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FORMING ASBESTOS PRODUCTS FROM POLYVALENT ION DISPERSED ASBESTOS

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This invention relates to asbestos products and processes for producing them, and is more particularly directed to formed bodies comprising Crystallite chrysotile asbestos fibers from 20 to 40 millimicrons in diameter in intimate, substantially homogeneous admixture and surface-cemented with a positively charged hydrous oxide of a metal which in the oxide has a valence in the range of 3 to 4 and is incapable of a valence greater than 4, and is further directed to processes for producing such formed bodies, in which oriented chrysotile asbestos is disoriented by mechanical action at a pH of 3 to 6 in an aqueous solution containing as a dispersing agent a dissolved metal salt having a monovalent anion and a cation containing a polyvalent metal, the amount of dispersing agent being not more than enough to give 3 milligram moles of dissociated anion per gram of asbestos, whereby the asbestos is obtained in the form of an aqueous dispersion of discrete, Crystallite fibers from 20 to 40 millimicrons in diameter, mixing therewith a dispersed, positively charged hydrous oxide of a metal which in the oxide has a valence in the range of 3 to 4 and is incapable of a valence greater than 4, and drying the dispersion as a formed body.

Chrysotile asbestos, as it occurs in nature, is made up of a mass of oriented fibers of a complex magnesium silicate. Masses of asbestos can quite readily be broken up by ordinary mechanical methods into relatively coarse fibers which consist of bundles of fibrils. By specialized techniques such as those described in British Patent 562,161 these relatively large fibers can be broken down into ultimate fibrils estimated as having a diameter of the order of 300 Ångstroms. However, in aqueous suspension as well as when dried, these ultimate fibrils are associated in discrete groups or flocs easily observable by the unaided eye, and because of this flocculation the system is non-homogeneous and has properties characteristic of the flocs. Therefore, it has not hitherto been possible to work with or on homogeneously distributed discrete individual fibrils; hence their usefulness has been greatly impaired.

If it is attempted to make formed bodies from aqueous suspensions in which asbestos is either not completely broken down into ultimate fibers or the fibers are flocculated, it is found that the formed bodies so produced have very poor tensile and tear strength and poor water resistance. For instance, asbestos sheet, made by casting the dispersion of British Patent 562,161 as a sheet and drying, has a tensile strength below 500 pounds

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per square inch, disintegrates in water in a few seconds, and is commercially unusable.

It has been proposed, as for instance in Stoewener Patent 2,085,129 and Hauser Patent 2,266,638, to use aluminum hydroxide or other hydrous oxides as binders for asbestos products in which the asbestos fibers were present in the coarse form into which asbestos can readily be broken up by ordinary means. While some improvement in tensile strength can thus be obtained, the products are of relatively heterogeneous character and the improvement in tensile strength is not sufficient to compensate for other disadvantages which severely limit commercial usability of the products.

Now according to the present invention it has been found that formed asbestos bodies, such as sheet, having high dry and wet tensile strength and good tear and flex strength may be produced by processes in which oriented chrysotile asbestos is disoriented by mechanical action in an aqueous solution containing as a dispersing agent a dissolved metal salt having a monovalent anion and a cation containing a polyvalent metal, the amount of dispersing agent being not more than enough to give 3 milligram moles of dissociated anion per gram of asbestos, at a pH from 3 to 6, whereby the asbestos is obtained in the form of an aqueous dispersion of discrete Crystallite fibers from 20 to 40 millimicrons in diameter, mixing with this aqueous dispersion a positively charged dispersed hydrous oxide of a metal which in the oxide has a valence in the range of 3 to 4 and is incapable of a valence greater than 4, and drying the dispersion as a formed body. In the formed bodies thus produced the asbestos is present as Crystallite chrysotile fibers from 20 to 40 millimicrons in diameter in intimate, substantially homogeneous admixture and surface-cemented with the hydrous oxide. The preparation of the initial aqueous dispersion of chrysotile is the subject of my co-pending application Serial No. 127,529 filed concurrently herewith, and no claim thereto is made in the present application except in combination with the steps of preparing formed asbestos bodies therefrom in admixture with a hydrous metal oxide binder.

