or heat of oxidation used to provide a source of power. The use of heat generated in a process of rehabilitation to preheat the treating agent, sorbent, or catalyst is not considered to be forming a by-product.
- 40 And adding heat by admixing solid heat carrier:**  
This subclass is indented under subclass 38. Process in which a transfer of heat is effected by intimately contacting the spent material and/or treating gas with extraneous material having a higher temperature.
- (1) Note. Extraneous solid material includes recycled regenerated material which may be mixed with incoming spent material to cool such regenerated material and preheat the spent material.
- 41 In gaseous suspension, (e.g., fluidized bed, etc.):**  
This subclass is indented under subclass 38. Process wherein particles of material are contacted by a column of gas rising at a velocity which supports them in a state of turbulence.
- SEE OR SEARCH CLASS:  
423, Chemistry of Inorganic Compounds, Dig. 16 for a collection of fluidization techniques.

- 42 And substantially complete oxidation of carbon monoxide to carbon dioxide within regeneration zone:**  
This subclass is indented under subclass 41. Process in which is recited a positive step or condition serving to ensure that any carbon monoxide produced is further reacted to form carbon dioxide before leaving the site of the regeneration process.
- (1) Note. A process which is claimed to meet legally acceptable emission standards for carbon monoxide is classifiable here.
- 43 Plural distinct serial combustion stages:**  
This subclass is indented under subclass 41. Process including two or more sequential steps of energetic oxidation.
- (1) Note. The serial combustion stages may occur in the same or different reaction zones by, in the first case, utilizing distinctly differing combustion conditions or, in the second case, causing a continuous flow of material through different reaction zones.
- 44 Indirectly heating or cooling spent material within regeneration zone or prior to entry into regeneration zone:**  
This subclass is indented under subclass 41. Process employing a heat exchanger to change the temperature of the sorbent or catalyst before or during contact with the treating gas.
- (1) Note. Heating of the treating gas, autogenous heating and directly contacting the material with a heating or cooling medium do not satisfy the requirement of indirectly heating the spent material.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
40, for a similar process in which heat is added by use of an admixed solid heat carrier.
- 45 Moving bed (e.g., vertically or horizontally, etc., moving bulk material):**  
This subclass is indented under subclass 38. Process in which the spent material is contacted by the gas while progressing or being carried as a relatively compact mass.
- (1) Note. The moving bed may be supported on a belt or be a continuous flow of material through a zone and includes a rising column of material supported by sequentially added catalyst or sorbent. Additionally rotary motion is included, as in a rotary kiln or screw conveyor.
- (2) Note. Disclosures for this subclass will either be silent as to relative movement of gas and spent material or indicate all such relative movement to be equivalent. Specified relative movement between gas and material is provided for in an indented subclass.
- 46 Generally concurrent flow of oxygen containing gas and material:**  
This subclass is indented under subclass 45. Process in which the treating fluid and the catalyst or sorbent move along the same path and in the same direction.
- 47 Generally countercurrent flow of oxygen containing gas and material:**  
This subclass is indented under subclass 45. Process in which the treating fluid and the catalyst or sorbent are fed in opposite directions.
- 48 Generally transverse (i.e., lateral) flow of oxygen containing gas relative to material:**  
This subclass is indented under subclass 45. Process in which the treating fluid travel is normal (at a right angle) to the direction of catalyst or sorbent feed.
- (1) Note. The gas may contact the material from above, below or a side.
- 49 Plural distinct oxidation stages:**  
This subclass is indented under subclass 38. Process including a second treatment of the spent material with an oxidizing agent differing in either location or reaction condition.

- (1) Note. Recitation of two or more stages differing in temperature, pressure, or oxygen content is considered to indicate plural distinct stages.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 41+, for a similar plural stage oxidation process using a fluidized bed.  
50, for a second reactive gas treatment other than oxidation (e.g., reduction, replacement etc.).

**50 Reactive gas treating after oxidation:**

This subclass is indented under subclass 38. Process in which, subsequent to the gaseous oxidation, the spent material is subjected to reaction with a nonoxidizing gas.

**51 Oxidation gas comprises essentially steam and oxygen:**

This subclass is indented under subclass 38. Process in which water vapor is intentionally added to the free oxygen containing gas.

**52 With control of oxygen content in oxidation gas:**

This subclass is indented under subclass 38. Process in which the concentration of oxygen is maintained at or adjusted to a predetermined parameter.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 6, for a process in which the oxygen is automatically controlled.  
42, for a fluidized process in which sufficient oxygen is maintained to ensure elimination of carbon monoxide.

**53 Elemental hydrogen:**

This subclass is indented under subclass 34. Process in which the treating fluid includes free element number one.

**54 Ammonia or derivative thereof:**

This subclass is indented under subclass 34. Process in which the treating fluid comprises the compound of nitrogen and three atoms of hydrogen or its substituted or additive forms including ammonium salts, amines and salts thereof, amides, and quaternary compounds.

**55 Steam:**

This subclass is indented under subclass 34. Process in which the treating fluid consists essentially of vaporized water.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 51, for a similar process using steam added to air or other free oxygen containing gas.

**56 By heat:**

This subclass is indented under subclass 20. Process in which regeneration or rehabilitation is effected by an increase in temperature.

- (1) Note. The processes of this subclass may include the use of a solid treating agent, but the use of a liquid or gas treating agent is provided for in subclasses higher in the schedule.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 22+, for a liquid treating process which may include heating.

**60 ZEOLITE OR CLAY, INCLUDING GALLIUM ANALOGS:**

This subclass is indented under the class definition. Composition which contains a naturally occurring earthy aluminum silicate having the characteristics set out in the glossary term "clay" or "zeolite" or a synthetic replica of the natural material, or similar materials which contain gallium rather than aluminum.

- (1) Note. A synthetic zeolite, per se, is provided for in Class 423, Chemistry of Inorganic Compounds, and subclass 700 definition explains the distinction between what is considered a zeolite compound and a mixture. For placement in this class (502) a zeolite must be admixed with something or be claimed in terms of structure, sufficient to cause classification in Class 428 rather than in Class 423. A simple ion exchange operation is considered to give a different zeolite compound still proper for Class 423. A subsequent reduction of an exchanged ion is considered to comprise a mixture, proper for a composition class. Because

particular pore size and/or shape is an inherent property of a zeolite, recitation of pore structure peculiar to catalysis or sorption, by itself, is not sufficient for placement in this class (502). This contrasts with classification of Raney-type catalysts and activated carbon sorbents.

- (2) Note. See section V, Glossary, of the class definition for this class (502) for definitions of clay and zeolite.
- (3) Note. A better understanding of zeolites may be had by consulting such literature as *Zeolite Molecular Sieves*, O. W. Breck, John Wiley and Sons, 1974.
- (4) Note. Some earthly silicon compounds that are not clay or zeolite include Asbestos, Diaspore, Diatomaceous, Diatomite, Feldspar, Guhr, Kieselguhr, Mica earth, Quartz, and Sand.

**SEE OR SEARCH CLASS:**

252, Compositions, subclass 179 and 184 for a zeolite composition used in ion-exchange.

**61 Gallium containing:**

This subclass is indented under subclass 60. Composition which includes element 31.

- (1) Note. The gallium may be elemental or in a compound and either in addition to the clay or zeolite or may replace some or all of the aluminum in clay or zeolite.

**62 Including organic component:**

This subclass is indented under subclass 60. Composition which includes a carbon compound as set out in the glossary term "organic".

**63 And additional Al or Si containing component:**

This subclass is indented under subclass 60. Composition including along with either a clay or a zeolite, element 13 or 14 or a compound of such element.

- (1) Note. The additional Al or Si component may include a clay or zeolite of a different source but does not include a naturally occurring clay of mixed Aluminum silicates.

**64 Zeolite:**

This subclass is indented under subclass 63. Composition in which a component comprises zeolite.

**65 And rare earth metal (Sc, Y or Lanthanide) containing:**

This subclass is indented under subclass 64. Composition which includes scandium, yttrium, or a lanthanide.

**66 And Group VIII (Iron Group or Platinum Group) metal containing:**

This subclass is indented under subclass 64. Composition containing an iron group or platinum group metal.

**67 Mixed zeolites:**

This subclass is indented under subclass 64. Composition which the additional Al or Si is in the form of a second zeolite.

**68 Mixed with clay:**

This subclass is indented under subclass 64. Composition, in which the additional Al or Si is in the form of clay.

- (1) Note. The zeolite may be synthesized from a clay which is positively recited as remaining in excess.

**69 Heterogeneous arrangement:**

This subclass is indented under subclass 64. Composition in which components are claimed as occupying spatially distinct areas.

- (1) Note. Such terms as layered, coated particles, discrete areas etc., are considered to describe a heterogeneous arrangement.

**70 Gelling in presence of zeolite:**

This subclass is indented under subclass 64. Process in which a lyophilic sol containing zeolite is partially coagulated or a product of such process.

**71 ZSM type:**

This subclass is indented under subclass 64. Composition in which the zeolite is synthetic, analogous to a product originally produced by using an organic template.

**72 Mixed clays:**

This subclass is indented under subclass 63. Composition containing different earthy materials as encompassed by the glossary term "clay"

- (1) Note. This subclass requires a deliberate admixture of clays and does not encompass a naturally occurring mixture of clays.

**73 And Group III or rare earth metal (Al, Ga, In, Ti, Sc, Y) or Lanthanide containing:**

This subclass is indented under subclass 60. Composition including aluminum, gallium, scandium, yttrium, indium, thallium or a lanthanide.

**74 And Group VIII (Iron Group or Platinum Group) containing:**

This subclass is indented under subclass 60. Composition including an iron group or a platinum group metal.

**75 Including chemical reduction of exchanged cation:**

This subclass is indented under subclass 60. Process in which a positive ion which has replaced an original ion gains electrons or product of such process.

- (1) Note. The bulk of art in this subclass is concerned with exchanging alkali metal ions in zeolite and reducing the new ion to the free metal.

**76 Coprecipitation:**

This subclass is indented under subclass 60. Process in which different solutes are simultaneously thrown out of solution.

**77 ZSM type:**

This subclass is indented under subclass 60. Composition containing a synthetic zeolite of the type originally produced using an organic template or a zeolite analogous thereto.

