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METHOD OF DISPERSING ASBESTOS AND RESULTING PRODUCT

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This invention relates to a method of dispersing asbestos in a watery vehicle and to the product thereof; and it comprises the treatment of an aqueous suspension of asbestos with an agent productive of strongly adsorbable cations, all as hereinafter more fully described and claimed.

An object of the invention is to provide an aqueous magma of asbestos in which the disseminated asbestos displays less tendency to settle in the aqueous vehicle than has hitherto been possible of attainment. This is of advantage in many processes which involve the wet treatment of asbestos. Asbestos paper or panel board prepared from the magma of the present invention displays greater strength, flexibility, and uniformity of texture than has hitherto been attainable in otherwise like products. Another object of the invention is to provide means whereby the beating of asbestos, which has hitherto been a necessary concomitant of asbestos paper manufacture, may be materially lessened or even eliminated. Still another object of the invention is to provide an aqueous asbestos magma in which greater surface per unit weight of asbestos is exposed and available for reactivity or consociation with, or for the deposition of, aqueously dispersed fillers, pigmenting or binding agents than has been feasible or possible by prior methods. Other objects and advantages of the invention will become apparent with its more detailed description.

The paper maker's art furnishes a well developed technique for the preparation of a magma of asbestos and water such as is adapted to the formation of a sheet by passing such magma or slurry over a Fourdrinier machine, or a series of suction rolls (wet machine). It is the object of such preparatory processes to disseminate the asbestos in the water as uniformly as possible by breaking up existing bundles of fibrous crystals and also to fray the ends of the persisting bundles so that there may be a maximum of cohesive surface available to hold the material together in the resultant sheet. This is accomplished by subjecting the asbestos to the macerating and fraying action of a beater or Jordan engine.

In the manufacture of paper or sheet material from asbestos it has been found in practice that when dry disseminated asbestos is added to water, clumps, flocks, or masses of fibrous crystals tend to form by flocculation and that only to a limited extent can these be deflocculated and distributed as individuals. These flocks tend to remain as knotted or entwined masses; and such a slurry when allowed to stand is observed to separate rapidly into a heavy asbestos sediment and a clear supernatant liquid. Paper resulting from such material is of coarse texture and is lacking in strength and flexibility.

A microscopic study of asbestos shows that what is sometimes spoken of as a "fiber" is in reality a bundle or aggregate of a great number of individual fibrous crystals. These bundles of crystals may be longitudinally divided and sub-divided almost without limit. If the bundles or aggregates be long, and the sub-division extensive, the product is called "spinning fiber" and is employed in the production of woven asbestos articles: when too short for spinning, it serves as a stock for making paper, asbestos board, panel board, and the like.

When such asbestos aggregates are subjected to the action of a beater engine, they are not only more or less divided and sub-divided longitudinally into fibrous crystals of the length of the original bundle, but they are cut or broken into smaller fragments. In so doing, the ends of the crystal aggregates shatter or fray, forming a great number of very minute tentacles or hairlike protuberances. These very small filaments, as well as the slender fibrous crystal fragments themselves, act, when suspended in water, as though there existed between them a mutually attractive force. They show little inclination to float off by themselves while the filament-like protuberances coalesce and close up on the larger crystalline aggregates like the bristles of a wet shaving brush in the air. The result of this tendency is that if the action of the beater engine be continued long enough to distintegrate the bundles of fibrous crystals sufficiently to pass over a paper machine with the production of an even finely textured sheet, the length of the fibrous crystals is unduly sacrificed.