The asbestos employed in the processes and products of this invention is known as chrysotile. This is a fibrous form of asbestos and the most common form. It may be mined from naturally occurring deposits and should be cleaned of rocks and dirt before use. It preferably should be broken up in a preliminary way, as in a chopping mill, such preliminary treatment being of a char-

acter to break up very long fibers and fiber bundles which might otherwise interfere with the agitation means subsequently to be employed. Preliminary breaking up may be done in the dry way, as is the case in a chopping mill.

Following preliminary chopping the chrysotile is further broken down by mechanical action in aqueous suspension in the presence of a chemical dispersing agent. In this step of the process the oriented chrysotile becomes disoriented into its ultimate, Crystallite fibrils by a combination of mechanical action and chemical treatment under such conditions that adverse chemical change of the fiber does not occur.

The mechanical action employed to effect disorientation must be of a character which tends to separate the individual fibrils from each other but which does not provide a high degree of attrition or grinding such as would break the fibrils into very short pieces. A discussion of various means applicable to this purpose is found in British Patent 562,161 and any of the methods there disclosed for mechanical treatment of the fibers in the presence of water may be used. As is there pointed out, the fibrous material is subjected to a bending and squeezing action under such conditions that the fibrous body has freedom to expand at substantially right angles to the direction of the applied force to spread out and liberate individual fibers as they are released from the pencil or bundle and that excessive breaking or cutting up of the individual fibers is substantially avoided. A ball mill may be used for this purpose and the mass thus produced may be broken up by stirring, vibration of the mass of liquid and asbestos, by spraying through a nozzle or by blowing with air or steam or by explosive heat shattering treatment using steam, air or the like. Various types of beater mills may be used and the mass may be subjected to ultrasonic treatment. A laboratory mill of the Waring Blendor type, in which propeller-shaped knives are revolved at very high speed, has been found to give excellent disorientation in a minimum of time with minimum reduction in fiber length.

It has been found that mechanical means alone are insufficient to give a deflocculated dispersion of chrysotile. Rather, it has been found that control of the pH during dispersion and also the presence of a dispersing agent is essential in order to obtain complete disorientation and avoid flocculation.

The dispersing agents in a process of this invention are dissolved metal salts having a monovalent anion and a cation containing a polyvalent metal. Such salts are not ordinarily thought of as being dispersing agents. Aluminum chloride, for example, has been described in the prior art as having the opposite effect on chrysotile asbestos. (N. N. Serb-Serbina and K. N. Shumikhina, J. Applied Chem. (U. S. S. R.) 16, 173–9 (1943)). However, under the conditions described herein these salts have been found to have a dispersing action of chrysotile. The salts employed must be sufficiently soluble in water to have the desired action, but it will be understood that even sparing solubility may be sufficient for this purpose. Thus, plumbous chloride, $PbCl_2$, is sufficiently soluble to have a dispersing action.

The anion of the dispersing agent must be monovalent. It has been found that polyvalent anions have a distinctly adverse effect and their presence must be avoided. If present as impurities in the raw materials, they may be removed by the addition of a small amount of a precipitant, as for example, barium acetate to remove sulfate ions. It is also preferred not to use the monovalent anion, fluoride, because this anion has a pronounced tendency to form complex, polyvalent anions. Representative anions which may be used, in the order of their effectiveness are the following radicals: formate, acetate, chloride, nitrate, bromide.

The polyvalent cation of the dispersing agent may be a cation which contains only the polyvalent metal or may be one which contains a polyvalent metal in combination with another element such as oxygen. Representative of the metals which may be present in the cation are aluminum, iron, chromium, zirconium, titanium, beryllium, lead, copper, tin, indium, magnesium, barium and zinc. Representative cations containing another element in addition to the polyvalent metal include zirconyl, titanyl and basic aluminum cations.

It is particularly preferred to employ as a dispersing agent a salt having a cation containing aluminum, iron, chromium, zirconium or titanium, and of these the aluminum salt is outstanding.

