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METHOD FOR DISPERSING ASBESTOS FIBERS

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ABSTRACT OF THE DISCLOSURE

A method for dispersing asbestos fibers employing low concentrations of selected acrylic or methacrylic acid polymers is described; said method providing dispersions being particularly characterized by their excellent homogeneity.

RELATED APPLICATIONS

This application is a continuation of our copending application Ser. No. 874,071, filed Nov. 4, 1969, and assigned to the assignee of the instant application and now abandoned.

BRIEF SUMMARY OF THE INVENTION

This invention relates to a method for dispersing asbestos fibers. More particularly, the invention provides a means for opening up bundles or aggregates of asbestos fibers so as to produce a homogeneous and highly dispersed slurry of fiber elements. In a further aspect, the invention relates to a homogeneous dispersion of asbestos fibers prepared in accordance with the method of this invention.

BACKGROUND OF THE INVENTION

Asbestos, such as chrysotile asbestos, is generally found in mineral deposits and recovered therefrom by mechanical crushing and screen classification procedures in the form of tightly packed bundles of longitudinally aligned fibers. The fiber bundles are comprised of a multitude of smaller, longitudinally aligned elements termed fibrils, the smallest of which have a diameter of about 200 angstroms. Clusters of closely bound fibers termed pencils are often found in these fiber bundles and are the main cause of poorly processed asbestos having a coarse hand or feel. Thus, in the initial processing of crude asbestos it is desired to open up or disperse these asbestos fibers and pencils so as to release the constituent fibrils, preferably without substantially reducing their length.

The dispersing of asbestos fibers has been proposed by a number of known methods which include, for example, the use of surfactants, the use of dimethylsulfoxide, and the use of monocarboxylic acids. Thus, U.S. Pat. No. 2,626,213 discloses a method for dispersing asbestos fibers wherein the fibers are treated with a selected surfactant such, for example, as Aerosol OT, a dioctyl ester of sodium sulfosuccinate. U.S. Pat. No. 3,410,751 discloses a method wherein asbestos fibers are slurried in dimethylsulfoxide which is subsequently removed by washing, while U.S. Pat. No. 3,409,499 discloses a method which makes use of a carboxylic acid and high speed shearing forces.

All of the prior art techniques, however, serve only with accompanying disadvantages or weaknesses. The surfactant method leads to the undesirable formation of large quantities of foam. In addition, residual surfactant renders the process completely undesirable where in certain applications the presence of even minute amounts of surfactant cannot be tolerated. The method of U.S. Pat. No. 3,410,751 suffers essentially from the inherent dangers

attendant in using large quantities of a strong solvent whose properties and physiological effects on man are not completely known. Moreover, the dimethylsulfoxide method requires an additional step of washing the solvent from the asbestos subsequent to the opening of the fibers and prior to the use of the dispersion in the manufacture of a selected product. The high shearing action which is required in addition to the monocarboxylic acid in the method of U.S. Pat. No. 3,409,499 produces dispersions containing fibrils whose length are undesirably shortened.

It is accordingly, the principal object of this invention to provide a method for dispersing asbestos with the use of a selected polymeric dispersing agent.

It is another object of this invention to provide homogeneous, aqueous dispersions of asbestos by means of a small but effective concentration of a dispersing agent.

It is still another object of this invention to provide a method for dispersing asbestos wherein the dispersing operation itself does not substantially shorten the length of the constituent fibers.

Other objects of the present invention will be made apparent from the disclosure which follows.

TECHNICAL DISCLOSURE OF THE INVENTION

In accordance with our invention, asbestos fibers are dispersed or opened in an aqueous slurry containing a specified concentration of a selected acrylic or methacrylic acid polymer. The asbestos to be treated, i.e. dispersed, can be either unopened in its original form as obtained from mineral deposits, or it can be partially opened by any of the conventional mechanical or other means used for this purpose. The asbestos, can, of course, be opened prior to its being added to the water or after the slurry has been formed.