**78 Mordenite type:**

This subclass is indented under subclass 60. Composition in which a zeolite comprises 4 or 5 membered rings of  $\text{SiO}_4$  and  $\text{AlO}_4$  tetrahedra, so arranged that the crystal lattice comprises pores and channels running parallel along the

crystal axis to give a tubular configuration without intersections allowing access to the cavities in only one direction.

- (1) Note. Mordenite generally has a silica to alumina ratio of about 8 to about 12.

**79 Faujasite type (e.g., X or Y, etc.):**

This subclass is indented under subclass 60. Composition in which a zeolite is characterized by having a silica to alumina ratio of about 2.5 to about 7 and a very open framework, comprising truncated octahedra (B cages) characteristic of sodalite linked by hexagonal prisms forming super cages, and a pore size of approximately 60 to 15° A.

- (1) Note. The type of zeolite is generally determined by X-ray diffraction and the patterns may be found in the literature cited in the notes to subclass 60. Faujasite type includes X, Y, Z 14 and H S.

**80 Clay:**

This subclass is indented under subclass 60. Composition containing the earthy hydrous aluminum silicate as set out in the Glossary term "clay".

**SEE OR SEARCH CLASS:**

119, Animal Husbandry, particularly subclass 173 for material used for absorbing moisture from an animal waste product, i.e., excrement or urine, and having a clay component.

**81 Acid treating:**

This subclass is indented under subclass 80. Process in which the clay is contacted with an acid or the product of such process.

**82 Plural acid treatment:**

This subclass is indented under subclass 81. Process in which the clay is treated with a second acid or product of such process.

- (1) Note. The treatment may involve the use of the same acid more than once or different acids either simultaneously or sequentially.

- 83 Sulfuric or hydrochloric acid:**  
This subclass is indented under subclass 81. Process in which the treatment is effected by either hydrochloric or sulfuric acid.
- 84 And metal, metal oxide, or metal hydroxide:**  
This subclass is indented under subclass 80. Composition in which the clay is associated with an element listed as one of the metals of Group I to VIII, lanthanides or actinides in the table at the top of the class schedule, free or as the oxide or hydroxide.
- 85 Activating treatment:**  
This subclass is indented under subclass 60. Process in which a zeolite is subjected to an agent which prepares it for a sorbent or catalytic function.
- (1) Note. The agent may be a chemical substance or a physical treatment.
- 86 Utilizing ammonium ions:**  
This subclass is indented under subclass 85. Process in which a compound containing the dissociable moiety comprising nitrogen and four hydrogen atoms contacts the Zeolite.
- 87 Support per se:**  
This subclass is indented under subclass 60. Composition in which a zeolite has no catalytic or sorbent property and is intended only to support other material which has such property.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
439, for other materials within the purview of Class 502 which serve as carriers or supports, per se.
- 100 CATALYST OR PRECURSOR THEREFOR:**  
This subclass is indented under the class definition. Composition which is a catalyst\* or which is claimed or disclosed to be useful solely as an essential component of a catalyst composition or method of making such a composition. (\* See glossary for definition.)
- (1) Note. A precursor is classified with the complete disclosed catalyst composition. If a composition is disclosed or claimed as both a catalyst, per se, and as a precursor for another catalyst, it is classified in the first appearing subclass providing for any complete catalyst composition. In this regard, a composition comprising a Group VIII metal compound claimed or disclosed for use solely as a Ziegler catalyst is classifiable in subclass 103, rather than in subclass 100.
- (2) Note. Included hereunder as catalysts are compositions employed to modify the course of a reaction so as to yield a different product than that which would be otherwise obtained, even though the modifying composition will not, per se, cause the reaction to take place. (c.f. pat. no. 4,125,481 to a molecular weight regulating mixture of mercaptan and emulsifier).
- (3) Note. This and indented subclasses include inventions directed to negative catalysts, and also known as inhibitors, except preservatives (e.g., octane improvers of antioxidants etc.).
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
520, for a collection of art directed to controlling production of various possible products.
- SEE OR SEARCH CLASS:  
106, Composition: Coating or Plastic, subclass 1.11 for a sensitizing composition for activating a substrate to be subsequently electrolessly metal plated and which may have a catalytic function.  
252, Compositions, for a composition intended to preserve a material, e.g., an anti-oxidant or for an octane improver composition which controls the rate of combustion in an internal combustion engine.  
423, Chemistry of Inorganic Compounds, appropriate subclasses for inorganic compounds, per se, which may be useful as catalysts.

**101 Making catalytic electrode, process only:**

This subclass is indented under subclass 100. Method or process for manufacturing an electrode having catalytic properties, generally for use in an electrolytic or fuel cell.

- (1) Note. This subclass does not provide for the catalytic composition, per se, and a copy of a patent containing a claim to a catalytic electrode composition must be placed in the appropriate subclass, e.g., 300.

**SEE OR SEARCH CLASS:**

- 204, Chemistry: Electrical and Wave Energy subclass 280 for an electrode of that class which may be catalytic.  
429, Chemistry: Electrical Current Producing Apparatus, Product, and Process, subclasses 40+ for an electrode of that class.

**102 Plural component system comprising A - Group I to IV metal hydride or organometallic compound - and B - Group IV to VIII metal, lanthanide or actinide compound - (i.e., alkali metal, Ag, Au, Cu, alkaline earth metal, Be, Mg, Zn, Cd, Hg, Sc, Y, Al, Ga, In, Tl, Ti, Zr, Hf, Ge, Sn or Pb hydride or organometallic compound and Ti, Zr, Hf, Ge, Sn, Pb, V, Nb, Ta, As, Sb, Bi, Cr, Mo, W, Po, Mn, Tc, Re, Iron group, Platinum group, atomic number 57 to 71 inclusive or atomic number 89 or higher compound):**

This subclass is indented under subclass 100. Composition which contains (1) a metal hydride or a compound in which a carbon atom of an organic compound is bonded directly to a metal atom combined with (2) a compound of a Group IV to Group VIII metal or a metal of atomic number 57 to 71 inclusive or 89 to 103 inclusive or process of making same.

- (1) Note. Compounds in which a metal is completed with the electrons of an organic carbon to carbon multiple bond are considered to have carbon bonded directly to metal e.g., Bi-allyl or cyclopentadienyl complexes etc.  
(2) Note. The metal hydride or organometallic compound includes a metal of Groups I to IV and the other metal compound

includes a metal of groups IV to VIII, an actinide or lanthanide as set out in the list preceding the schedule.

**103 Component A metal is Group IA, IIA or IIIA and component B metal is Group IVB to VIIB or VIII (i.e., alkali metal, alkaline earth Metal, Be, Mg, Al, Ga, In or Tl and Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, Re, the iron Group or Platinum group) (e.g., Ziegler Catalyst, etc.):**

This subclass is indented under subclass 102. Composition wherein the metal hydride or the organometallic compound contains Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, or Tl bonded directly to hydrogen or carbon atom of an organic compound combined with a compound of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, Re, Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt, and a process of making same.

- (1) Note. These catalyst are often referred to in the art as "Ziegler" catalysts and are commonly employed to polymerize olefins to form resins.

**104 Preparing catalyst or precursor:**

This subclass is indented under subclass 103. Methods, claimed for preparing a catalyst or precursor, .

- (1) Note. To be originally classified hereunder, a patent must contain a claim to a process of preparing a catalyst or precursor.  
(2) Note. The method for preparing the precursor is classifiable with the intended complete catalyst, see definition of 100 (1) Note.

**105 Including comminuting (e.g., milling, grinding, etc.):**

This subclass is indented under subclass 104. Process which includes a step of mechanically breaking up a solid ingredient of the catalyst.

- (1) Note. This process generally employs such apparatus as rod or ball mills, etc.

**106 Fluidized bed feature:**

This subclass is indented under subclass 104. Process wherein either (a) a fluidized bed is employed in the manufacture of a catalyst or

- (b) a catalyst is made which is disclosed or claimed as useful when employed in a fluidized bed process.
- 107 Including heating to higher temperature:**  
This subclass is indented under subclass 104. Process wherein after an initial mixing or reacting of ingredients, the temperature of the system is increased by the application of outside heat, with or without the addition of additional materials.
- 108 Utilizing hydrocarbon containing unsaturation not part of benzene ring:**  
This subclass is indented under subclass 104. Process wherein during the manufacture of the catalyst a compound containing only carbon and hydrogen and which contains unsaturation which is not part of a benzene ring is added.
- 109 Utilizing high molecular weight synthetic polymer:**  
This subclass is indented under subclass 104. Process wherein a high molecular weight synthetic polymer made up of numerous smaller molecules is added to the catalyst system.
- 110 Including plural additions of component A:**  
This subclass is indented under subclass 104. Process wherein two or more separate additions of a Group Ia to Group IIIa metal hydride or organometallic compound are made at separate times.
- (1) Note. The Group Ia to Group IIIa compounds added at the separate additions may be the same or different substances.
- 111 Utilizing water or compound containing hydroxyl bonded to carbon:**  
This subclass is indented under subclass 104. Process including a step of adding a compound which contains a hydroxyl group bonded to carbon e.g., alcohol, phenol, carboxylic acid, etc. or water to the catalytic composition.
- 112 Containing iodine:**  
This subclass is indented under subclass 103. Composition containing an atom of iodine.
- 113 Containing two or more different component b metals:**  
This subclass is indented under subclass 103. Composition which contains two or more different Group IVb to Group VIIb or Group VIII metals which may be in different compounds or part of a single complex compound.
- 114 Containing hydrides or organometallic of two or more different component A metals:**  
This subclass is indented under subclass 103. Composition which contains two or more different Group Ia to Group IIIa metals bonded directly to hydrogen or organic carbon. These metals may be in different compounds or in the same complex compound e.g.,  $\text{LiAlH}_4$  etc.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
110, for a process of adding different Component A metals in separate steps to make a catalyst.
- 115 Magnesium containing:**  
This subclass is indented under subclass 114. Composition in which one of the Group Ia to Group IIIa metals bonded to hydrogen or organic carbon is magnesium.
- 116 And compound containing silicon-hydrogen or silicon-carbon bond:**  
This subclass is indented under subclass 115. Composition which additionally contains a compound in which silicon is bonded directly to hydrogen or carbon.
- 117 Component B metal is other than titanium or vanadium:**  
This subclass is indented under subclass 103. Composition which does not contain either element 22 or element 23 in the component B.
- 118 And a third component C (i.e., an additive other than a saturated hydrocarbon or an aromatic hydrocarbon free of aliphatic or cycloaliphatic unsaturation):**  
This subclass is indented under subclass 103. Catalyst composition which contains an added substance not provided for specifically by subclass 103 other than a saturated compound of carbon and hydrogen only, or other than a benzene ring containing compound containing no