The amount of dispersing agent used is critical. The minimum amount is, of course, that necessary to effect dispersion. As little as 0.1 milligram molecular weights of a suitable salt per gram of asbestos has been found to give effective dispersion. The maximum amount of dispersing agent must be carefully controlled. The permissible maximum is related to the character of the anion formed when the metal salt is dissolved in water. When this anion does not strongly associate with the hydrogen ion present in the dispersion, the maximum amount of dispersing agent that can be added is less than when the anion associates with the hydrogen ion to form a poorly dissociated acid. For instance, when a chloride is used, the chloride ion formed upon dissolution does not strongly associate with hydrogen ion, whereas when the dispersing agent is an acetate, the acetate ion does associate with the hydrogen ion to form acetic acid which, being poorly ionized, ties up the acetate ion and reduces the effective amount present. The maximum amount of any salt used must be not more than enough to give three milligram moles of dissociated anion per gram of asbestos. Since the anions of strong acids such as hydrochloric, hydrobromic, and nitric acids are, at this dilution, practically 100% dissociated, it will be apparent that one milligram molecular weight of a trivalent metal chloride such as aluminum chloride or 1.5 milligram molecular weights of a chloride of a divalent metal such as beryllium is the maximum which can be tolerated. On the other hand, when the acetate or formate of a polyvalent metal is used, the amount of dispersing agent can be larger because the anion is poorly dissociated. The number of milligram moles of a salt which will give a particular concentration of anions in the dispersion may readily be calculated by reference to the dissociation constant of the acid corresponding to the anion, at the dilution and pH used.

In making a chrysotile dispersion the pH of the aqueous medium is maintained in the range from 3 to 6. The ordinary pH of chrysotile dispersions is in the range from 8 to 10, and until the pH is lowered to 6 no substantial amount of chemical dispersing action occurs. On the other hand if the pH is lowered below about 3, acid

attack of the individual fibers occurs and deterioration of the fiber results. This deterioration would occur at a higher pH than 3 in the absence of the dispersing agent. The pH range is critical and the considerations pertaining to it herein referred to have apparently not been recognized in the prior art.

The novel chrysotile dispersions used in this invention therefore are aqueous dispersions having a pH of from 3 to 6. They comprise up to about 5% by weight of chrysotile fibers, and the fibers are in the form of nonflocculated, discrete Crystallites from 20 to 40 millimicrons in diameter. The length of the fibers should be several times their diameter, and preferably as long as possible, provided adequate dispersion can be maintained. The dispersions also contain the dissolved dispersing agent as described above.

Having prepared a chrysotile dispersion as above described as a step in a process of this invention, there is then mixed therewith a dispersed positively charged hydrous oxide of a metal which in the oxide has a valence in the range of 3 to 4 and is incapable of a valence greater than 4. The hydrous oxide acts as a binder for the asbestos and surface-cements the individual fibers in the formed bodies produced therefrom.

The metal in the hydrous oxide has a valence of 3 or 4 but is incapable of a valence greater than 4. Thus the oxides of aluminum, zirconium, titanium, and ferric iron are included, because the metal has a valence of 3 or 4, but the oxides of chromium and bismuth, for instance, are excluded because these metals, in some of their compounds, exhibit a valence greater than 4. Hydrous oxides of other metals such as stannic tin may also be used.

The hydrous metal oxide should be in dispersed form. Colloidal sols are highly satisfactory. Various methods for making such colloidal sols are well known, and any of these methods may be used. Dispersions of particles larger than commonly included in the colloid range may also be used, provided the particles are not so large as to prohibit intimate mixing and association with the asbestos. Colloidal hydrous aluminum oxide sols are particularly preferred as the binding agent and such a sol may preferably be prepared according to recently developed processes which are described as follows:

The colloidal alumina, which is usually employed as a 3–10% aqueous sol, can be prepared as described in U. S. Patents 1,775,640, 2,085,129, J. Phys. Chem. 35, 29 (1931) or J. Phys. Coll. Chem. 51, 768–70 (1947). In a preferred process colloidal alumina hydrate is prepared from aluminum chloride by reaction with ammonium hydroxide, the precipitated alumina hydrate filtered and washed with water to remove excess ammonium chloride, the concentrate heated and then subjected to strong shearing forces. By this procedure all of the particles of alumina hydrate obtained are in the colloidal range.