It is contemplated that this method is feasible in dispersing all fibrous forms of asbestos. Examples of asbestos suitable for use in the process of this invention include the fibrous forms of the serpentine and amphibole asbestos classes. The fibrous form of serpentine asbestos is chrysotile and the fibrous forms of amphibole asbestos are amosite, crocidolite, anthophyllite, and tremolite.

The acrylic or methacrylic acid polymers which are utilized as the dispersants or dispersing agents in the process of this invention can be homo- or random copolymers of acrylic or methacrylic acids as well as any mixtures thereof. Useful copolymers include random copolymers of acrylic acid or methacrylic acid with at least one monomer selected from the group consisting of styrene, alpha-methyl styrene and chlorostyrene; and the linear and branched C_1–C_8 alkyl and hydroxyalkyl esters of ethylenically unsaturated monocarboxylic acids such as ethyl acrylate, hydroxypropyl acrylate and hydroxyethyl methacrylate. The acrylic or methacrylic acid content in these copolymers should be no lower than about 20%, by weight, and preferably, should be within about 50 to 70%. The intrinsic viscosity of these polymers measured at 1% resin solids in acetone at 30° C. should be from about 0.1 to 2.3.

All of the above-described homo- or random copolymers of acrylic and methacrylic acids used in the process herein may be prepared by means of free radical initiated polymerization procedures or by other polymerization procedures well known to those skilled in the art. However, they are most conveniently prepared by means of free radical initiated solution polymerization techniques. Alternatively, they may be prepared as 100% resin solids material and subsequently dissolved in water or organic solvents prior to their use. Thus, it can be seen that the polymers can be used either in aqueous solution or emulsion form, or in organic solution form.

In actual practice of dispersing asbestos fibers, an asbestos-water slurry is prepared containing up to about

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10%, by weight, of asbestos. The selected polymer can be added to the water prior to the addition of the asbestos or, if desired, at any time thereafter providing, however, sufficient time is permitted for stirring in order to insure contact, i.e. commingling of the polymer with the asbestos. Preferably, the concentration of the polymer in the slurry should be from about 0.05 to 5%, based on the weight of the asbestos. Use of a lower concentration of the polymer will result in unsatisfactory dispersion. In general, increasing the concentration of the polymer to above 5% is not precluded although it normally gives little added benefit. Moderate agitation during the dispersing step to insure a homogeneous slurry is required for a period of at least one minute, but severe mechanical agitation or shear action is unnecesary. Foaming is not a problem, generally. Normal production runs, wherein the asbestos dispersions are subsequently processed to produce asbestos-containing end use products, are usually carried out at temperatures from 90 to 110° F., but temperatures as low as about 40° F. and as high as about 250° F., which are often employed in the production of molded asbestos products, can also be used, if desired, for the dispersing operation.

Additives such as binders, dyes, colorants, anti-oxidants, etc. can be added to the asbestos slurry in a concentration up to about 35%, based on the weight of the asbestos. These additives can be added to the slurry at any time prior to the formation of a finished product but generally, however, such additives are admixed with the dispersion subsequent to the addition of the polymeric dispersant. Conventional fillers or loading agents such as cellulose, glass and synthetic fibers, etc. can also be admixed with the slurry in a concentration up to about 50%, based on the weight of the asbestos.

After the addition of the selected dispersant, together with any optional additives and fillers that are desired, the homogeneous asbestos dispersion thus obtained is ready for use in the production of an asbestos-containing end use product. Some of the typical end use applications for the asbestos fibers dispersed in accordance with this invention include the production of asbestos paper and board, flooring tiles, and molded brake linings.

The embodiment of this invention is further illustrated by the following examples in which all parts given are by weight unless otherwise noted.

EXAMPLE I

This example illustrates the typical preparation of an asbestos dispersion in accordance with the process of this invention.