- other unsaturation and containing only carbon and hydrogen.
- (1) Note. Exemplary additives include olefins, cycloalkenes, alkenylaromatics, dihydro naphthlene, substituted hydrocarbons and inorganic compounds etc. The composition may include an alkyl, cycloalkyl or aromatic compound in addition to the unsaturated compound but these latter do not alone qualify as additives for this subclass.
- 119 Nonmetallic inorganic halogen containing:**  
Composition under 118 in which the additive is halogen, elemental or combined with a non-metal other than carbon.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
112, for an iodine containing Ziegler catalyst.
- 120 Elemental oxygen or nonmetallic inorganic oxygen-containing material, other than water:**  
This subclass is indented under subclass 118. Composition in which the additive is oxygen, elemental or combined with a nonmetal other than organic carbon and excluding water.
- (1) Note. Organic has the same meaning as defined in Class 260 and does not include carbonate, carbon monoxide or carbon dioxide which are provided for in this subclass.
- 121 Nonmetallic organic phosphorous containing:**  
This subclass is indented under subclass 118. Composition in which phosphorous combined with a metal-free moiety including carbon-bonded to a second carbon, hydrogen, halogen or nitrogen by a single or double bond.
- 122 Nonmetallic organic sulfur containing:**  
This subclass is indented under subclass 118. Composition in which sulfur is combined with a metal-free moiety including carbon bonded to a second carbon, hydrogen, halogen or nitrogen by a single or double bond.
- 123 Nonmetallic organic nitrogen containing:**  
This subclass is indented under subclass 118. Composition in which nitrogen is combined with a metal-free moiety including carbon bonded to a second carbon, hydrogen, halogen or nitrogen by single or double bond.
- 124 Including element in addition to carbon, hydrogen, and nitrogen (e.g., nitro, etc.):**  
This subclass is indented under subclass 123. Composition in which the nitrogen compound additionally includes an element other than hydrogen.
- 125 Nonmetallic organic oxygen containing:**  
This subclass is indented under subclass 118. Composition in which oxygen is combined with a metal-free moiety including carbon bonded to a second carbon, hydrogen, halogen or nitrogen by a single or double bond.
- 126 Ether:**  
This subclass is indented under subclass 125. Composition in which the oxygen is bonded to two noncarbonylic carbons.
- 127 Ester:**  
This subclass is indented under subclass 125. Composition in which the oxygen is bonded to two carbon atoms, one of which is carbonylic.
- 128 Nonmetallic organic halide:**  
This subclass is indented under subclass 118. Composition in which a nonmetallic Group VII element is bonded to a metal free moiety including carbon.
- 129 Metal compound other than that which could be produced in situ by reaction of a Group IA, IIA, or Group IIIA metal compound present with a titanium or vanadium compound present:**  
This subclass is indented under subclass 118. Composition wherein the additive is a metal compound excluding any compound which could be made by reaction of a Group Ia to IIIa metal compound present as required by subclass 103 with a titanium or vanadium compound present.
- (1) Note. It must be noted that in many instances when the basic catalyst ingredients required by subclass 103 are com-

bined, some reaction takes place, generally, with reduction of the Group IVb to Group VIIb or Group VIII metal compound to a lower valence state with elimination of hydride or organo groups from the Group Ia to IIIa metal compound and their replacement with the anionic group removed from the Group IVb or Group VIIb or Group VIII metal compound. Thus, for example,  $TiCl_4 + AlCl_3 \rightarrow TiCl_3 + AlCl_3$ . In this circumstance, the external addition of  $AlCl_3$  would not be provided for hereunder, but the addition of  $AlBr_3$  or  $NaCl$  would be classified hereunder, since these substances could not possibly be made by the above reaction.

**130 Lead compound:**

This subclass is indented under subclass 129. Composition in which the metal has atomic number 82.

**131 Tin compound:**

This subclass is indented under subclass 129. Composition in which the metal has atomic number 50.

**132 Aluminum compound:**

This subclass is indented under subclass 129. Composition in which the metal has atomic number 13.

**133 Magnesium compound:**

This subclass is indented under subclass 129. Composition in which the metal has atomic number 12.

**134 Halogen containing:**

This subclass is indented under subclass 133. Composition in which the Mg compound includes a nonmetal of Group VII.

**150 Organic compound containing:**

This subclass is indented under subclass 100. Composition which contains a compound containing two atoms of carbon bonded together, an atom of carbon bonded to at least one atom of hydrogen or halogen, or an atom of carbon bonded to an atom of nitrogen by a single or double bond.

(1) Note. See "organic" in the glossary for a complete definition.

(2) Note. To be classified in this or an indented subclass, a composition must contain an organic compound as defined above or a method which produces a composition in which an organic compound is present. A method of making a catalyst in which an organic compound is employed, which organic compound is removed or destroyed later in the process leaving a composition with no organic constituent, or the composition with no organic constituent, or the composition so produced, is placed below in the appropriate subclass based on the material remaining. A cross-reference art collection appears at the end of the schedule for a process of this type.

(3) Note. The term "calcining" in a process or "calcined" in a product shall be interpreted as meaning that any organic substances that were present are either removed or destroyed in the absence of any specific indication to the contrary.

SEE OR SEARCH THIS CLASS, SUBCLASS:

506+, for a process of making an inorganic catalyst by a method which employs a fugitive organic substance, removed or destroyed later in the process.

**151 Method of making including comminuting of solid material (e.g., grinding, crushing, etc.):**

This subclass is indented under subclass 150. Process wherein solid starting material or product is reduced in size by physical means.

(1) Note. When a reaction or mixing process involving a solid starting material or producing a solid product is carried out in a device wherein the starting material or product is impacted by solid media, e.g., ball or rod mill etc., it will be conclusively presumed that comminution takes place and the patent placed in this subclass.

- 152 Organic compound including carbon-metal bond:**  
This subclass is indented under subclass 150. Composition containing an organic compound having a metal atom bonded to a carbon atom of the compound.
- (1) Note. Complexes of metal atoms with the pi-electrons of a carbon to carbon double bond, e.g., pi-allyl or cyclopentadienyl complexes etc., are included within the scope of this subclass.
- 153 Diverse metals bonded to carbon:**  
This subclass is indented under subclass 152. Composition which contains either a single organic compound containing two or more different metals bonded to carbon, or two or more organic compounds having different metals bonded to carbon.
- 154 Including metal compound containing different metal than that bonded to carbon:**  
This subclass is indented under subclass 153. Composition including a second metal chemically bound to an element other than carbon (e.g., as in a salt, alcoholate, oxide, etc.).
- 155 Including phosphorus or sulfur or compound containing nitrogen or phosphorus or sulfur:**  
This subclass is indented under subclass 152. Composition including element 15 or 16, free or chemically bound or a compound containing element number 7.
- 156 Including alcohol, phenol, or ether:**  
This subclass is indented under subclass 152. Composition including a constituent which has oxygen bonded to a non carbonylic carbon, the other valence being occupied by hydrogen or a similar carbon or which has been produced by use of such oxygen containing compound.
- 157 Alkali metal bonded to carbon:**  
This subclass is indented under subclass 152. Composition in which the metal is alkali.
- 158 Compound with silicon-hydrogen bond or organic compound with silicon-carbon bond:**  
This subclass is indented under subclass 150. Composition containing element number 14 chemically attached to element number one or to an atom of element number 6 in a compound which meets the Glossary term organic.
- 159 Resin, natural or synthetic, polysaccharide or polypeptide:**  
This subclass is indented under subclass 150. Composition containing macromolecules of recurring units of carbohydrates, -amino acids, condensed interactive molecules or unsaturated addition polymers or solid or semi-solid viscous secretions of plants.
- 160 Peroxygen compound containing:**  
This subclass is indented under subclass 150. Composition in which a compound includes a linked pair of oxygen atoms.
- 161 With metal carbonyl or carbon monoxide complex:**  
This subclass is indented under subclass 150. Composition including the partially oxidized carbon-monoxide or a metal compound including the C=O moiety.
- 162 Organic phosphorus or nitrogen, except the ammonium ion:**  
This subclass is indented under subclass 150. Composition in which an organic compound contains elements number 7 or 15 with the proviso that no more than three of the valences of element 7 are occupied by hydrogen.
- (1) Note. Quaternary ammonium compounds are provided herein, see subclass 164, but the ammonium ion (NH<sub>4</sub>)<sup>+</sup> is excluded.
- 163 Phthalocyanine:**  
This subclass is indented under subclass 162. Composition including the porphine formed by isoindole.
- 164 Quaternary ammonium or phosphonium:**  
This subclass is indented under subclass 162. Composition in which the nitrogen or phosphorus has four valence satisfied by organic moieties.