It is also possible to form some or all of the binding agent by chemically converting a portion of the dispersing agent to the hydrous oxide form. The hydrous oxide is thus formed in situ in the asbestos dispersion. Aluminum acetate or formate or basic aluminum acetate may, for instance, thus be converted by hydrolysis, the acetic or formic acid being volatilized in the process. The hydrous oxide may also be formed in situ by adding to the asbestos dispersion a finely divided compound of the metal such as aluminum sulfide, which hydrolyzes completely to form the hydrous oxide and a volatile gas, in this case hydrogen sulfide, which is expelled from the dispersion.

The colloidal hydrous oxide particles should be positively charged, and this is characteristic of colloidal sols of the hydrous oxides mentioned above as being suitable. The hydrous oxide binder should be thoroughly mixed with the asbestos dispersion and it will be found that ordinary means of agitation will suffice for this purpose. A high speed propeller-type agitator is well suited to the purpose.

The hydrous oxide and the asbestos may be dispersed simultaneously by adding them as a mixture to a violently agitated solution of the dispersing agent or preferably by slurrying the asbestos in water and adding a mixture of the dispersing agent and the hydrous oxide.

Having mixed a dispersed hydrous oxide with the chrysotile dispersion, one may then form an asbestos body of this invention by drying down the mixture. The manner of drying will vary widely depending upon the nature of the formed body. Thus, when it is desired to form a sheet the dispersion may be cast upon a suitable surface and the water may be evaporated as by heating. The water may also be removed by filtration. The art is already familiar with methods for forming bodies from asbestos suspensions and these methods are applicable to the novel mixtures of dispersed chrysotile and dispersed hydrous oxide binders of the present case.

The formed bodies of the present invention may be sheets, castings, molded products, wrapping tape, or other similar shapes. They comprise Crystallite chrysotile asbestos fibers from 20 to 40 millimicrons in diameter, in intimate, substantially homogeneous admixture and surface-cemented with positively charged hydrous oxides of metals in which the oxide has a valence in the range of 3 to 4 and is incapable of a valence greater than 4. They have high tensile strength, usually from 1000 to over 5000 lbs. per sq. in., and after being heated to elevated temperatures, that is, upwards of 100° C., they develop excellent wet strength and water resistance.

As little as one part by weight of the binding agent may be present for each 25 parts by weight of asbestos, but larger amounts of binding agent can often be used to advantage. It is generally preferred to use from about one part by weight of the hydrous aluminum oxide for each 25 parts of asbestos to equal parts of each. In each instance the precise physical properties desired in the formed body is the determining factor. Other neutral or positively charged binding agents and fillers which will not cause flocculation of the dispersions may be used in conjunction with the hydrous metal oxides and the properties of the formed bodies may be varied accordingly.

The formed asbestos bodies of this invention, such as ash trays, insulators, and the like, are particularly useful by reason of the fact that they may be made completely out of inorganic materials and nevertheless possess high dry or wet tensile strength and reasonable tear strength. They may thus be subjected to elevated temperatures which would decompose products containing an organic binder. The sheets have a surprising degree of flexibility and may be translucent or may be pigmented to be completely opaque. From the sheets may be fabricated such articles as permanent records and fire-resistant coatings.

The nature of this invention and its manner of application will be better understood by reference to the following illustrative examples.