A total of 120 parts of chrysotile asbestos (Canadian grade 7) was admixed with 6000 parts of soft water and the slurry was hydropulped, i.e. subjected to a high speed mixing operation which produces an even suspension of the asbestos in the water and further serves to partially open the fiber for a period of 15 minutes employing a Williams Standard Pulp Testing Apparatus (Williams Apparatus Company, Watertown, N.Y.). One-thousand parts of the hydropulped slurry was placed in a mixing kettle equipped with means for agitation and was stirred mechanically using a paddle blade at a speed of about 280–350 r.p.m. A total of 0.1 part (0.5%, based on the weight of the asbestos) of a dispersant comprising an acrylic acid:hydroxypropyl acrylate (62.5:37.5) copolymer in the form of an aqueous solution was admixed with the slurry and stirring was continued for a period of about 4 minutes. The thus prepared dispersion presented a homogeneous appearance and was ready for use as, for example, in the preparation of asbestos paper or board.

A control prepared using the identical asbestos in the manner described hereinabove displayed a poor dispersing of the asbestos fiber which was evident even upon a cursory inspection of the dispersion.

In a repetition of the above procedure, three additional dispersions were prepared using the identical chrysotile asbestos used hereinabove, but the dispersant was varied in each instance. Thus, dispersions were prepared using each of the following dispersants of this invention:

(1) Acrylic acid:styrene (50:50) copolymer.

(2) Methacrylic acid:methyl methacrylate:ethyl acrylate (50:25:25) terpolymer.

(3) Methacrylic acid:methyl methacrylate:hydroxyethyl methacrylate (20:50:30) terpolymer.

All of the resulting dispersions were visibly homogeneous and comparable to the dispersion described hereinabove.

EXAMPLE II

This example illustrates the preparation of a number of asbestos dispersions typical of this invention, whose degree of dispersion was measured in terms of the amount of time required to drain the water therefrom utilizing a wire screen.

A total of 120 parts of chrysotile asbestos (Canadian grade 6D) was admixed with 6000 parts of soft water and the slurry was hydropulped for a period of 15 minutes employing a Williams Standard Pulp Testing Apparatus in order to partially open the asbestos fiber. The hydropulped slurry was then subjected to a beating operation, i.e. an operation whereby the asbestos fibers are slightly opened and cut, utilizing a Valley Beater (Valley Iron Works Company, Appleton, Wis.) which was run with a 1-kilogram weight for an initial period of 5 minutes and thereafter run with a 5-kilogram weight for an additional 10-minute period.

A portion of the hydropulped and beaten slurry (1000 parts) was then placed in a mixing kettle equipped with means for agitation and was stirred mechanically using a paddle blade at a speed of about 280 to 350 r.p.m. A total of 0.02 part (0.1%, based on the weight of the asbestos) of an acrylic acid:hydroxypropyl acrylate (62.5:37.5) copolymer in the form of an aqueous solution was admixed with the slurry and stirring was continued. After a period of about 1 minute, a polymeric binder comprising a butyl acrylate:vinyl chloride:acrylic acid (50:50:3) terpolymer was added to the slurry in a concentration of about 20%, based on the weight of the asbestos, in order to approximately duplicate conditions often used in commercial applications employing asbestos dispersions.

Stirring was continued for an additional 5-minute period after which time the dispersion was drained through a screen having a mesh equal to a No. 60 U.S. Standard Sieve as utilized in a Noble & Wood Sheet Mold Apparaturs, manufactured by The Noble & Wood Machine Company, Hoosick Falls, N.Y., containing 5840 parts of soft water at a temperature of 68° F. The period of time which was required for the slurry to drain through the screen was recorded in seconds. Needless to say, a relatively short period of draining is indicative of poor asbestos dispersion whereas a relatively longer period is indicative of a well dispersed system.

In a repetition of the above procedure additional dispersions containing other concentrations of the dispersant and other dispersants of this invention, as well as a control, as outlined in Table I hereinbelow, were prepared and tested with results obtained being summarized therein.

TABLE I

Concentration of dispersant	Time needed to drain (seconds)			
	A	B	C	D
0 (control)	3.9	3.9	3.9	3.6
0.1%	12.0	7.0	4.7	4.5
0.2%	74.0	67.0	11.0	12.0
0.3%	138.0	113.0	27.0	39.0

NOTE.—A=Acrylic acid:hydroxypropyl acrylate (62.5:37.5) copolymer; B=Polyacrylic acid; C=Acrylic acid:methyl methacrylate (40:60) copolymer; D=Acrylic acid:ethyl acrylate:methyl methacrylate (50:25:25) terpolymer.