- 165 Copper containing:**  
This subclass is indented under subclass 162. Composition which includes element number 29.
- 166 Rhodium containing:**  
This subclass is indented under subclass 162. Composition which includes element number 45.
- 167 Organic nitrogen containing:**  
This subclass is indented under subclass 162. Composition in which an organic compound, as set out in the Glossary, includes element number 7.
- 168 Organic sulfur compound:**  
This subclass is indented under subclass 150. Compound in which an organic compound, as set out in the Glossary includes element number 16.
- 169 With metal halide:**  
This subclass is indented under subclass 150. Composition including a compound comprising a metal and halogen, each as set out in the table at the beginning of the schedule.
- 170 With metal carboxylate or metal compound and carboxylic acid or anhydride:**  
This subclass is indented under subclass 150. Composition in which a compound contains the RCOOX group where R is a radical or an organic compound, X is a metal, hydrogen or acyl group of an acid and in which there is a metal compound when X is not a metal.
- 171 Organic compound contains metal (e.g., Na-O-Ethyl, etc.):**  
This subclass is indented under subclass 150. Composition in which an organic compound contains metal as set out in the list at the top of the schedule.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
152+, for a composition including a carbon-metal bond.  
161, for a metal carbonyl containing composition.  
170, for a composition containing a metal carboxylate.
- 172 Alcohol, phenol, ether, aldehyde or ketone:**  
This subclass is indented under subclass 150. Composition in which an organic compound has oxygen singly bonded to a carbon and hydrogen or a second carbon or doubly bonded to a carbon.
- 173 Elemental metal in organic dispersing medium:**  
This subclass is indented under subclass 150. Composition in which a metal, as set out at the top of the schedule, in the free state is distributed throughout the organic material.
- 174 Inorganic carbon containing:**  
This subclass is indented under subclass 100. Composition which contains element 6, in the free state or combined with elements such that the compound does not meet the definition of organic in the Glossary.
- 175 Cyanide:**  
This subclass is indented under subclass 174. Composition in which the carbon is bound to nitrogen by a triple bond.
- 176 Hydroxycarbonate:**  
This subclass is indented under subclass 174. Composition in which a compound includes both a hydroxyl and a carbonate ion e.g., CO<sub>3</sub>-M-OH.
- (1) Note. These compounds are sometimes referred to as basic carbonates.
- 177 Carbide:**  
This subclass is indented under subclass 174. Composition including binary compound of carbon and a metal or metalloid.
- 178 Silicon carbide:**  
This subclass is indented under subclass 177. Composition in which the carbide is of element number 14.
- 179 Group Va (N, P, As, Sb, Bi) containing:**  
This subclass is indented under subclass 178. Composition including one of elements number 7, 15, 33, 51, or 83.

- 180 Elemental carbon:**  
This subclass is indented under subclass 174. Composition in which the carbon is in the free state.
- (1) Note. Bone black, generally considered to be a form of carbon, includes approximately 80% calcium phosphate.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
416+, for a free carbon containing sorbent composition.
- SEE OR SEARCH CLASS:  
201, Distillation: Processes, Thermolytic, for a process of producing carbon by destructive distillation.  
423, Chemistry of Inorganic Compounds, subclass 445 for elemental carbon, per se, and processes of producing carbon.
- 181 And halogen containing:**  
This subclass is indented under subclass 180. Composition which includes a halogen as set out in the list at the beginning of the schedule.
- 182 And metal, metal oxide, or metal hydroxide:**  
This subclass is indented under subclass 180. Composition which includes a metal as set out in the list at the beginning of the schedule, free or combined with oxygen or with hydrogen and oxygen.
- 183 Of Group II (i.e., alkaline Earth, Be, Mg, Zn, Cd or Hg):**  
This subclass is indented under subclass 182. Composition in which the metal is an alkaline earth, Beryllium, Magnesium, Zinc, Cadmium or Mercury.
- 184 Of Group I (i.e., alkali, Ag, Au or Cu):**  
This subclass is indented under subclass 182. Composition in which the metal is an alkali, copper, gold or silver.
- 185 Of Group VIII (i.e., iron or platinum group):**  
This subclass is indented under subclass 182. Composition in which the metal is from the iron or platinum group.
- 200 Nitrogen compound containing:**  
This subclass is indented under subclass 100. Composition containing chemically combined element number 7.
- 201 Nitrate:**  
This subclass is indented under subclass 200. Composition in which the nitrogen is part of a radical comprising three oxygen atoms.
- 202 Boron or compound containing same:**  
This subclass is indented under subclass 100. Composition which contains element number 5.
- 203 Boron halide:**  
This subclass is indented under subclass 202. Composition in which the boron is chemically united to a halogen as set out in the list at the beginning of the schedule.
- 204 And Group VI metal containing (i.e., Cr, Mo, W or Po):**  
This subclass is indented under subclass 202. Composition in which there is a Group VI metal free or chemically combined.
- 205 And bismuth containing:**  
This subclass is indented under subclass 204. Composition which also includes element number 83.
- (1) Note. The Bismuth may be combined with either or both the boron or group VI metal.
- 206 Molybdenum containing:**  
This subclass is indented under subclass 204. Composition in Which the group VI metal is element number 42.
- 207 And Group VIII metal containing (i.e., iron or platinum group):**  
This subclass is indented under subclass 202. Composition in which there is an iron or platinum group metal.
- 208 Phosphorous or compound containing same:**  
This subclass is indented under subclass 100. Composition including element number 15.

- 209 And vanadium containing:**  
This subclass is indented under subclass 208. Composition additionally including element number 23, free or chemically combined.
- 210 And Group VI metal (i.e., Cr, Mo, W or Po):**  
This subclass is indented under subclass 208. Composition additionally including a group VI metal as set out in the list at the beginning of the schedule.
- 211 Molybdenum:**  
This subclass is indented under subclass 210. Composition in which the metal is element number 42.
- 212 And bismuth containing:**  
This subclass is indented under subclass 211. Composition which also includes element number 83, free or chemically combined.
- 213 And Group VIII metal containing (i.e., iron or platinum group):**  
This subclass is indented under subclass 208. Composition additionally including an iron or platinum group metal.
- 214 And silicon containing:**  
This subclass is indented under subclass 208. Composition which includes element number 14, free or combined.
- 215 Selenium or tellurium or compound containing same:**  
This subclass is indented under subclass 100. Composition including either element 34 or 52, free or chemically combined.
- 216 Sulfur or compound containing same:**  
This subclass is indented under subclass 100. Composition including element 16, either free or chemically combined.
- 217 Sulfate:**  
This subclass is indented under subclass 216. Composition in which the sulfur is combined with four oxygen atoms to form a divalent ion.
- 218 And Group I metal containing (i.e., alkali, Ag, Au or Cu):**  
This subclass is indented under subclass 217. Composition including a alkali metal, copper, gold or silver, free or chemically combined.
- 219 And Group VI metal containing (i.e., Cr, Mo, W or Po):**  
This subclass is indented under subclass 216. Composition including a group VI metal as listed at the beginning of the schedule, free or chemically combined.
- 220 Molybdenum containing:**  
This subclass is indented under subclass 219. Composition in which the metal is element number 42.
- 221 And Group VIII metal containing (i.e., or iron or platinum group):**  
This subclass is indented under subclass 219. Composition additionally including an iron group or platinum group metal, free or chemically combined.
- 222 And Group VIII metal containing (i.e., iron or platinum group):**  
This subclass is indented under subclass 216. Composition additionally including an iron group or platinum group metal, free or chemically combined.
- 223 Platinum group (i.e., Ru, Rh, Pd, Os, Ir, Pt):**  
This subclass is indented under subclass 222. Composition in which the metal is element number 44, 45, 46, 76, 77, or 78.
- 224 Halogen or compound containing same:**  
This subclass is indented under subclass 100. Composition including a halogen as listed at the beginning of the schedule, free or chemically combined.
- 225 Copper halide:**  
This subclass is indented under subclass 224. Composition in which the halogen is combined with element number 29.
- 226 And Group II metal (i.e., alkaline earth, Be, Mg, Zn, Cd or Hg):**  
This subclass is indented under subclass 224. Composition including a metal of group II as listed at the beginning of the schedule, free or chemically combined.

- 227 Any Group IV metal (i.e., Ti, Zr, Hf, Ge, Sn or Pb):**  
This subclass is indented under subclass 224. Composition including a metal of group IV as listed in the beginning of the schedule, free or chemically combined.
- 228 And Group VI metal (i.e., Cr, Mo, W or Po):**  
This subclass is indented under subclass 224. Composition including a metal of Group VI as listed at the beginning of the schedule, free or chemically combined.
- 229 And Group VIII metal (i.e., iron or platinum group):**  
This subclass is indented under subclass 24. Composition containing a metal of the iron group or the platinum group, free or chemically combined.
- 230 Platinum group (i.e., Ru, Rh, Pd, Os, Ir or Pt):**  
This subclass is indented under subclass 229. Composition in which the metal is element number 44, 45, 46, 76, 77, or 78.
- 231 And Group III metal (i.e., Sc, Y, Al, Ga, In or Te):**  
This subclass is indented under subclass 224. Composition including a metal of Group III as listed at the beginning of the schedule, free or chemically combined.
- (1) Note. Metal silicates are classified as a mixture of silicon dioxide and a metal oxide. Illustration: magnesium silicate is classified as SiO<sub>2</sub> and MgO and will be found in subclass 251.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
60+, for a composition including a clay or zeolite.
- 232 Silicon containing or processing of making:**  
This subclass is indented under subclass 100. Composition containing element number 14 free or chemically combined.
- (1) Note. Metal silicates are classified as a mixture of silicon dioxide and a metal oxide. Illustration: a composition with magnesium silicate is classified as SiO<sub>2</sub> and MgO and will be found in subclass 251.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
60+, for a composition including a clay of zeolite.
- 233 Forming silica gel:**  
This subclass is indented under subclass 232. Process in which an amorphous form of hydrate silica is produced; generally by precipitation or coagulation of a silica sol or decomposition of a silicate.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
8+, for a process of making or treating a sphere which may include formation of a silica gel.  
400+, especially 407+ for a sorbent composition in which silica gel is a constituent.
- SEE OR SEARCH CLASS:  
423, Chemistry of Inorganic Compounds, subclass 335 for silica gel, per se, in the dried state.  
516, Colloid Systems and Wetting Agents; Subcombinations Thereof; Processes of Making, Stabilizing, Breaking, or Inhibiting, subclass 34 for colloid systems of colloid-sized silica dispersed in primarily organic continuous liquid phase (organosilica sols), subclasses 79+ for colloid systems of colloid-sized silica dispersed in aqueous continuous liquid phase (aquasilica sols), subclass 111 for colloid systems of continuous or semicontinuous solid phase with discontinuous liquid phase (silica gel); or agents for such systems or making or stabilizing such systems or agents; in each instance, when generically claimed or when there is no hierarchically superior provision in the USPC for the specifically claimed art.

