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WATER-RESISTANT AND FIRE-RESISTANT FIBROUS PRODUCT AND METHOD OF MAKING SAME

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This invention relates to fibrous products and particularly to artificial board, wall board, insulation board, and similar compositions which are composed chiefly of vegetable fibers and it has for its object to provide a simple, cheap and efficient method of treating materials of this character to increase their fire-resistant and moisture-resistant properties. The improvements are directed to both the article itself and to the process or method through which it is produced and to the waterproofing or fireproofing whether conducted individually or jointly. A further object of the invention is to provide a method of waterproofing and a method of fireproofing which can be conducted together without the one interfering with the action or beneficial effects of the other.

To these and other ends the invention resides in certain improvements which will be hereinafter fully set forth, the novel features being pointed out in the claims at the end of the specification.

Of course, in the nature of things, hardly any material can, technically, be rendered absolutely either waterproof or fireproof but a satisfactory product must be both water-resistant and fire-resistant. However, the incorporation of fireproofing substances in a product ordinarily has a tendency to partially or completely destroy the water resistance of such product. This is particularly true if the fireproofing substances impart an alkaline reaction to the finished product. It is also true to a lesser, but very material degree if the fireproofing substances are neutral or acid and impart a neutral or acid reaction to the finished product.

It is ordinarily impractical, if not impossible, to waterproof fibrous products containing fireproofing salts or acids with the usual rosin size. Similarly, metallic soaps and acetate of alumina, if present in reasonable commercial proportions, do not have the strength to adequately waterproof fibrous compositions containing fireproofing salts or acids. Also, fibrous compositions containing fireproofing salts or acids cannot be adequately waterproofed by paraffin applied in any ordinary manner. If applied in the form of an aqueous emulsion, sufficient paraffin to overcome the de-waterproofing effect of the fireproofing salts or acids cannot be incorporated in the fibrous composition, as the emulsified paraffin escapes with the water during the de-watering process, particularly when the stock is passed over screens for de-watering purposes.

An object of this invention is to provide a process by means of which sufficient waterproofing substances may be incorporated in fibrous compositions to overcome the de-waterproofing effect of fireproofing salts which may be contained therein. Another object is to provide an improved fire-resistant fibrous product. Another object is to provide an improved water-resistant fibrous product. Another object is to provide an improved water-resistant and fire-resistant fibrous product.

Other objects will be in part obvious or in part pointed out hereinafter.

According to this invention the ammonium salts of phosphoric acid are utilized as fireproofing substances and organic substances in combination with finely comminuted or colloidal organic or inorganic substances are used as waterproofing agents.

The ammonium salts of phosphoric acid, when incorporated in a fibrous composition and dried, impart an acidic reaction to the fibrous composition, reducing its inflammability and substantially eliminating any tendency of the composition to smoulder and hold fire in the event that it is ignited.

The ammonium salts may be prepared in any suitable manner, but satisfactory products may be obtained by admitting anhydrous ammonia gas into a solution of phosphoric acid in water in proportions equal to or somewhat in excess of the stoichiometrical amounts required to produce mono-, di-, or tri-ammonium phosphate, or by adding ammonium hydroxide to phosphoric acid in amounts equal to or greater than the stoichiometrical amounts required to produce mono-, di-, or tri-ammonium phosphate. A satisfactory solution of ammonium phosphate may be produced by adding 40 parts by volume

of a 26° Baumé aqueous solution of ammonium hydroxide to 31 parts by volume of a 50% aqueous solution of H_3PO_4.

In making the composition or insulation board, it is preferable that an ammonium phosphate solution formed as described above, be present in the furnish containing the water, fibers and other material in a concentration of from one to ten percent. Less than one percent is generally an insufficient amount to render the finished composition adequately fire-resistant, while more than ten percent provides such a high concentration of acidic substance in the finished product that the vegetable fibers are weakened during the drying process. Also, the ammonium phosphate is relatively costly and if more than ten percent is used the cost of the finished product may be prohibitive. In general, if two or three percent of a mono-, di-, or tri-ammonium phosphate solution made as described above be present in a furnish of vegetable fibers and other ingredients suitable to the manufacture of a fibrous composition or insulation board, the fire resistance of the product after it is formed and dried is satisfactory.

The waterproofing substances which may be used according to this invention include such compounds as exist among the higher members of the paraffin series and their derivatives such as fatty aldehydes, fatty ketones, and fatty acids, and mixtures of bituminous and asphaltic materials in both the aliphatic and aromatic field which are adapted to provide fibrous products with water-resistant qualities. The waterproofing substances also include waxes, fatty acids, fatty aldehydes and ketones derived from other sources than petroleum or earth pitches, such as, for example, carnauba wax, ceresin, gums, rosin, etc. In general, any organic substance that has a waterproofing effect upon fibrous compositions may be used to advantage.

The efficiency of the process and the quality of the finished product, particularly where it is desired to produce a composition which is both waterproof and fireproof, depends upon the provision of a suitable adsorbent or carrier by means of which the paraffin or other waterproofing substance may be incorporated and retained in the finished product in an amount sufficient to overcome the de-waterproofing effect of any fireproofing salts or acids or compounds which may be present. Such suitable adsorbents or carriers comprise finely divided material such as clay, colloidal clay, bentonite, diatomaceous earth, calcium sulphate, gypsum, mineral dusts, animal or vegetable charcoal, wood flour, etc.