Example I

Crude chrysotile asbestos from Quebec, Canada, was hand cobbed, freed from adhering rock impurities, and put through a Wiley chopping mill to reduce the average fiber length to about ¼ inch. A suspension of three grams of the fiber in 297 grams of water was mixed in the Waring Blendor at full speed (approximately 12,000 R. P. M.) for three minutes to disorient the fiber bundles. Two-tenths of a milligram mol of aluminum acetate per gram of asbestos were added to the suspension while mixing was continued in the Waring Blendor for another three minutes. To the resulting thin, translucent dispersion was added 56.2 grams of a dispersed colloidal hydrous alumina sol containing 3 grams of Al_2O_3. (The dispersed colloidal aluminum hydroxide was prepared by mixing approximately stoichiometrical quantities of aluminum chloride and ammonium hydroxide to precipitate aluminum hydroxide at pH=8, filtering and washing until 95% of the chloride ions had been removed, resuspending the filter cake in water by agitation, heating to 95° C. for thirty minutes and colloid milling.) The mixing was continued for two minutes in the Waring Blendor. Air bubbles were removed from the thin, translucent dispersion by placing it under reduced pressure. The dispersion was then cast in a stainless steel pan and allowed to dry in a stream of air at room temperature. A strong, but relatively stiff, white, opaque film with a smooth finish resulted. It contained approximately equal parts by weight of asbestos and Al_2O_3. The tensile strength measured on the Scott horizontal tensile tester was found to be 4000 pounds per square inch.

Example II

A suspension of three grams of disoriented chrysotile asbestos in 297 grams of water was prepared in the Waring Blendor as in Example 1. Dispersed colloidal hydrous alumina sol prepared as in Example 1, 18.7 gm. containing one gram of Al_2O_3 and 0.1 gram of added aluminum acetate dispersing agent, was added to the asbestos suspension which was mixed for three minutes more in the Waring Blendor. The preparation of a sheet of this dispersion was carried out as described in Example 1. A strong, flexible, smooth white sheet resulted, with a tensile strength of 5400 pounds per square inch as measured on the Scott inclined plane tensile tester. The stiffness was 4.5 measured on the Taber stiffness tester, and the tear strength was 30 gm. per cm. as measured on the Junior Elmendorf tear tester. A portion of this film was heated for 1 hour at 350° C. The tensile strength of the dry heated film was then 5000 pounds per square inch, the stiffness was 14.3, and the tear strength was 29 gm. per cm. The heated film was soaked in water at room temperature for one week, after which the tensile strength of the wet film was 2100 pounds per square inch.

Example III

Chrysotile asbestos No. 2 grade, 3 grams, was suspended in 297 grams of water and mixed for 3 minutes in the Waring Blendor to disorient the fibers. Dispersed colloidal hydrous alumina sol prepared as in Example 1, 9.4 grams, containing 0.5 gram Al_2O_3, 0.072 gram of added aluminum acetate dispersing agent and 0.004 gram of added barium acetate, was added to the disoriented asbestos suspension while mixing was continued in the Waring Blendor for 3 minutes. The dispersion was cast into a film as in Examples 1 and 2. The dried, strong, flexible, smooth white sheet containing about six parts by weight of asbestos for each part of Al_2O_3 had a tensile strength of 3000 pounds per square inch, a stiffness of 1.7 and a tear strength of 52 gm. per cm. A portion of the sheet was heated at 350° C. for one hour. It then had a tensile strength of 2800 pounds per square inch, a stiffness of 5.1, and a tear strength of 21 gm. per cm. A portion of the heated sheet was soaked in water for 16 hours, and then had a wet strength of 1700 pounds per square inch. All measurements were carried out as in Example 2.

Example IV

Chrysotile asbestos No. 2 grade, 3 grams, was suspended in 297 grams of water and the suspension mixed in the Waring Blendor for 3 minutes to disorient the fibers. Dispersed colloidal hydrous alumina sol prepared as in Example 1, 3.75 grams, containing 0.2 gram Al_2O_3, and 0.155 gram of added aluminum acetate dispersing agent, was added to the disoriented asbestos suspension and mixing was continued in the Waring Blendor for 3 minutes. A film containing about 15 parts by weight of asbestos for each part of Al_2O_3 was cast as in the above examples. Dry tensile strength was 1900 pounds per square inch, stiffness 3.9, and tear strength 32 grams per centimeter. A portion of the sheet was heated for one hour at 350° C. The tensile strength was then 2200 pounds per square inch, stiffness was 4.4, and tear strength was 35 grams per centimeter. After the heated film was soaked in water for 16 hours its wet strength was 500 pounds per square inch. All measurements were carried out as in Example 2.