- 234 Coprecipitating:**  
This subclass is indented under subclass 233. Process which includes the simultaneous precipitation of another material with the precipitation of the silica gel.
- 235 Group III or rare earth metal, metal oxide, or metal hydroxide containing (i.e., Sc, Y, Al, Ga, In, Tl or lanthanide):**  
This subclass is indented under subclass 234. Process which includes the precipitation of a Group III or Rare Earth Metal, Metal Oxide or Hydroxide simultaneously with the precipitation of the silica gel.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
263, for a catalyst which is a mixture of silica gel and a group III metal, oxide or hydroxide.
- 236 Group IV metal, metal oxide, or metal hydroxide (i.e., Ti, Zr, Hf, Ge, Sn, Pb):**  
This subclass is indented under subclass 234. Process which includes the precipitation of a Group IV metal, metal oxide or hydroxide simultaneously with precipitation of the silica gel.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
242, for a catalyst which is a mixture of silica gel and a group IV metal, metal oxide or hydroxide.
- 237 Metal, metal oxide, or metal hydroxide containing:**  
This subclass is indented under subclass 233. Process wherein the precipitation is effected in the presence of a metal, metal oxide or hydroxide or the metal or metal compound is added subsequently to the precipitation.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
240, for a particular metal, metal oxide or hydroxide with silica, per se.
- 238 Of Group III metal (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 237. Process including a Group III or rare earth metal, metal oxide or hydroxide.
- 239 Of Group IV metal (i.e., Ti, Zr, Hf, Ge, Sn or Pb):**  
This subclass is indented under subclass 237. Process including a Group IV metal, metal oxide or hydroxide.
- 240 With metal, metal oxide, or metal hydroxide:**  
This subclass is indented under subclass 232. Composition including a metal, metal oxide or hydroxide.
- (1) Note. This and indented subclasses include compositions comprising synthetically produced silicates and processes of making such compositions except those processes involving the formation of silica gel, for which, see subclasses 233+.
- 241 Of Group VII (i.e., Mn, Tc, or Re):**  
This subclass is indented under subclass 240. Composition including a group VII metal, metal oxide or Hydroxide.
- 242 Of Group IV (i.e., Ti, Zr, Hf, Ge, Sn or Pb):**  
This subclass is indented under subclass 240. Composition including a group IV metal, metal oxide or hydroxide.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
236, for a mixtures of silica gel and a group IV metal oxide produced by coprecipitation process.  
239, for mixtures of silica gel and a group IV metal, metal oxide or hydroxide added after formation of the silica gel.
- 243 Of Group I (i.e., Alkali, Ag, Au or Cu):**  
This subclass is indented under subclass 240. Composition including a group I metal, metal oxide or hydroxide.
- 244 Of copper:**  
This subclass is indented under subclass 243. Composition which contains copper, copper oxide or hydroxide.

- 245 And Group VIII metal containing (i.e., iron or platinum group):**  
This subclass is indented under subclass 244. Composition which also includes a group VIII metal, metal oxide or hydroxide.
- 246 Of Group V (i.e., V, Nb, Ta, As, Sb or Bi):**  
This subclass is indented under subclass 240. Composition including a group V metal, metal oxide or hydroxide.
- 247 Of vanadium:**  
This subclass is indented under subclass 246. Composition which contains vanadium, vanadium oxide or hydroxide.
- 248 And Group VI metal (i.e., Cr, Mo, W or Po):**  
This subclass is indented under subclass 247. Composition which also includes a group VI metal, metal oxide or Hydroxide.
- 249 Of antimony or bismuth:**  
This subclass is indented under subclass 246. Composition in which the metal or compound thereof is antimony or bismuth.
- 250 Of Group II (i.e., alkaline earth, Be, Mg, Zn, Cd or Hg):**  
This subclass is indented under subclass 240. Composition including a group II metal, metal oxide or hydroxide.
- 251 Magnesium:**  
This subclass is indented under subclass 250. Composition which contains magnesium, magnesium oxide or hydroxide.
- 252 And Group VIII metal containing (i.e., iron or platinum group):**  
This subclass is indented under subclass 251. Composition which also includes a group VIII metal, metal oxide or hydroxide.
- 253 Of zinc, cadmium, or mercury:**  
This subclass is indented under subclass 250. Composition which contains zinc, cadmium or mercury or the oxide or hydroxide thereof.
- 254 Of Group VI (i.e., Cr, Mo, W or Po):**  
This subclass is indented under subclass 240. Composition including a group VI metal, metal oxide or hydroxide.
- 255 Molybdenum:**  
This subclass is indented under subclass 254. Composition which contains molybdenum, molybdenum oxide or hydroxide.
- 256 Chromium:**  
This subclass is indented under subclass 254. Composition which contains chromium, chromium oxide or hydroxide.
- 257 And Group VIII metal containing (i.e., iron or platinum group):**  
This subclass is indented under subclass 256. Composition which also includes a group VIII metal, metal oxide or hydroxide.
- 258 Of Group VIII (i.e., iron or platinum group):**  
This subclass is indented under subclass 240. Composition including a group VIII metal, metal oxide or hydroxide.
- 259 Nickel:**  
This subclass is indented under subclass 258. Composition in which the metal or metal compound comprises nickel.
- 260 Cobalt:**  
This subclass is indented under subclass 258. Composition in which the metal or metal compound comprises cobalt.
- 261 Platinum Group (i.e., Ru, Rh, Pd, Os, Ir or Pt):**  
This subclass is indented under subclass 258. Composition which contains a platinum group metal, metal oxide or hydroxide.
- 262 Platinum or palladium:**  
This subclass is indented under subclass 261. Composition in which the free metal or compound comprises element 46 or 78.
- 263 Of Group III or lanthanide group (i.e., Sc, Y, Al, Ga, In, Te, or atomic number 57 to 71 inclusive):**  
This subclass is indented under subclass 240. Composition including a group III or lanthanide metal, free or combined with oxygen or hydrogen and oxygen.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

235, mixture of silica gel and group III or rare earth metal oxide produced by coprecipitation process.

**300 Metal, metal oxide or metal hydroxide:**

This subclass is indented under subclass 100. Composition which contains a metal\* either as the free element or combined with oxygen or with hydrogen and oxygen.

- (1) Note. A metal metallate is considered to be a mixture of a metal oxide with a metal or other metal oxide. For example, a composition comprising nickel chromate is considered to include nickel oxide and chromium oxide.
- (2) Note. This and indented subclasses do not provide for a metal hydride, per se, unless mixed with a metal, or oxide or hydroxide thereof.
- (3) Note. See Glossary under metal for synonyms or archaic terms for elements provided in this or an indented subclass.
- (4) Note. This subclass is residual for a catalyst composition comprising an actinic or group VII (other than manganese) metal, oxide or hydroxide not containing a metal provided for in an indent.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

100+, for a catalyst comprising a metal hydride and 102+ for a metal hydride in combination with a compound of a metal from Group IV to Group VIII, a lanthanide or an actinide.

SEE OR SEARCH CLASS:

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, for ferrous alloy of structural or general utility.

106, Composition: Coating or Plastic, subclass 1.11 for a sensitizing composition for activating a substrate to be subsequently electrolessly metal

plated and which may have a catalytic function.

420, Alloys or Metallic Composition, for an alloy of general utility.

**301 Raney type:**

This subclass is indented under subclass 300. Composition prepared by removing a metal from an alloy, leaving the remaining metal behind as the catalyst.

- (1) Note. The remaining catalytic metal is generally in a highly active porous or finely divided state.
- (2) Note. The metal may be removed by any method, e.g., dissolving out by chemical means or by volatilization, etc.
- (3) Note. If a metal catalyst is named a "Raney" catalyst, it will be presumed to be proper for this subclass unless it is positively disclosed to be made by a method not within the scope of the definition of this subclass.

**302 Of lanthanide series (i.e., atomic number 57 to 71 inclusive):**

This subclass is indented under subclass 300. Composition in which the metal is selected from those with atomic numbers 57 to 71 (La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu).

- (1) Note. The metals Lanthanum and Actinium are not included in Group III for purposes of this class (502) but are considered with the lanthanides and actinides respectively.

**303 Lanthanum:**

This subclass is indented under subclass 302. Composition in which the lanthanide is the first of the series - element number 57.

**304 Cerium:**

This subclass is indented under subclass 302. Composition in which the lanthanide is the second of the series - element number 58.

**305 Of Group VI (i.e., Cr, Mo, W or Po):**

This subclass is indented under subclass 300. Composition in which the metal is one of Cr, Mo, W, or Po.

- 306 And Group II metal containing (i.e., alkaline earth, Be, Mg, Zn, Cd or Hg):**  
This subclass is indented under subclass 305. Composition which additionally includes an alkaline earth metal, Be, Mg, Zn, Cd, or Hg.
- 307 Zinc:**  
This subclass is indented under subclass 306. Composition in which the additional metal is element number 30.
- 308 And Group IV metal containing (i.e., Ti, Zr, Hf, Ge, Sn or Pb):**  
This subclass is indented under subclass 305. Composition which additionally includes one of Ti, Zr, Hf, Ge, Sn, or Pb.
- 309 Titanium containing:**  
This subclass is indented under subclass 308. Composition in which the additional metal is element number 22.
- 310 Tin containing:**  
This subclass is indented under subclass 308. Composition in which the additional element is element number 50.
- 311 And Group V metal containing (i.e., V, Nb, Ta, As, Sb or Bi):**  
This subclass is indented under subclass 305. Composition which additionally includes one of V, Nb, Ta, As, Sb, or Bi.
- 312 Vanadium containing:**  
This subclass is indented under subclass 311. Composition in which the additional metal is element number 23.
- 313 And Group VIII metal containing (i.e., iron or platinum group):**  
This subclass is indented under subclass 305. Composition which additionally contains an iron group or a platinum group metal.
- 314 Iron group metal and Group III metal containing (i.e., Fe, Co or Ni and Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 313. Composition in which the Group VIII metal is Fe, Co, or Ni and additionally includes one of Sc, Y, Al, Ga, In or Tl.
- 315 Nickel containing:**  
This subclass is indented under subclass 313. Composition in which the Group VIII metal is element number 28.
- 316 Iron containing:**  
This subclass is indented under subclass 313. Composition in which the Group VIII metal is element number 26.
- 317 And Group I containing (i.e., alkali, Ag, Au or Cu):**  
This subclass is indented under subclass 305. Composition which additionally includes an alkali metal, Cu, Ag, or Au.
- 318 Copper containing:**  
This subclass is indented under subclass 317. Composition in which the Group I metal is element number 29.
- 319 Of chromium:**  
This subclass is indented under subclass 305. Composition in which the Group VI metal is element number 24.
- 320 And Group III metal containing (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 319. Composition which additionally includes Sc, Y, Al, Ga, In, or Tl.
- 321 Of molybdenum:**  
This subclass is indented under subclass 305. Composition in which the Group VI metal is element number 42.
- 322 And Group III metal containing (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 321. Composition which additionally includes Sc, Y, Al, Ga, In or Tl.
- 323 And Group III metal containing (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 305. Composition which additionally includes Sc, Y, Al, Ga, In, or Tl.
- 324 Of manganese:**  
This subclass is indented under subclass 300. Composition in which the metal, oxide or hydroxide is element number 25.