The paraffin or other organic waterproofing substance is melted and the dry adsorbent or carrier is preferably added thereto little by little with constant stirring. The paraffin or other waterproofing substance is adsorbed on the surfaces of the colloidal, semi-colloidal or finely comminuted material and a mass of waterproofed particulate material is thus formed. The resulting mass may be dispersed in water to form a suspension which may be added to the furnish containing the fibers during the process of making the fibrous composition. For example, five parts by weight of colloidal clay such as bentonite, either cold or preheated, may be stirred into one part by weight of melted paraffin and the resulting mixture allowed to cool, after which it may or may not be rubbed through a fine screen. The waterproofed material may be dispersed in water by ordinary means such as stirring, or by special means such as by passing it through one or more agitating machines such as beaters or Hollanders, or Jordans or Claflins used in the paper industry. A satisfactory dispersion or suspension may contain five percent by weight of the waterproofed comminuted material.

The aqueous suspension formed as described above may be added to a furnish containing water and fibers and which may or may not contain fireproofing salts or acids, and when the mixture is molded, de-watered and dried, a fibrous composition which is water repellant or both water repellant and fire repellant is obtained. Products manufactured according to this process retain sufficient waterproofing material to overcome the de-waterproofing effects of any fireproofing salts, or acids or compounds which may be incorporated therein. This is true because of the fact that the waterproofed comminuted material is well retained as a filler in the fibrous composition. The concentration of waterproofing material retained in the finished product as a result of treatment by this process is greater than it is possible to obtain by any other practical means.

Instead of first dispersing the waterproofed comminuted material in water, the mixture of colloidal or semi-colloidal material and waterproofing material may be added directly to the furnish containing the fibers, water and fireproofing agents, and a homogeneous dispersion of all the materials may be obtained by passing the entire mixture through a Jordan or Claflin such as used in the paper industry.

A homogeneous mixture containing five parts of wood pulp, eighty-two parts of water, ten parts of waterproofed comminuted material and three parts of ammonium phosphate solution made as described above may be de-watered, molded, compressed and subsequently dried to provide an insulation panel that is strong, water repellent, and difficult to ignite, and

which does not tend to smoulder or hold fire once the igniting flame is removed, but which, on the other hand, tends to rapidly cease burning or glowing and become entirely extinguished.

In making up the waterproofed comminuted materials, waterproofing materials that are liquid at ordinary temperatures, such as oils of animal, mineral, or vegetable origin, may be used. These waterproofing materials, having low melting points, present some possible advantages in respect to cost and because they can be adsorbed by the particulate material without the aid of heat. On the other hand, waterproofing materials which are solid at ordinary temperatures, and which must be adsorbed in a heated condition are better adsorbed by the particulate material, and upon cooling freeze upon the surfaces of the adsorbing media and are therefore better retained by the adsorbing media.

As a further example of the application of this invention in the production of water-resistant and fire-resistant fibrous products, one hundred parts by weight of colloidal clay or Bentonite, or ordinary china clay, or calcium sulphate in a finely divided form, or other comminute materials or mixtures of such materials which are characterized by being highly insoluble in water may be added little by little with constant stirring to twenty parts by weight of molten paraffin, higher fatty acids, rosins, waxes or other waterproofing compounds or mixtures of such compounds. The comminuted material or materials may be preheated to aid in keeping the waterproofing materials in liquid form. After mixing, the mass is permitted to cool to ordinary room temperature. To six parts by weight of the cooled waterproofed comminuted material, ninety-four parts by weight of water that is cold enough not to melt or to materially soften the waterproofing material may be added. This mixture may then be vigorously stirred by any well known means until the waterproofed comminuted material is dispersed in the water to form a substantially homogeneous suspension, or colloidal, or semi-colloidal solution.

The aqueous suspension thus formed may be utilized by adding four hundred parts by weight to a pulp containing five parts more or less of fibers, two parts more or less of fireproofing salts, acids or compounds and ninety-three parts more or less of water. The resulting mixture may be agitated or stirred by any well known means and de-watered and molded to provide a fibrous composition, artificial board, wallboard or insulation board which is water and fire-resistant.

The above procedure may be varied by adding one part by weight of the cooled, waterproofed material, which may or may not have been passed through a fine screen, to a mixture containing five parts more or less of fibers, three parts more or less of fireproofing acids, salts or compounds, and ninety-two parts more or less of water, and passing the resulting mixture through such paper making machinery as a beater or Hollander, a Claflin, or a Jordan until the waterproofed comminuted material is substantially homogeneously dispersed or disseminated in the mixture. The resulting mixture may then be de-watered and molded to provide a fibrous product which is fire and water-resistant.

I claim as my invention:

1. The process of making a fire-resistant and water-resistant fibrous product which comprises mixing ammonium phosphate and paraffin coated comminuted material with fibers in fluid suspension.

2. The process of making a water-resistant and fire-resistant fibrous product which comprises adding a fireproofing substance and paraffin coated comminuted material to stock containing fibers in fluid suspension.

3. The process of making a water-resistant and fire-resistant fibrous product which comprises adding ammonium phosphate and waterproofed comminuted material to stock containing fibers in fluid suspension.

4. The process of making a fire-resistant and water-resistant fibrous product which comprises mixing fibers, ammonium phosphate, and paraffin coated comminuted material and subsequently molding the mixture.

5. A fibrous product which is impregnated with ammonium phosphate and paraffin coated comminuted material.

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