Thus, it may be seen from the above results, that the addition of even small concentrations of the polymeric dispersant of this invention provide, in all cases, significantly improved asbestos dispersions as compared to the

control dispersion which was prepared in comparable manner but devoid of any dispersant.

EXAMPLE III

This example illustrates the preparation of additional asbestos dispersions typical of this invention and further compares the dispersing properties of the dispersants of this invention with a variety of conventional dispersants.

A total of 16 grams of chrysotile asbestos (Canadian grade 5) was admixed with 800 milliliters of soft water and the slurry was stirred at high speed (about 10,000 r.p.m.) in a Waring Blendor for a period of seven seconds. The resultant slurry was transferred to a large beaker and a dispersant as identified in Table II, hereinbelow, at the indicated concentration, was added thereto. The slurry was stirred mechanically for a period of 2 minutes using a paddle blade at a speed of about 280–350 r.p.m. after which time a polymeric binder comprising a butyl acrylate:vinyl chloride:acrylic acid (50:50:3) terpolymer was added in a concentration of about 15%, based on the weight of the asbestos. Stirring was continued for an additional 5-minute period, whereupon the dispersion was drained through a screen utilized in the Noble & Wood Sheet Mold Apparatus as described in Example II in order to measure the degree of asbestos dispersion.

In a repetition of the above procedure, additional dispersions containing other concentrations of the same dispersant, dispersions containing various concentrations of conventional dispersants, as well as control, as outlined in Table II hereinbelow, were prepared in similar manner and tested with results obtained being summarized therein.

TABLE II

Concentration of dispersant	Time needed to drain (seconds)			
	A	B	C	D
0 (control)	72	72	72	72
0.05%	85	72	76	73
0.10%	119	72	76	75
0.30%	186	72	76	77
0.05%	416	80	78	76

NOTE.—A=Acrylic acid:hydroxypropyl acrylate (62.5:37.5) copolymer; B=Tamol—a sodium salt of condensed naphthalene sulfonic acid; C=Daxad—polymerized potassium salts of alkyl naphthalene sulfonic acids; D=Darvan—sodium naphthalene sulfonic acid formaldehyde condensate.

The results summarized in Table II clearly show the vastly superior dispersions achieved with the acrylic acid: hydroxypropyl acrylate dispersant of this invention as contrasted to dispersions achieved in using three known dispersants. Thus, the novel dispersant of this invention provided superior dispersions at all concentrations tested, and at a concentration of 0.5% provided a dispersion which showed more than a five-fold difference in the time required to drain the water therefrom as compared to dispersions prepared using conventional dispersants. Accordingly, it is to be noted that although the use of various polymerized sulfonic acids in dispersing asbestos is known, the use of the described acrylic and methacrylic acid polymers surprisingly provides significantly superior dispersions as has been quantitatively shown hereinabove.

EXAMPLE IV

The example illustrates the preparation of additional dispersions in accordance with our invention.

A total of 120 parts each of chrysotile asbestos (Canadian grade 7) and amosite asbestos (crude grade W–3, mined in Weltevredin, South Africa) were respectively admixed with separate portions of 6000 parts of soft water and the slurries were each hydropulped for a period of fifteen minutes employing a Williams Standard Pulp Testing Apparatus. One thousand-part portions of each of these slurries were treated with various concentrations of an acrylic acid:hydroxypropyl acrylate (62.5:37.5) copolymer, as indicated in Table III, hereinbelow. Each of the resulting dispersions was stirred mechanically for a period of 1 minute using a paddle blade at a speed of about 280 to 350 r.p.m. following the admixture of the dispersant. Each of the dispersions was thereupon drained through a screen utilized in the Noble & Wood Sheet Mold Apparatus as described in Example II in order to measure the degree of asbestos dispersion. A control containing no dispersant was run in each instance. Table III summarizes the results observed.