- 325 Of Group VIII (i.e., iron or platinum group):**  
This subclass is indented under subclass 300. Composition in which the metal, oxide or hydroxide is of the iron group or of the platinum group.
- 326 Of platinum group metal and of iron group (i.e., Ru, Rh, Pd, Os, Ir, or Pt and Fe, Co or Ni):**  
This subclass is indented under subclass 325. Composition in which there is at least one metal, oxide, or hydroxide from each of the iron group and the platinum group.
- (1) Note. To be classifiable here, a patent must claim for example iron oxide and platinum; a mixture of iron and nickel or a mixture of rhodium and palladium are not proper for this subclass.
- 327 And Group III metal containing (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 326. Composition which additionally includes Sc, Y, Al, Ga, In, or Tl.
- 328 And Group II metal containing (i.e., alkaline earth, Be, Mg, Zn, Cd or Hg):**  
This subclass is indented under subclass 325. Composition which additionally includes an alkaline earth metal Be, Mg, Zn, Cd, or Hg.
- 329 Zinc containing:**  
This subclass is indented under subclass 328. Composition in which the additional metal is element number 30.
- 330 And Group I metal containing (i.e., alkali, Ag, Au or Cu):**  
This subclass is indented under subclass 325. Composition additionally including a metal of Group I as listed at the beginning of the schedule, free or as the oxide or hydroxide.
- 331 Copper containing:**  
This subclass is indented under subclass 330. Composition in which the metal is element number 29.
- 332 And Group III metal containing (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 325. Composition additionally containing a metal of Group III as listed at the beginning of the schedule, free or as the oxide or hydroxide.
- 333 Of palladium:**  
This subclass is indented under subclass 332. Composition in which the additional metal is element number 46.
- 334 Of platinum:**  
This subclass is indented under subclass 332. Composition in which the additional metal is element number 78.
- 335 Of nickel:**  
This subclass is indented under subclass 332. Composition in which the additional metal is element number 28.
- 336 Of iron:**  
This subclass is indented under subclass 332. Composition in which the additional metal is element number 26.
- 337 Of nickel:**  
This subclass is indented under subclass 325. Composition in which the additional metal is element number 28.
- 338 Of iron:**  
This subclass is indented under subclass 325. Composition in which the additional metal is element number 26.
- 339 Of palladium or platinum:**  
This subclass is indented under subclass 325. Composition in which the additional metal is element number 46 or 78.
- 340 Of Group II (i.e., alkaline earth, Be, Mg, Zn, Cd or Hg):**  
This subclass is indented under subclass 300. Composition in which the additional metal is from Group II as listed at the beginning of the schedule.

- 341 And Group III metal containing (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 340. Composition in which there is also a metal from Group III as listed at the beginning of the schedule.
- 342 Of zinc:**  
This subclass is indented under subclass 341. Composition in which the additional metal is element number 30.
- 343 Of zinc:**  
This subclass is indented under subclass 340. Composition in which the additional metal is element number 30.
- 344 Of Group I (i.e., alkali, Ag, Au or Cu):**  
This subclass is indented under subclass 300. Composition containing a metal of Group I as listed in the beginning of the schedule.
- 345 Of copper:**  
This subclass is indented under subclass 344. Composition in which the additional metal is element number 29.
- 346 And Group III metal containing (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 345. Composition additionally containing a metal or compound thereof from Group III as listed at the beginning of the schedule.
- 347 Of silver:**  
This subclass is indented under subclass 34. Composition in which the additional metal is element number 47.
- 348 And Group III metal containing (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 347. Composition additionally containing a metal from Group III as listed at the beginning of the schedule.
- 349 Of Group IV (i.e., Ti, Zr, Hf, Ge, Sn, or Pb):**  
This subclass is indented under subclass 300. Composition including a metal of Group IV as listed at the beginning of the schedule.
- 350 Of titanium:**  
This subclass is indented under subclass 349. Composition in which the metal is element number 22.
- 351 And Group III metal containing (i.e., Sc, Y, Al, Ga, In or Tl):**  
This subclass is indented under subclass 350. Composition additionally including a metal of Group III as listed at the beginning of the schedule.
- 352 Of tin:**  
This subclass is indented under subclass 349. Composition in which the additional metal is element number 50.
- 353 Of Group V (i.e., V, Nb, Ta, As, Sb or Bi):**  
This subclass is indented under subclass 300. Composition in which the metal is from Group V as listed at the beginning of the schedule.
- 354 And Group III metal containing (i.e., Sc, Y, Al, Ga, In, or Tl):**  
This subclass is indented under subclass 353. Composition additionally including a metal of Group III as listed at the beginning of the schedule.
- 355 Of Group III (i.e., Sc, Y, Al, Ga, In or Ti):**  
This subclass is indented under subclass 300. Composition in which the metal is from Group III as listed at the beginning of the schedule.
- 400 SOLID SORBENT:**  
This subclass is indented under the class definition. Composition in nonfluent phase which serves to attract and hold on its surface, within its pores, or throughout its mass a material which is generally fluent.
- (1) Note. The material is reversibly held and does not react with the sorbent.
- SEE OR SEARCH CLASS:  
119, Animal Husbandry, particularly subclasses 171+ for material used for absorbing moisture from an animal waste product, i.e., excrement or urine.

- 401 **Organic:**  
This subclass is indented under subclass 400. Composition in which a constituent is a compound in which an atom of carbon is bonded to hydrogen, a halogen, a second atom of carbon or to nitrogen by a single or double bond as set out in the Glossary term "organic".
- 402 **Synthetic resin:**  
This subclass is indented under subclass 401. Composition in which the organic material is polymeric, derived by the addition across ethylenic unsaturation or the condensation of reactive components, or a polymer which could be made by such addition or condensation reaction.
- (1) Note. These compositions include essentially material which, per se, is classifiable in the Class 520 series of classes.
- SEE OR SEARCH CLASS:  
520, Synthetic Resins or Natural Rubbers, for a material, per se, of that class which is cellular form could inherently be sorbent.
- 403 **Protein:**  
This subclass is indented under subclass 401. Composition in which the organic material comprises a chain of acylated alpha-amino acids.
- 404 **Carbohydrate:**  
This subclass is indented under subclass 401. Composition in which the organic material is a poly hydroxy mono-aldehyde or mono-ketone generally of the empirical formula  $C_n (H_2O)_m$  or a polymeric anhydride hydrolyzable to such aldehyde or ketone and wherein n is at least 5.
- 405 **Inorganic gel containing (e.g., silicagel):**  
This subclass is indented under subclass 400. Composition in which an inorganic material, usually a metal or silicon oxide in relatively minor amount is distributed in suspension in water, appearing to be solid while the water constitutes as much as 95 to 99% of the mixture.
- (1) Note. A true gel is considered a composition, but a completely dried gel is no more than a compound and classifiable in Class 423.
- SEE OR SEARCH CLASS:  
423, Chemistry of Inorganic Compounds, appropriate subclass for a completely dried inorganic gel.  
516, Colloid Systems and Wetting Agents; Subcombinations Thereof; Processes of Making, Stabilizing, Breaking, or Inhibiting, subclasses 98+ for colloid systems of continuous or semicontinuous solid phase with discontinuous liquid phase (gels, pastes, flocs, coagulates) or agents for such systems or making or stabilizing such systems or agents, when generically claimed or when there is no hierarchically superior provision in the USPC for the specifically claimed art.
- 406 **Having specifically intended extraneously added iron group (i.e., Fe, Co, Ni) component:**  
This subclass is indented under subclass 400. Composition in which the free metal or a compound of element number 26, 27 or 28 is deliberately included and not incidentally present as an impurity or part of another ingredient.
- 407 **Silicon containing:**  
This subclass is indented under subclass 400. Composition in which there is element number 14, free or chemically combined.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
60+, for a clay or zeolite composition.  
405, for a silica gel sorbent.
- 408 **Acid treated:**  
This subclass is indented under subclass 407. Composition in which the silicon material is contacted with a proton donor.
- 409 **Quartz:**  
This subclass is indented under subclass 407. Composition containing crystalline silicon dioxide.

**410 Magnesium silicate (e.g., asbestos, vermiculite, etc.):**

This subclass is indented under subclass 407. Composition in which the silicon is chemically combined with magnesium and oxygen.

- (1) Note. The silicate may include an other element e.g., Magnesium Aluminum silicate.

**411 Having extraneously added alkali metal or alkaline earth metal:**

This subclass is indented under subclass 407. Composition to which an alkali or alkaline earth metal as listed in the schedule has been added.

SEE OR SEARCH THIS CLASS, SUBCLASS:

410, for a magnesium silicate sorbent composition.

**412 Diatomaceous earth:**

This subclass is indented under subclass 407. Composition wherein the silicon containing material is a diatomaceous earth.

**413 Free carbon containing:**

This subclass is indented under subclass 407. Composition additionally, containing carbon in elemental form.

**414 Aluminum containing:**

This subclass is indented under subclass 400. Composition including element number 13, free or chemically combined.

**415 Alumina (i.e., dialuminum trioxide):**

This subclass is indented under subclass 414. Composition containing the compound dialuminum trioxide.

SEE OR SEARCH THIS CLASS, SUBCLASS:

405, for an alumina gel sorbent composition.

**416 Free carbon containing:**

This subclass is indented under subclass 400. Composition comprising "activated" carbon or containing the element with atomic number 6 in substantially elemental form.

- (1) Note. While relatively pure carbon is provided for in Class 423, subclass 445, the term "activated" will be construed as indicating a composition comprising carbon and unidentified components, functioning as a sorbent for this class.

