

UNITED STATES PATENT OFFICE

2,375,245

MANUFACTURE OF RUBBERIZED FIBERS
AND SHEETS

Paul W. Pretzel, Brookfield, Ill.

No Drawing. Application August 25, 1941,
Serial No. 408,255

3 Claims. (Cl. 92-21)

This invention relates to fibers coated with rubber-like binding material and paper or products made therefrom, and more particularly it pertains to furnish pulp fibers coated with the binder and sheets felted from same on any conventional type of paper making equipment. The invention is particularly useful where a rubber binder, natural or synthetic, is incorporated into a hydrated batch of fibrous furnish stock in dispersed or emulsified form. Rubber substitutes or a combination of them or with rubber is also suitable.

In the prior art practice, the rubber binder has been first mixed with the hydrated fibrous furnish stock, after which a coagulant is incorporated into the rubber-hydrated fibrous mixture to coagulate the rubber or other binding material. This causes agglomerates or lumps of the rubber particles being formed between adjacent fibers which may adhere or cling to portions thereof in discrete and segregated lumps. The fibers have no affinity or attraction for the rubber particles, but are in fact repellent because both are negative electric charged materials.

The aim of my invention is to coat or sheath the fibers with a thin coating of binding material, and this may be advantageously attained by rendering the fibers, or associating therewith, a material that is positive electric charged, thereby causing the fibers to have an affinity or attraction for the binding material when same is incorporated in the hydrated fibrous furnish stock. This causes the binder to coat or sheath the fibers without agglomerates or lumps of the binder being formed. A sheet felted from the rubberized stock is thus more uniform and homogeneous in composition, structure and finish than is a sheet felted from a furnish stock in which the binding particles are agglomerated in lumps. So too, it is more uniform and homogeneous in composition, structure and finish than is a sheet that is first felted from a batch of fibrous furnish stock and then the felted sheet is coated or impregnated with a rubber solution, and can be made more economically.

The invention is especially suitable for treating organic or vegetable fibers such as cotton, linen, wood fibers and the like which are cellular in structure, having a cellulose membrane wall and a hollow bore or canal. The structure of the cells of the different vegetable fibers are substantially the same although they may differ in form and shape. Cotton fibers for example are flat or ribbon-like whereas wood and linen fibers are cylindrical. The cells are made up of an exterior

cell wall filled with protoplasm and a nucleus. These cells expand in size during the growth of the fibers. However, the protoplasm does not expand but forms a thin sheath within the cell surrounding the bore or canal. When the cell dies, the protoplasm disappears, leaving the cell a hollow shell of which the wall is mainly cellulose.

The cellulose wall is permeable to water, and since various electrolyte materials will diffuse into and through these permeable membranes by osmotic pressure, it has been found that water permeable fibers may be advantageously treated with an electrolyte which is reactive with a suitable agent, also diffusible through the permeable fibers, to form a reacted precipitate that is positive electric charged and thereby attractive to the binding material. The rubber particles are attracted from the emulsion, with which the fibers are mixed, to the fibers with which the precipitate is associated, thereby causing said fibers to be coated or sheathed in films of binding material without agglomerates being formed.

The invention is not limited to associating with the fibers any particular electrolyte but one that is preferably water-soluble in order to be impregnated in the fiber walls. Some suitable electrolytes are alum, aluminum chloride, aluminum sulphate, magnesium chloride, magnesium sulphate, magnesium silico-fluoride, zinc chloride, zinc sulphate, and the like or any combination of them.

Fibrous pulp, such as rag, chemical wood pulp or the like from which the paper is to be made, is introduced into a conventional paper beater with water and hydrated to the desired consistency or fineness. The hydration will vary according to the characteristics desired in the finished paper. An electrolyte, such as aluminum sulphate $Al_2(SO_4)_3$ is added to the hydrated cellulose fibers in the beater. By osmotic forces, the aluminum ions thereof diffuse into and through the semi-permeable or permeable cellulosic membrane walls of the fibers, these forces continuing until the ion concentration is equalized in the bore or canal and walls of the fibers, and the water adjacent the fibers.

It is preferred, although not an indispensable feature of the invention, to have the fibers absorb as much water as possible and yet have the furnish stock mix of a flowable consistency. Under these conditions a large proportion, preferably a major part of the ions (aluminum and sulphate ions combined) may be impregnated in the fibers (the walls and/or canals thereof).

After a sufficient degree of impregnation of the

electrolyte is obtained, an agent is added to react therewith and form an insoluble inorganic jelly to be precipitated out in the walls and canals of the fibers and the water adjacent the fibers.

