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METHOD OF MAKING FELTED, FIBROUS SHEET MATERIAL

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This invention relates to the deposition of binders upon fibrous materials contained in a water slurry. More particularly, the invention relates to an improved method of beater saturating fibers with hard, nontacky resins, and still more particularly it relates to an improvement in the production of fibrous materials containing binder constituents by treating the fibers while in suspension to render them more receptive to the deposition of both hard, nontacky resins and of rubberlike solids which make up a binder system.

Compositions containing fibrous materials and binders are produced in a number of ways. A fibrous material, such as a kraft paper sheet, may be formed into a sheet on conventional papermaking equipment and then passed through a bath containing a binder composition, for example, a rubber latex. Alternatively, a sheet prepared by conventional papermaking methods may be simply coated with a heavy paste containing a rubber or other suitable binder as by means of a doctor blade or similar applicator. Another well-known method of manufacturing such materials is the beater saturation technic. In this method, a slurry of fibers is formed and a binder dispersion is added thereto. The solids content or a portion thereof of the binder dispersion is then coagulated onto the fibers and the resulting slurry of coated fibers is formed into a sheet. Generally speaking, the binder is a synthetic rubber latex such as GR-S (a copolymer of butadiene and styrene), Hycar (a copolymer of butadiene and acrylonitrile), neoprene (polymerized chloroprene), and the like.

Although such materials have found wide use, they are unduly expensive and, in addition, do not produce a sheet sufficiently hard, stiff, or resistant to indentation for many uses, particularly where the sheet is to be used as a backing for resilient flooring.

It is, therefore, an object of this invention to provide a method of depositing solid binder material upon fibers in water suspension which may be swiftly carried out and which may be duplicated as desired. It is a further object of this invention to provide a method of depositing solid binder material upon fibers such that a sheet made therefrom will be less expensive and will be harder, stiffer, and more resistant to indentation than sheets made by known processes. It is still a further object to present a method wherein hard, nontacky resins may be deposited on fibrous materials in a simple and straightforward process in amounts as high as 100% on the weight of the fibers and in which the retention of such resins is substantially complete.

In accordance with the present invention, there is first formed a slurry containing sheet-making fibers. There is also formed an aqueous dispersion of a solid, substantially water-insoluble resin having a density less than about 1.5; this dispersion is formed by adding the selected resin and locust bean gum to water, the locust bean gum being added in an amount of about 0.5 to about 3 parts by weight of said gum per about 100 parts of said resin. This dispersion, or at least a portion thereof, is added to

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the slurry containing the fibers, usually after pretreatment with alum and ammonia according to the Pretzel process, described in U. S. Patent No. 2,375,245, issued May 8, 1945. The resulting slurry is agitated to coagulate the solids content of the dispersion onto the fibers. The slurry of coated fibers is then formed into a sheet.

The fibers contemplated for treatment by the present invention are those fibers usually found in felted products and include such fibers as kraft, sulfite, cotton, and asbestos. The character of the fibers involved in the present process is not critical.

The use of the aqueous resin-locust bean gum dispersion, however, is critical. The resin should be ground, for example, by a ball mill or colloid mill until the resulting powder feels smooth and nongranular to the touch. This normally means that the resin has sufficient fineness that it will substantially all pass through a 150 mesh screen while about 80% will pass through a 200 mesh screen. The resin is slurried in water along with locust bean gum. The amount of locust bean gum to be added must be between about 0.5 to 3 parts by weight of the gum per about 100 parts by weight of the resin. If lower amounts of gum are used, then the surprising effect utilized by the present process is not achieved, whereas if greater amounts of gum are used, an excessive amount of water must be used to keep the viscosity of the dispersion down; the sheets obtained from the coated fibers exhibit poor retention and slow drainage. The amount of water used in the resin-gum dispersion is not critical, except as a control on the dispersion viscosity, but it is preferred that about 180 parts by weight of water plus gum be used for every about 100 parts by weight of resin. A dispersion of this concentration offers an unusually convenient means for adding the resin-gum mixture to the fiber slurry. It must be pointed out that the resin-gum dispersion must be prepared separately and then added to the fibrous slurry in the beater; poor pick-up results if an attempt is made to disperse the resin and gum directly into the fiber slurry.