- (2) Note. Charred, coked, pyrolyzed, or incompletely combusted organic material, which may retain some chemically bound carbon will be considered as being in substantially elemental form for this subclass.

SEE OR SEARCH CLASS:

516, Colloid Systems and Wetting Agents; Subcombinations Thereof; Processes of Making, Stabilizing, Breaking, or Inhibiting, subclass 32 for colloid systems of colloid-sized carbon (e.g., diamond, graphite) dispersed in primarily organic continuous liquid phase, subclasses 38+ for colloid systems of colloid-sized bituminous, coal, or Carbon phase dispersed in aqueous continuous liquid phase, cross-reference 901 for colloid systems of substantially pure elemental carbon (graphite, lamp black, carbon black, fullerenes); or agents for such systems or making or stabilizing such systems or agents; in each instance, when generically claimed or when there is no hierarchically superior provision in the USPC for the specifically claimed art.

**417 And specified added active sorbent material:**

This subclass is indented under subclass 416. Composition to which a material, not found in the original source or carbon, has been added to enhance sorbability by its presence.

- (1) Note. This subclass requires a named additive intended to contribute to the function by its presence and not by its action on carbon and does not include an activating agent such as nitric acid added during an activating process.

- (2) Note. Animal or bone black is 80% Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>, and a patent claiming a mixture of its with another source of carbon is proper for this subclass.

**418 Process utilizing solid or liquid source carbonizable material, or product thereof:**

This subclass is indented under subclass 416. Process in which the sorbent is produced by (a) chemically reacting to a nongaseous carbon compound to produce elemental carbon or (b) adding to or removing from elemental carbon, some other material or chemically or physically treating such carbon to enhance its sorbability.

- (1) Note. A disclosure of material which may be shaped or pelletized is an indication of solid or viscous material. An oil is not considered solid or viscous, however a process including spraying an acid sludge on cake particles is considered to utilize solid or viscous material.
- (2) Note. Such processes as destructive distillation, charring, pyrolysis etc. to produce a sorbent (e.g., activated) carbon are provided for in this or an indented subclass.

**SEE OR SEARCH CLASS:**

- 201, Distillation: Processes, Thermolytic, for destructive distillation in general.
- 202, Distillation: Apparatus, for apparatus in which a process of this subclass may be carried out.
- 264, Plastic and Nonmetallic Article Shaping or Treating Processes, subclasses 29.1+ for carbonizing and Shaping.
- 423, Chemistry of Inorganic Compounds, subclass 455 for carbonizing to pure carbon.

**419 Producing diverse useful byproduct:**

This subclass is indented under subclass 418. Process in which the production or collection of a different useful material or energy (e.g., heat) is positively claimed.

- (1) Note. The positive recitation of collection of volatiles and use of these as fuel

in an upstream phase is considered to give a diverse by product.

**SEE OR SEARCH CLASS:**

- 201, Distillation: Processes Thermolytic appropriate subclasses for a process of coking which may also produce a byproduct fuel gas.
- 208, Mineral Oils: Processes and Products appropriate, subclasses for production of tar or pitch from mineral oil.

**420 Temperature vs. time factor:**

This subclass is indented under subclass 418. Process in which a relationship between the amount and the duration of heat is positively recited e.g., rise from x to x<sub>1</sub> in y hours.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 436, for a process including 2 distinct heating stages.

**421 Including recycling product or intermediate thereof to prior stage of process:**

This subclass is indented under subclass 418. Processes wherein at least a portion of a product is used in an earlier stage of the process.

- (1) Note. This subclass does not include the use of products or intermediates as fuel in the process. See subclass 422.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 422, for use of part of source as fuel.

**422 Including diverting part of source to providing fuel for process:**

This subclass is indented under subclass 418. Process in which the starting material is physically divided, one part being burned, thereby providing heat or treating agents used in converting the remainder of the material to the desired composition.

- (1) Note. This subclass provides for a process in which fines are screened and burned to carbonize the layer of particles of starting material.

- 423 Adding nongaseous inorganic, or inorganic yielding component prior to or during process:**  
This subclass is indented under subclass 418. Process including by admixing a liquid or solid material, which is, per se, inorganic or which yields an inorganic constituent such as by decomposition, with the carbonable material before or while the latter material is being converted to carbon.
- 424 Zinc containing:**  
This subclass is indented under subclass 423. Subject matter in which the inorganic component includes element number 30.
- 425 Phosphorus containing:**  
This subclass is indented under subclass 423. Subject matter in which the inorganic component includes element number 15.
- 426 Acid:**  
This subclass is indented under subclass 423. Subject matter in which the inorganic component is a proton donor.
- 427 Alkali metal, alkaline earth metal or magnesium containing:**  
This subclass is indented under subclass 423. Subject matter including element number 12, an alkali or alkaline earth metal, as set out in the list at the beginning of the schedule, free or in the combined state.
- 428 Including pelletizing or briquetting and subsequently comminuting:**  
This subclass is indented under subclass 418. Process in which a material of indefinite or mixed size or shape is molded or agglomerated into shaped pieces by compression or a similar operation and the pieces then subdivided.
- (1) Note. A step or operation such as charring may be performed between the pelletizing and the comminuting or the comminuting may immediately follow the pelletizing.
- 429 Using carbonaceous binder:**  
This subclass is indented under subclass 428. Process in which a carbon containing material is utilized in making a shapeable mass or to hold together particles of the material in briquettes.
- (1) Note. Aqueous solutions of sugar or starch or pitch are examples of carbonaceous binders.
- 430 Treating with gas:**  
This subclass is indented under subclass 418. Process in which the material is contacted with a specified fluid above its fluid boiling point at the conditions of the treatment.
- 431 Fluidized bed having specified parameter:**  
This subclass is indented under subclass 430. Process in which a column of gas rises at a velocity to support particles of material in a state of turbulence and a rate, distance, temperature, or other condition is positively recited.
- (1) Note. A specified composition is not considered a parameter for a fluidized bed.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
41+, for a fluidized bed process of regenerating a sorbent.
- SEE OR SEARCH CLASS:  
423, Chemistry of Inorganic Compounds, Digest 16 for a collection of art on fluidized bed techniques.
- 432 Specified atmosphere:**  
This subclass is indented under subclass 430. Process in which the composition of the gas is recited.
- (1) Note. The claim may recite an upper limit or a range of percentages.
- 433 Including free oxygen:**  
This subclass is indented under subclass 432. Process in which uncombined element number 8 is recited, either diatomic or as ozone.
- 434 And subsequent diverse gas:**  
This subclass is indented under subclass 433. Process in which after treatment with the oxygen containing gas, the carbon source material is contacted with a different gas, which may also contain oxygen.

- (1) Note. The treatment with diverse gas may be in the same or a different zone and may employ the same constituents in a different mixture - i.e., other percentages or ingredients.
- 435 Exposure to hot flue or exhaust gas:**  
This subclass is indented under subclass 432. Process in which the material is bathed in (treated by contact with) the products of an adjacent and upstream combustion.
- 436 Diverse temperatures:**  
This subclass is indented under subclass 418. Process in which material is heated at two clearly distinct temperatures or ranges of temperatures.
- (1) Note. A process in which material is subjected to heat which may increase or decrease during the treatment does not suffice for placement here. The process must recite two heating stages which differ unequivocally e.g., at 900° and 1500° or 600° to 900° and 1200 to 1500°.
- 437 Specified source (e.g., peach pit, etc.):**  
This subclass is indented under subclass 418. Composition characterized by the original material carbonized to form the free carbon and not limited to a specific process by which it is produced.
- 438 Chemically reducing an oxide or product thereof:**  
This subclass is indented under subclass 416. Process in which electrons are supplied to a carbon atom bound to an oxygen atom, to give elemental carbon.
- 439 MISCELLANEOUS (E.G., CARRIER OR SUPPORT, PER SE, OR PROCESS OF MAKING, ETC.):**  
This subclass is indented under the class definition. Product serving as a substrate for the catalyst or sorbent and the process of preparing the same.
- (1) Note. A patent claiming (disclosing) a carrier or support acting as either a catalyst, or sorbent is placed in the first appearing subclass providing for the function and crossed in the other subclasses providing for the other functions.
- SEE OR SEARCH CLASS:  
252, Composition, subclass 1 for a patent having only generic claims(s) and plural disclosures, e.g., support for catalyst or sorbent, filler, pigment, etc.  
422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing, subclasses 310+ for an element for that class having a catalyst coated, laminated, etc. thereto.
- CROSS-REFERENCE ART COLLECTIONS
- 500 STABILIZED:**  
This subclass is indented under the class definition. Collection of art disclosing some feature which functions to prolong or maintain a desired property of a composition of this class, such as activity or resistance to deterioration.
- 501 For multi-regenerability:**  
This subclass is indented under subclass 500. Collection of art in which the desired property is the ability of the material to be regenerated (after being used or spent) a plurality of times.
- 502 Crystallinity:**  
This subclass is indented under subclass 500. Collection of art in which the composition retains a particular, desired crystal phase.
- 503 Crush strength:**  
This subclass is indented under subclass 500. Collection of art in which the composition is enable to withstand weight and/or pressure and resists fracturing or being compacted.
- 504 Abrasion resistance:**  
This subclass is indented under subclass 500. Collection of art in which the desired property is an ability of the material to retain its integrity under conditions usually contributing to spalling or attrition.
- 506 METHOD OF MAKING INORGANIC COMPOSITION UTILIZING ORGANIC COMPOUND (EXCEPT FORMIC, ACE-**

**TIC, OR OXALIC ACID OR SALT THEREOF):**

This subclass is indented under the class definition. Collection of art disclosing a process of making a composition of this class in which a transitory organic compound is used.

- (1) Note. See Glossary for definition of organic.
- (2) Note. The organic compound may serve as a solvent which is physically separated from the final composition or may be an intermediate reactant, removed or destroyed chemically, as by calcination, precipitation, etc.
- (3) Note. The use of an acetate, formate or oxalate is so conventional that disclosure of the use of these materials is not collected here.

**507 Synthetic resin, natural resin, polysaccharide, or polypeptide:**

This subclass is indented under subclass 506. Process in which the organic compound is macro-molecular film-or fiber-forming or moldable material, manmade or existing in nature of a polymer of alpha-amino acids or of repeating carbohydrate units.