I have discovered that these disadvantages may be overcome, and other benefits accrue, if there be added to the water in which suitably opened up asbestos is suspended a small amount of an agent which provides selectively adsorbable cations, such for example as aluminum chloride or thorium nitrate. The action on the asbestos is almost instantaneous and a visible increase in the dispersive dissemination thereof in the water is clearly seen. In a conventional "freeness" tester it will be found, everything else being equal, that the dispersing effect of this invention is measurable in the usual terms. Thus the addition to a 5% asbestos water slurry, having a freeness of about 250 seconds, of sufficient aluminum chloride solution to provide a quantity of aluminium chloride ($AlCl_3 6H_2O$) equal to .15% of the weight of asbestos present will so increase the dispersion as to produce a freeness of about 500 seconds; and a similar addition of a quantity of aluminum chloride in solution equal to .3% of the weight of asbestos present will yield a freeness of about 600 seconds while an addition of .8% will give a value of about 800 seconds when measured immediately after admixture of the dispersing agent. There is usually a still further numerical increase when a slurry containing a dispersing agent is allowed to stand.

Not only are the masses or clusters of fibrous crystals more easily disintegrated and distributed at random in the water, but the very small tendrils or tentacles which are attached to the fibrous crystals are distended and held apart as though under some mutually repulsive force. The sub-division of the original bundles by the action of the beater engine is also rendered less difficult as the fibrous crystals when once separated show little tendency to again become entangled or reintegrate themselves.

It is obvious that when sheets or boards or felted structures of whatever shape be formed from a slurry of this character, the individual asbestos elements will tend to be more heterogeneously arranged relative to each other and to be more completely interlaced than if the flocculated, matted, or entwined masses had not been distended and disseminated. Further, the internal friction, set up as the asbestos filaments are separated when the sheet is torn or severely flexed, is much greater in a thoroughly felted structure formed from a slurry of this invention by reason of the open and disseminated character of the fine fibrous crystals or hair-like tentacles extending out into the water from such fibrous crystals. A sheet of greater strength and flexibility is thus produced from asbestos than can be obtained from a slurry in which the asbestos is not so disseminated.

When once the fibrous crystals of asbestos are as completely disseminated through the watery medium as described above, it is of course necessary, if benefit therefrom is to be derived, to fabricate the felted structure from the slurry while the asbestos therein is still thoroughly dispersed.

Asbestos dispersions obtained in this manner are superior to dispersions thereof prepared by mechanical beating alone.

Alternative to the use of aluminum chloride or thorium nitrate there may be employed any material which provides selectively adsorbable cations. These materials include substances of inorganic origin such as polyvalent metal salts, or materials of organic origin such as the salts of certain complex amines. Among the latter may be mentioned acid proteins, such as acid serum albumen, casein, and the like; or certain acid soaps, such as salts of the material obtained by condensing ethylene diamine with oleic acid and generally described by Hartmann and Kägi, Zeitschrift für Angewandte Chemie, 41, 127–130 (1928). In all these instances salts of acids should be chosen which do not yield strongly adsorbable anions. Thus, for example, if a strongly adsorbable anion, such as might be derived from the salt of a polybasic acid, be present, the anion will diminish or offset the beneficial influence of the strongly adsorbable cation. Salts of the monobasic inorganic acids, such as the chlorides, nitrates, etc., are well adapted to the purposes of the present invention. Trivalent metal salts are more effective than bivalent metal salts and quadrivalent metal salts are most effective of all polyvalent metal salts. Thus, for example, thorium nitrate is one of the most active of disintegrating and dispersing agents for the purposes of this invention.

It is believed that substances productive of selectively adsorbable cations facilitate the dispersion and dissemination of asbestos throughout an aqueous suspending medium by imparting to the very fine fibrous crystals or hair-like tentacles, of which the asbestos is largely composed, a strong electropositive charge which renders the individual fibrous crystals or hair-like tentacles thereof mutually repulsive of one another and causes them to open up and spread apart in the aqueous bath. Thus, just as the leaves of a gold leaf electroscope become repulsive of one another when an electrostatic charge is imparted to them, so it is believed that the fibrous crystals or hair-like tentacles, of which asbestos is largely composed, become mutually repulsive when an electrical charge is imparted to their surfaces due to selective adsorption of cations from the aqueous suspending medium.