It is essential that the resin utilized in the present process have a density of 1.5 or less. Resins having a greater density than 1.5 will not coat on the fibers to the desired degree. It is also apparent that the resin to be utilized must be a solid substantially insoluble in water. Soluble resins are simply lost in the white water to the extent of their solubility. The type of resin is not critical as long as it is substantially insoluble in water and has a density of less than about 1.5. Exemplary of resins suitable in the present process are the various phenol-formaldehyde resins, urea-formaldehyde resins, melamine-formaldehyde resins, and any of the resinous materials formed through unsaturated linkages such as the vinyl resins. Both synthetic and natural resins are contemplated. It is, in fact, one of the outstanding advantages of the present process that low-cost natural resins such as high melting asphalt, coal tar byproducts, petroleum by-products, and the like can be utilized in the present process. Both thermosetting and thermoplastic resins are suitable.

The locust bean gum utilized in the present process is critical. This locust bean gum is a known item of commerce and is extracted from the locust bean, otherwise known as the carob bean. It is one of the surprising features of the present process that only locust bean gum functions as the desired coating agent. Other colloidal dispersing or thickening agents, such as synthetic detergents, glue, carboxy methyl cellulose, or casein are inadequate to give the desired results; all these latter agents give only partial retention and slow drainage. Thus, it is a completely unexpected and surprising feature of the present invention that locust bean gum in certain amounts and no other agent, when used with powdered resins

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having certain physical characteristics, will result in 100% retention of the resins in the beater saturation technic.

The process of the present invention may be used to coat any desired fibers with a resin or mixture of resins. Deposition will be enhanced by pretreating the fibers with alum and ammonia. This will result in a hard, stiff, and strong felted material which can be used as insulation board and as similar materials of construction. Plasticizers may be incorporated if desired. It is preferred, however, that the process of the present invention be utilized in conjunction with the deposition of a rubber on the fibers. Thus, when the above-described dispersion of resin and gum is added to the beater, along with a rubber latex, both the resin and the rubber coat out on the fibers without interference with one another. It is this process which results in the production of a flexible felt backing which is pre-eminently suitable to serve as a flexible backing with flexible flooring, such as linoleum and the like. If this latter process be utilized, the backing will be harder, stiffer, more resistant to indentation, and more inexpensive than backing prepared using rubber alone, and yet it will possess sufficient flexibility to serve in the usual manner.

The following examples illustrate specific embodiments of the invention:

Example I

The resin formulation is ground in a ball mill until smooth and nongranular to the touch. The resin formulation is as follows:

	Parts by weight
Resin	100
Locust bean gum.....	0.5-3
Water	176-179

Example II

40 grams of kraft fiber was suspended in 4,000 grams of water, to which was added a solution containing 5 grams of aluminum sulfate. After a short period of agitation to disperse the solution, 4.5 cc. of aqua ammonia was added to the slurry to convert the aluminum sulfate to aluminum hydroxide. Thereafter, 56 grams of a resin dispersion prepared as in Example I utilizing Bakelite BR-17620, a water-insoluble, B-stage phenol-formaldehyde resin (20 grams dry resin), was added to the slurry. Upon agitation, the total solids content of the dispersion deposited upon the fibers. The slurry of fibers was formed into a sheet in a laboratory sheet mold, producing an excellent thermosetting hardboard.