TABLE III

Concentration of dispersant	Time needed to drain (seconds)	
	Chrysotile asbestos	Amosite asbestos
0 (control)	77	18.4
0.5	342	26.6
1.0	656	37.7
3.0	1,000+	62.8

Summarizing, it is seen that this invention provides a means of producing excellent dispersions of asbestos using a minimum of mechanical action.

Variations may be made in materials, proportions and procedures without departing from the scope of this invention.

What is claimed is:

1. An aqueous dispersion comprising finely divided chrysotile asbestos fibers and at least one dispersant for said chrysotile asbestos fibers selected from the group consisting of (1) acrylic acid homopolymer and random copolymers of at least 20%, by weight, acrylic acid copolymerized with at least one monomer selected from the group consisting of styrene, alpha-metal styrene and chlorostyrene; and the linear and branched C_1–C_8 alkyl and hydroxyalkyl esters of ethylenically unsaturated monocarboxylic acids, and (2) methacrylic acid homopolymer and random copolymers of at least 20%, by weight, of methacrylic acid copolymerized with at least one monomer selected from the group consisting of styrene, alphamethyl styrene and chlorostyrene; and the linear and branched C_1–C_8 alkyl and hydroxyalkyl esters of ethylenically unsaturated monocarboxylic acids.

2. An aqueous dispersion comprising up to about 10%, by weight, of finely divided chrysotile asbestos fibers and a dispersant for said chrysotile asbestos fibers comprising an acrylic acid:hydroxypropyl acrylate random copolymer; said copolymer containing not less than about 20%, by weight, of acrylic acid and being present in a concentration of from about 0.05 to 5%, based on the weight of the asbestos.

3. A method for the preparation of a homogeneous aqueous dispersion of chrysotile asbestos fibers which comprises:

(1) commingling an aqueous slurry of chrysotile asbestos with from about 0.05 to 5%, based on the weight of the asbestos, of at least one dispersant selected from the group consisting of (1) acrylic acid homopolymer and random copolymers of at least 20%, by weight, acrylic acid copolymerized with at least one monomer selected from the group consisting of styrene, alpha-methyl styrene and chlorostyrene; and the linear and branched C_1–C_8 alkyl and hydroxyalkyl esters of ethylenically unsaturated monocarboxylic acids, and (2) methacrylic acid homopolymer and random copolymers of at least 20%, by weight, methacrylic acid copolymerized with at least one monomer selected from the group consisting of styrene, alpha-methyl styrene and chlorostyrene; and the linear and branched C_1–C_8 alkyl and hydroxyalkyl esters of ethylenically unsaturated monocarboxylic acids; and (2) applying moderate agitation to said slurry.

4. A method for the preparation of a homogeneous aqueous dispersion of chrysotile asbestos which comprises:

(1) commingling an aqueous slurry of chrysotile asbestos with from about 0.05 to 5%, based on the

weight of the asbestos, of a dispersant comprising an acrylic acid:hydroxypropyl acrylate random copolymer, said copolymer containing not less than about 20%, by weight, of acrylic acid; and

(2) applying moderate agitation to said slurry.

5. In the method of preparing a homogeneous, aqueous dispersion of chrysotile asbestos fibers by treatment of said chrysotile asbestos fibers with a diperant, the step which comprises admixing the aqueous dispersion with from about 0.05 to 5%, based on the weight of the asbestos, of at least one disperant selected from the group consisting of: (1) acrylic acid homopolymer and random copolymers of at least 20%, by weight, acrylic acid copolymerized with at least one monomer selected from the group consisting of styrene, alpha-methyl styrene and chlorostyrene; and the linear and branched C_1–C_8 alkyl and hydroxyalkyl esters of ethylenically unsaturated monocarboxylic acids; and (2) methacrylic acid homopolymer and random copolymers of at least 20%, by weight, methacrylic acid copolymerized with at least one

monomer selected from the group consisting of styrene, alpha-methyl styrene and chlorostyrene; and the linear and branched C_1–C_8 alkyl and hydroxyalkyl esters of ethylenically unsaturated monocarboxylic acids.

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MELVIN GOLDSTEIN, Primary Examiner

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