Example V

Crude chrysotile asbestos was hand cobbed, picked free of adhering rock fragments, and put through the Wiley chopping mill to reduce the fibers to an average length of ¼ inch. Three grams of the asbestos fiber in 297 grams of water was mixed in the Waring Blendor for three minutes to disorient the fiber bundles. A one molar solution of ferric chloride, 0.6 cc., containing 0.097 gram of $FeCl_3$, was added to the disoriented asbestos suspension and mixing was continued in the Waring Blendor for three minutes to disperse the asbestos. Dispersed colloidal hydrous ferric oxide (prepared from ferric chloride and ammonium hydroxide in a manner similar to that described for the preparation of colloidal aluminum hydroxide in Example 1), 150 cc. containing 1.6 grams of Fe_2O_3, was added to the dispersed asbestos and mixing continued for five minutes in the Waring Blendor. An excellent thin dispersion resulted which was cast to a film and dried as in the previous examples. The strong, smooth, brown film had a tensile strength of 2065 pounds per square inch. A sample of the film heated to 350° C. for one hour had a tensile strength of 3000 pounds per square inch and exhibited good wet strength and water resistance. All measurements were carried out as in Example 2.

Example VI

Crude chrysotile asbestos was chopped and disoriented in the Waring Blendor, as described in Example 5. To a suspension of 3 grams of the

disoriented fiber in 297 grams of water, was added 0.6 cc. of 1 normal aluminum acetate solution and mixing was continued for three minutes to disperse the fibers. A dispersion of colloidal hydrous zirconium oxide, (prepared from zirconyl chloride and ammonium hydroxide in a manner similar to that used in the preparation of the hydrous oxides in the previous examples.) 160 cc., containing 2.5 grams of ZrO_2 and 0.21 gram of $ZrOCl_2$ was slowly added to the dispersed asbestos in the Waring Blendor, and the mixing was continued for five minutes. The resulting dispersion was cast to a film and dried as described in the previous examples. A smooth, white film resulted with tensile strength of 1930 pounds per square inch. After being heated at 350° C. for one hour, the film had a tensile strength of 2700 pounds per square inch and exhibited good wet strength and water resistance. All measurements were made as in Example 2.

Example VII

Crude chrysotile asbestos was chopped and disoriented in the Waring Blendor, as described in Example 5. To a suspension of three grams of the disoriented fiber in 225 grams of water was added 1.2 cc. of 0.5 molar aluminum acetate solution and mixing in the Waring Blendor was continued for five minutes to disperse the fibers. A dispersion of colloidal hydrous stannic oxide (prepared from stannic chloride and ammonium hydroxide in a manner similar to that used in the preparation of the hydrous oxides of the previous examples) 75 cc., containing 1.5 grams of SnO_2, was added to the dispersed asbestos while mixing was continued for five minutes. Since some thickening resulted during the mixing an additional portion of 1.5 cc. of 0.5 molar aluminum acetate was added and the mixing was continued in the Waring Blendor for three minutes to improve the dispersion. The dispersion was cast into a film and dried, as described in the previous examples. A white, fairly soft film resulted, with a tensile strength of 1500 pounds per square inch. After being heated to 350° C. for one hour, the film had a tensile strength of 1700 pounds per square inch, and the wet strength and water resistance were greatly improved. All measurements were made as in Example 2.