Example III

40 grams rag fiber was suspended in 4,000 grams of water, to which was added a solution containing 2 grams aluminum sulfate. After a short period of agitation, 1.8 cc. aqua ammonia was added. Thereafter 33.8 grams resin dispersion prepared as in Example I, using a Piccopale petroleum by-product resin, a hard hydrocarbon resin from polymerized unsaturates derived from deep cracking of petroleum, melting point $85^{\circ}\text{C} \pm 3^{\circ}\text{C}$. (12 grams dry), was added. Upon agitation, the solids content of the dispersion was deposited upon the fibers. From this slurry of fibers there was formed a hard sheet of thermoplastic hardboard possessing excellent properties.

Example IV

A furnish containing 30 grams rag fiber and 10 grams of 60 to dust cork particles was suspended in 4,000 grams of water. To the slurry was added a solution containing 5 grams aluminum sulfate, and after agitation 4.5 cc. aqua ammonia and 0.24 gram of Agerite white dispersion, sym. d-beta-naphthyl-p-phenylene diamine (47% solids), as an antioxidant.

To this slurry was added a diluted mixture containing 15 grams (6 grams dry) GR-S 2000 and 16.6 grams of a dispersion prepared as in Example I with a coal tar

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by-product commercially known as C-5 resin, coumarone-indene resin, melting point $101^{\circ}\text{C} - 105^{\circ}\text{C}$. (6 grams dry). After agitation, the solids content of the respective binder dispersions deposited upon the fibers. The slurry of fibers was then formed into the sheet which exhibited excellent flexibility and yet was harder and more resistant to indentation than was a sheet prepared in the same manner using GR-S 2000 in place of the resin-gum dispersion.

I claim:

1. A method of making felted, fibrous sheet-making material comprising forming a slurry containing sheet-making fibers, forming separately an aqueous dispersion of a solid, nontacky, substantially water-insoluble resin having a density less than about 1.5 by adding said resin and locust bean gum to water in an amount of about 0.5 to about 3 parts by weight of said gum per 100 parts by weight of said resin, adding said dispersion to said slurry, agitating the resulting slurry to coagulate the solids content of said dispersion onto said fibers, and forming the slurry of coated fibers into a sheet.

2. The method according to claim 1 wherein said aqueous dispersion comprises about 180 parts by weight of water plus locust bean gum for every 100 parts by weight of resin.

3. The method according to claim 1 wherein said resin is ground to a size such that about 80% passes through a 200 mesh screen.

4. The method according to claim 1 wherein said resin comprises a petroleum by-product resin.

5. The method according to claim 1 wherein said slurry containing sheet-making fibers is pretreated with aluminum sulfate and ammonia.

6. The method according to claim 1 wherein said gum is used in an amount of about 1 part by weight per 100 parts by weight of said resin.

7. A method of making felted, fibrous sheet material comprising forming a slurry containing sheet-making fibers, pretreating said fibers with alum and ammonia, forming separately an aqueous dispersion of a powdered, nontacky, substantially water-insoluble resin having a density less than about 1.5 by adding said resin and locust bean gum to water in an amount of about 0.5 to about 3 parts by weight of said gum per about 100 parts by weight of said resin for each about 180 parts by weight water, adding said dispersion to said slurry, adding a latex of a synthetic rubber to said slurry, agitating the resulting slurry to coagulate the solids content of said dispersion and said latex onto said fibers, and forming the slurry of coated fibers into a sheet.

8. The method according to claim 6 wherein said latex comprises a butadiene-styrene copolymer.

9. A method of making felted, fibrous sheet material comprising forming a slurry containing sheet-making fibers, forming separately an aqueous dispersion of a powdered nontacky, substantially water-insoluble coal tar by-product resin having a density less than about 1.5 by adding said resin and locust bean gum to water in an amount of about 0.5 to 3 parts by weight of said gum per 100 parts by weight of said resin, adding said dispersion to said slurry, adding a butadiene-styrene copolymer to said slurry, agitating the resulting slurry to coagulate the solids content of said dispersion and said copolymer onto said fibers, and forming the slurry of coated fibers into a sheet.

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