- (1) Note. These materials are sometimes used as binders and removed from the shaped final material.

**508 Sulfur containing organic compound:**

This subclass is indented under subclass 506. Process in which the organic material contains element number 16.

**509 Nitrogen containing organic compound:**

This subclass is indented under subclass 506. Process in which the organic material includes element number 7.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 159, for a process using a resin, natural, or synthetic, polysaccharide or polypeptide.
- 507, for a process using a polypeptide or a resin that may include nitrogen.

**510 Also containing hydroxyl bonded to carbon, e.g., carboxylic acid, etc:**

This subclass is indented under subclass 509. Process in which the organic nitrogen compound also includes the -OH group which may form an alcohol, a phenol, hydroxamic acid or carboxylic acid.

**511 Two or more nitrogen atoms bonded to different carbon atoms:**

This subclass is indented under subclass 509. Collections of art in which a second nitrogen atom is bonded to a different carbon atom than that to which the first nitrogen is bonded.

**512 Carboxyl acid or salt thereof other than formic, acetic, or oxalic acid:**

This subclass is indented under subclass 506. Collection of art in which the organic material includes the moiety - COX in which X is hydrogen, a metal or the nitrogen of ammonia or an amine radical.

**513 Alcohol, phenol, or ether or metallate thereof:**

This subclass is indented under subclass 506. Collection of art in which a carbon of the organic compound is singly bonded to an oxygen atom, the other valence of which is satisfied by hydrogen, carbon or a metal.

**514 PROCESS APPLICABLE EITHER TO PREPARING OR TO REGENERATING OR TO REHABILITATING CATALYST OR SORBENT:**

This subclass is indented under the class definition. Collection of art disclosing operations which are claimed or shown to be useful in the original production or in the restoration of a composition having a utility of this class.

- (1) Note. A process of treating carbon with steam which is disclosed as activating it abinitio or as reactivating a spent carbon sorbent is classifiable here.

**515 SPECIFIC CONTAMINANT REMOVAL:**

This subclass is indented under the class definition. Collection of art directed to regenerating or rehabilitating a composition of this class and concerned primarily with freeing the composition of some specific material usually called a "poison".

- 516 Metal contaminant removal:**  
This subclass is indented under subclass 515. Collection of art in which the poison or contaminant comprises an element (or compound thereof) which exhibits a positive ionic property is set out in the Glossary as a metal.
- 517 Sulfur or sulfur compound removal:**  
This subclass is indented under subclass 515. Collection of Art in which the element number 16 or a compound of such element is removed from the composition.
- 518 Carbonaceous contaminant:**  
This subclass is indented under subclass 515. Collection of art in which the material removed comprises a substantial amount of element number 6 in relatively free state, or partially oxidized organic material known as char.
- 519 REAGENT GRADE (E.G., ULTRA PURE):**  
Collection of art disclosing compositions of this class (generally sorbents) which are free of any components which could contaminate or interfere in subsequent chemical reactions or analysis.
- (1) Note. An example of art to be found here is an ash free sorbent used in chemical analysis.
- 520 SUPPRESSED SIDE REACTIONS:**  
This subclass is indented under the class definition. Collection of art disclosing a composition exhibiting selectivity from among several possibly sorbable materials or competing reactions normally expected under the conditions of use of the composition.
- (1) Note. Exemplary is a catalyst which inhibits the formation of butyne in a reaction to give butadiene from butane.
- 521 METAL CONTAMINANT PASSIVATION:**  
This subclass is indented under the class definition. Collection of art directed to a process of counteracting the undesired effect of a metal in a catalyst or sorbent, without removing said metal.
- 522 RADIANT OR WAVE ENERGY ACTIVATED:**  
This subclass is indented under the class definition. Collection of art disclosing a composition of this sorbent under the influence of energy capable of being transmitted through space of which is transmitted in regular pulses (i.e., quanta).
- 523 MISCELLANEOUS SPECIFIC TECHNIQUES OF GENERAL APPLICABILITY:**  
This subclass is indented under the class definition. Collection of art disclosing steps or methods which effect a useful or desirable property of function irrespective of the material acted upon.
- (1) Note. This subclass includes treatments of catalysts, sorbent and/or supports in general such as methods of coating, activating mixing, conditioning or increasing surface area. An example is patent no. 513,109 disclosing a method of applying a myriad of catalytic material on various supports.
- 524 SPINEL:**  
This subclass is indented under the class definition. Collection of art disclosing the particular crystalline structure of mixed metal oxides of the formula  $AB_2O_4$  in which A is a divalent metal e.g., Mg, Zn, Mn or ferrous iron and B is a trivalent metal such as Al, Cr, or ferric iron.
- 525 PEROVSKITE:**  
This subclass is indented under the class definition. Collection of art disclosing the particular crystalline structure of mixed metal oxides of  $ABO_3$  in which A is a divalent or rare earth metal and B is a transition metal, generally of cubic structure.
- 526 SORBENT FOR FLUID STORAGE, OTHER THAN AN ALLOY FOR HYDROGEN STORAGE:**  
This subclass is indented under the class definition. Collection of art disclosing sorbent material designed to retain a fluid (often a pressurized gas as acetylene) for release as a fluid at a desired time.

## SEE OR SEARCH CLASS:

- 252, Compositions, subclass 194, for a humidostatic composition.
- 420, Alloys or Metallic Compositions, pertinent, subclass for an alloy claimed or disclosed as a hydrogen storing medium, whether by sorption or by chemical reaction, i.e., hydride formation. See especially subclass 900.

**527.11 MONOLITH OF PECULIAR STRUCTURE OR PHYSICAL FORM, WITH SPECIFIED HEAT EXCHANGE CAPABILITY:**

This subclass is indented under the class definition. Collection of art disclosing monoliths wherein the material or composition of peculiar or specific shape is disclosed to exhibit significant heat exchange capability.

**527.12 PLURAL LAYERS ON A SUPPORT, EACH LAYER HAVING A DISTINCT FUNCTION:**

This subclass is indented under the class definition. Collection of art disclosing a support having plural layers thereon, wherein each layer has a distinct function.

**527.13 More than two overlapping layers:**

This subclass is indented under subclass 527.12. Collection of art wherein at least three overlapping layers are present on the support.

**527.14 SPECIFIED SUPPORT PARTICLES OF PECULIAR STRUCTURE OR PHYSICAL FORM E.G., WHISKERS, FIBER PIECES, ETC.):**

This subclass is indented under the class definition. Collection of art disclosing support particles of a peculiar structure or physical form.

**527.15 Layered deposition on support particle (i.e., on a carrier particle):**

This subclass is indented under subclass 527.14. Collection of art directed to carrier (support) particles having a layer thereon.

**527.16 Specified shape of support particle (e.g., hollow-carrier particle):**

This subclass is indented under subclass 527.14. Collection of art wherein the support particle is of a specified shape.

## SEE OR SEARCH CLASS:

- 428, Stock Material or Miscellaneous Articles, especially subclasses 357+ for a specifically shaped particle.

**527.17 Specified cross-section shape or area of elongated support particles (e.g., tape, with area of cross section stated):**

This subclass is indented under subclass 527.14. Collection of art wherein an elongated particle is described in terms of the shape or area of its cross-section.

**527.18 MONOLITH WITH SPECIFIED GAS FLOW PATTERNS, (E.G., TURBULENT FLOW MONOLITH):**

This subclass is indented under the class definition. Collection of art disclosing a monolith with a specified gas flow pattern.

**527.19 MONOLITH WITH SPECIFIC SHAPE OR DIMENSION OF CELL OPENING (E.G., HONEYCOMB, RINGS, ETC.)**

This subclass is indented under the class definition. Collection of art disclosing a monolith whose cell openings are of a specific shape or dimension.

- (1) Note. This subclass does not provide for nominal honeycomb disclosure. Specific disclosure of cell opening shape or dimension (e.g., octagon shape, noncircular opening, etc.) is intended for provision herein.

## SEE OR SEARCH CLASS:

- 428, Stock Material or Miscellaneous Articles, appropriate subclasses for specific opening shape in material(s) or article(s).

**527.2 Cell opening shape and dimensions are determined by the intersection of the woof and the warp of a woven structure, (e.g., of a fabric or gauze, etc.):**

This subclass is indented under subclass 527.19. Collection of art wherein the intersection of the woof and the warp of a woven structure determines the shape and dimensions of the cell opening.

**527.21 Cell openings are quadrilateral or triangular (e.g., pie shaped):**

This subclass is indented under subclass 527.19. Collection of art wherein the cell openings are triangular or quadrilateral in shape.

**527.22 Cell openings are spiral or corrugated:**

This subclass is indented under subclass 529.19. Collection of art wherein the cell openings are spiral or corrugated in shape.

**SEE OR SEARCH CLASS:**

428, Stock Material or Miscellaneous Articles, appropriate subclasses for spiral or corrugated material or articles.

**527.23 SPECIFIED EXTERNAL OR INTERNAL SHAPE OR CONFIGURATION OF CATALYST REACTOR OR OF SORBENT CONVERTER:**

This subclass is indented under the class definition. Collection of art wherein a catalyst reactor or a sorbent converter is characterized by a specific external or internal shape or configuration.

**SEE OR SEARCH CLASS:**

422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving or Sterilizing, for apparatus which may include a catalyst or sorbent of a specific shape.

**527.24 PECULIAR STRUCTURE OR PHYSICAL FORM (E.G., FOAM, SPONGES, FOIL, SACK, BAG, FIBER IN A MATRIX, MONOLITH, MICROSTRUCTURE (MICROCRACKING), MICROAGGREGATES, ETC.):**

This subclass is indented under the class definition. Collection of art disclosing a specific shape or configuration of the material of the composition.

(1) Note. The following physical concepts are not peculiar for purposes of belonging to this cross-reference art collection.

(a)Bimodal (multimodal) pore distribution.

(b)Coating of no special description, including nonuniform coating.

(c)Reactive complexes (particles on a surface, etc.)

(d)High specific surface area and/or high porosity.

(e)Particle diameter.

(f)Pores made by burning out a substance.

(g)Alloy.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

8+, for a process of forming or treating a sphere.

END