A suitable reaction agent is ammonium hydroxide in an aqueous solution. Ammonium ions and hydroxyl ions are formed in the water which also under osmotic forces diffuse into and through the semi-permeable cellulose walls of the fibers. The aluminum ions unite with the hydroxyl ions to form aluminum hydroxide, the insoluble inorganic jelly which is precipitated out as above described, in the canal and cell walls of the fibers as well as in the adjacent water surrounding the fibers. The ammonia ions unite with the sulphate ions to form ammonium sulphate which remains in solution. The chemical equation for the reaction is:



An excess of ammonium hydroxide is preferably added so that all the aluminum sulphate is reacted.

The aluminum hydroxide formed in the canals and walls of the fibers are trapped therein because of its water insolubility. If desired, the excess water from the fiber water mix may be withdrawn to rinse out as much of the ammonium sulphate as possible along with the small amount of aluminum hydroxide formed in the water adjacent the outside of the fibers. By rinsing, there is no substantial amount of aluminum hydroxide or ammonium sulphate present in the fiber water mix after the reaction and rinse except the aluminum hydroxide trapped in the fibers. It is not necessary to drain off the excess water however as most of the aluminum hydroxide is formed in the fibers, and what little, if any, that is not associated with the fibers is not objectionable in carrying out the invention.

The fibers thus treated are in condition to attract the rubber particles, and the rubber emulsion can now be added to the fibers. This is preferably slowly added to the fibers to assure better distribution of the rubber particles there-through. The particles of the binding material are held in uniform suspension in the emulsion because they bear small negative electric charges.

The aluminum hydroxide, associated with the fibers or impregnated therein, bear small positive electric charges, and therefore draw or attract the negative charged rubber particles towards the fibers. The binder particles are not able to diffuse into the fibers but will be drawn thereabout rather than agglomerating in lumps on or between the fibers.

A sufficient amount of binder is added so that each fiber may be completely sheathed or enveloped with a coating of binding material or to offset all the positive charges of the aluminum hydroxide. It will be apparent, therefore, that by regulating the impregnation of the fibers with the treating materials, the degree of attraction for the treated fibers for the binding material may be regulated, thereby determining the thickness of the sheathes about the fibers.

No coagulating material such as alum needs to be added to the treated fibers after the rubber emulsion is mixed therewith and sheathed about the fibers. The rubber treated furnish fiber stock is in condition to be fed to any paper forming machine, such as a Fourdrinier, cylinder machine,

wet machine or the like for being tested into fibrous sheets from which various products may be made, one of which is gaskets for airplane engines.

Among the materials which may be emulsified or dispersed and are suitable as binders are rubber as commercial latex or artificially dispersed latex, chloroprene emulsions or dispersions, mixed polymers in emulsions or dispersions, resins and other rubber or rubber substitute materials.

Having described my invention, I claim:

1. In the process of producing felted fiber products, the steps of beating a body of fibers composed substantially entirely of vegetable cellulose fibers in water to hydrate the fibers, suspending the fibers in a solution containing the dissolved salt of a metal of the group consisting of aluminum, magnesium and zinc whose hydroxide is insoluble in water and electropositively charged, mixing with said solution and the fibers suspended therein an aqueous solution of ammonium hydroxide reactable with said salt to precipitate said metallic hydroxide from the solution within the walls of said fibers whereby the precipitated hydroxide is retained within said walls, and thereafter mixing with the impregnated fibers an aqueous emulsion of an electronegatively charged organic binding material whereby the binding material is precipitated out of the emulsion and held on the fiber surfaces by the positively charged precipitate contained in the fiber walls.

2. In the process of producing felted fiber products, the steps of beating a body of fibers composed substantially entirely of vegetable cellulose fibers in water to hydrate the fibers, suspending the fibers in a solution containing the dissolved salt of a metal of the group consisting of aluminum, magnesium and zinc whose hydroxide is insoluble in water and electropositively charged, mixing with said solution and the fibers suspended therein an aqueous solution of ammonium hydroxide reactable with said salt to precipitate said metallic hydroxide from the solution within the walls of said fibers whereby the precipitated hydroxide is retained within said walls, and thereafter mixing with the impregnated fibers an aqueous emulsion of an electronegatively charged rubber binding material whereby the binding material is precipitated out of the emulsion and held on the fiber surfaces by the positively charged precipitate contained in the fiber walls.

3. In the process of producing felted fiber products, the steps of beating a body of fibers composed substantially entirely of vegetable cellulose fibers in water to hydrate the fibers, suspending the fibers in a solution containing the dissolved salt of aluminum, mixing with said solution and the fibers suspended therein an aqueous solution of ammonium hydroxide reactable with said salt to precipitate aluminum hydroxide from the solution within the walls of said fibers whereby the aluminum hydroxide is retained within said walls, and thereafter mixing with the impregnated fibers an aqueous emulsion of an electronegatively charged organic binding material whereby the binding material is precipitated out of the emulsion and held on the fiber surfaces by the positively charged precipitate contained in the fiber walls.

PAUL W. PRETZEL.