This hypothesis is strictly in accordance with the observed fact that when asbestos is dispersed in an aqueous medium containing selectively adsorbable cations, it assumes a positive electrical charge with respect to the aqueous dispersing medium; and furthermore, when there is added to such a well dispersed and disseminated asbestos magma an agent which one would expect to be destructive of the imparted positive electrical charge, i. e. an agent productive of a strongly adsorbable anion such as a chromate or a ferricyanide, the asbestos no longer remains well dispersed and disseminated throughout the aqueous medium, but the fibrous crystals or hair-like tentacles thereof again integrate to form flocks or bundles of fibrous crystals similar to those which existed before the asbestos was dispersed and disseminated. Then an examination of the aqueous suspension of asbestos would show that the positive electrical charge formerly borne by the asbestos, when existing in the well dispersed state, had been diminished or destroyed. Whatever the true explanation may be, however, so far as I am aware, all agents productive of selectively adsorbable cations are effective to facilitate dispersion and dissemination of asbestos throughout an aqueous medium.

By the term "asbestos" I intend to include all species of asbestos regardless of mineralogical derivation or geographical origin. I do not desire, however, to be understood to include herein inorganic filamentary materials such as rock wool, mineral wool, blown slag, or glass wool, which are frequently classified as asbestos-like materials as the latter materials do not respond to the process of the present invention.

According to the process of the present invention, only small quantities of the agent productive of strongly adsorbable cations are required to produce the desired result. For most purposes a quantity equal to 0.10% to 2.0% of the weight of asbestos present in a slurry of 5 to 15% solids will give satisfactory results. The optimum quantity of dispersing salt must be determined, however, for each specific case and will depend primarily on four factors: the extent of asbestos disintegration and dissemination desired, the salt used for disintegration and dissemination, the condition and character of the asbestos, and the concentration of the slurry.

The process of the present invention is not always an adequate substitute for beating. The function of beating is mechanical disintegration while the function of the process of the present invention involves an additional activating force. The process of the present invention is not, of itself, effective to disintegrate large tightly bound macroscopic bundles of asbestos; but it tremendously accelerates and facilitates their disintegration and dissemination by mechanical means. And once the asbestos bundles have been mechanically disintegrated, the process of the present invention is effective to disperse and disseminate the fibrous crystals throughout the aqueous medium. From this it is apparent that some species of asbestos which contain no large tightly bound crystalline bundles may be adequately dispersed without the necessity of mechanical beating. This is true also of certain grades of commercial asbestos, much employed in paper and fiber board manufacture, which has been subjected to a disintegrating treatment in its recovery from the rock with which it was associated in nature. In such cases the fiber may be merely agitated in a suitable tank with a very dilute solution of an agent productive of selectively adsorbable cations, a few minutes' agitation usually sufficing to accomplish dissemination. Asbestos consisting of large tightly bound fiber bundles requires mechanical beating. In this case the addition of agents productive of selectively adsorbable cations to the slurry will materially lessen the necessary time of beating, frequently cutting it to one-third or one-quarter the usual time, and will not only result in more complete dispersion and dissemination than can be obtained from mechanical beating alone, but will effect a considerable preservation of fibrous crystal length.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. Method of dispersing asbestos, which comprises the addition to an aqueous suspension thereof of a soluble salt of a polyvalent metal and a monobasic acid.

2. Method of dispersing asbestos, which comprises the addition to an aqueous suspension thereof of a soluble salt of aluminum and a monobasic acid.

3. Method of dispersing asbestos, which comprises the addition to an aqueous suspension thereof of a soluble salt of thorium and a monobasic acid.

4. An aqueous dispersion of asbestos containing a soluble salt of a polyvalent metal and a monobasic acid.

5. An aqueous dispersion of asbestos containing a soluble salt of aluminum and a monobasic acid.

6. An aqueous dispersion of asbestos containing a soluble salt of thorium and a monobasic acid.

Signed by me at Cambridge, Massachusetts, this 17 day of March 1931.

GEORGE R. TUCKER.