Example VIII

Crude chrysotile asbestos was chopped and disoriented in the Waring Blendor, as described in Example 5. To a suspension of three grams of disoriented asbestos in 200 grams of water was added 1.2 cc. of 0.5 molar aluminum acetate solution and mixing was continued in the Waring Blendor for five minutes to disperse the fibers. Colloidal hydrous titanium oxide dispersion, 117 grams (prepared from titanyl chloride and ammonium hydroxide in a manner similar to that used for the preparation of the hydrous oxides in the previous examples) containing 1.5 grams of TiO_2 was slowly added to the dispersed asbestos and mixing was continued for three minutes in the Waring Blendor. Since some thickening of the dispersion occured, an additional 0.6 cc. of 0.5 molar aluminum acetate solution was added and the mixing continued two minutes more to improve the dispersion. The dispersion was cast as a film and dried as described in the previous examples. The tensile strength of the film was 1130 pounds per square inch, measured as in Example 2.

Example IX

Crude chrysotile asbestos was chopped and disoriented in the Waring Blendor as described in Example 5. To a suspension of six grams of disoriented asbestos in 294 grams of water was added a colloidal hydrous alumina dispersion (prepared as in Example 1), 28.2 grams containing 1.5 grams Al_2O_3 and 0.122 gram of added aluminum acetate dispersing agent, while mixing was continued in the Waring Blendor for five minutes to disperse the fibers. The dispersion was poured into a concave mold made of plaster of Paris coated with a thin film of silicone grease. The mixture was allowed to set for one hour. The excess dispersion was then poured off leaving a thick gelatinous coating in the mold. The coating assumed the shape of the mold accurately but some shrinking occurred during the last stages of the drying. The dried formed body was easily removed from the mold and retained the desired shape.

I claim:

1. In a process for producing formed asbestos bodies the steps comprising disorienting oriented chrysotile asbestos by mechanical action at a pH of 3 to 6 in an aqueous solution containing as a dispersing agent a dissolved metal salt having a monovalent anion and a cation containing a polyvalent metal, the amount of dispersing agent being enough to give from 0.1 milligram moles of the salt to 3 milligram moles of dissociated anion per gram of asbestos, whereby the asbestos is obtained in the form of an aqueous dispersion of discrete, Crystallite fibers from 20 to 40 millimicrons in diameter, mixing therewith a dispersed, positively charged hydrous oxide of a metal selected from the group consisting of aluminum, zirconium, ferric iron, titanium, and stannic tin, and drying the dispersion as a formed body.

2. In a process for producing formed asbestos bodies the steps comprising disorienting oriented chrysotile asbestos by mechanical action at a pH of 3 to 6 in an aqueous solution containing as a dispersing agent a dissolved metal salt having a monovalent anion and a cation containing a polyvalent metal, the amount of dispersing agent being enough to give from 0.1 milligram moles of the salt to 3 milligram moles of dissociated anion per gram of asbestos, whereby the asbestos is obtained in the form of an aqueous dispersion of discrete, Crystallite fibers from 20 to 40 millimicrons in diameter, mixing therewith a dispersed, positively charged hydrous oxide of aluminum, and drying the dispersion as a formed body.

3. In a process for producing formed asbestos bodies the steps comprising disorienting oriented chrysotile asbestos by mechanical action at a pH of 3 to 6 in an aqueous solution containing as a dispersing agent a dissolved metal salt having a monovalent anion and a cation containing a polyvalent metal, the amount of dispersing agent being enough to give from 0.1 milligram moles of the salt to 3 milligram moles of dissociated anion per gram of asbestos, whereby the asbestos is obtained in the form of an aqueous dispersion of discrete, Crystallite fibers from 20 to 40 millimicrons in diameter, mixing therewith a dispersed positively charged hydrous oxide of zirconium, and drying the dispersion as a formed body.

4. In a process for producing formed asbestos bodies the steps comprising disorienting oriented chrysotile asbestos by mechanical action at a pH

of 3 to 6 in an aqueous solution containing as a dispersing agent a dissolved metal salt having a monovalent anion and a cation containing a polyvalent metal, the amount of dispersing agent being enough to give from 0.1 milligram moles of the salt to 3 milligram moles of dissociated anion per gram of asbestos, whereby the asbestos is obtained in the form of an aqueous dispersion of discrete, Crystallite fibers from 20 to 40 millimicrons in diameter, mixing therewith a dispersed positively charged hydrous oxide of ferric iron, and drying the dispersion as a formed body.

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