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FIBROUS SUBSTRATE WITH AN ALUMINA BONDED ORGANIC POLYMER COATING

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This invention concerns fibrous substrates bearing a basecoat of colloidal alumina and a topcoat of organic polymer containing ionic sulfonate groups and to methods for making the same.

The application of organic polymers containing sulfonate groups as topcoatings over base coatings of colloidal alumina particles upon fibrous substrates promotes and stabilizes the adherence of alumina particles to the fiber substrates in a most unexpected manner. Yet, such topcoatings do not detract seriously from the beneficial effects obtained from using colloidal alumina coatings upon fibers. The result is that topcoatings of organic polymers containing sulfonate groups enhance the desired properties of colloidal alumina coatings. Great improvements in the resistance to soiling and in the washability of fabrics made from fibers so treated are observed, for example. This specification discloses other novel and useful effects obtained by practicing this invention and those skilled in the art will appreciate still other advantages of this invention.

More particularly, this invention is directed to processes whereby at least one organic polymer containing sulfonate groups is applied as a topcoating over at least one type of colloidal alumina applied to the surface of a fiber or fibers. The invention is also directed to the so coated fibrous materials and to the articles made using these coated fibrous materials such as textiles and the like.

In the drawing, which is not to scale, there is illustrated an embodiment of the invention showing a section of substrate fiber 1, said fiber before coating being one having a positively charged surface, bearing a base coat of colloidal alumina particles 2 and said base-coated surface having a topcoat 3 of organic polymer containing sulfonic acid radicals.

The invention will now be described in detail.

THE FIBER SUBSTRATES

In general, the fibrous material comprising the substrate to be coated with colloidal alumina need have no special attributes. Physical characteristics such as density, porosity, surface area, strength and the like and chemical characteristics such as compositions, natural or synthetic origin and the like are, in general, not significant.

It is preferred, however, that the surface of the fiber to be treated with colloidal alumina be negatively charged with respect to the colloidal alumina. This is because such colloidal alumina, which is regarded as being positively charged, tends to exhaust uniformly and substantively upon the surfaces of fibers negatively charged. Thus, fibers which have negatively charged surfaces (with respect to the colloidal alumina particles) can be effectively coated in mono or multiple particle layers with colloidal alumina by simply bringing the substrate fiber surface into intimate contact with liquid dispersions of such positively charged colloidal aluminas.

Thus, when negatively charged substrate fiber surfaces are coated using dispersions of colloidal aluminas (the dispersions actually being either sols or suspensions of the colloidal aluminas), according to the teachings of the present invention, several distinct types of monomolecular forces may be involved in bonding the colloidal aluminas to these substrate surfaces. Those bonds due

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to opposite polar charges are concerned with Van der Waal's forces commonly having an energy of the order of 2,000 to 10,000 calories per mole. Chemical linkages through covalent bonds have an energy value of from about 10,000 to 200,000 calories per mole. Coordination bonding approximates covalent bonding in strength.

Generally, those fibers containing electronegative atoms are characterized by having substantial proportions, that is, above 5%, of an element or elements selected from the group consisting of oxygen, nitrogen, halogen and sulfur. These elements frequently are present in highly polar groups such as —OH, $—NH_2$, —COC—, —NH—, —CO, —CN, —COOH, $—SO_3H$, and others. Such fibrous substrates have a negative ionic charge in water when the polar group is at least slightly acidic in nature, such as —COOH, $—SO_3H$, —SH, —CONH—. Fibers having negatively charged surfaces which can be satisfactorily coated with colloidal aluminas for purposes of this invention include most of the principal industrially important, natural and synthetic fibers.

Those fiber substrate materials which are not negatively charged with respect to the colloidal aluminas or which do not contain substantial proportions of highly polar groups like those above indicated can nevertheless be adopted for use in the processes and products of this invention either by modifying their surfaces as by chemical incorporation of compounds which of themselves have substantial proportions of highly coated polar groups or by associating such materials with other materials which have negatively charged surfaces. Thus, polymers and copolymers during manufacturing processes for aging periods can partially oxidize or they can assimilate on or near their exposed surfaces certain compounds having free carboxylic, aldehydic, or other groups in sufficient amount to impart negative characteristics to surfaces normally not highly negatively charged. Further, natural and synthetic fibers, resins and broadly those polymers and copolymers containing substantial amounts of nitrogen, oxygen, halogen, sulfur, and the like can be incorporated into fabrics and fibers thereby presenting negatively charged surfaces which bond readily with colloidal aluminas. Thus, this invention is generically applicable to the large majority of fibers because those fibers which do not display negative characteristics can readily be modified so as to become negatively charged to the extent necessary for use in the processes and products of this invention. The surfaces of many fibers become negatively charged especially in water above pH 7.

Thus, natural and synthetic fibers of organic or inorganic origin can be used as substrates for use in the processes and products of this invention. Such fibers can be woven together so as to form fabrics and fabric-like materials as is fully appreciated in the art.

The term "fiber" includes both inorganic and organic and synthetic and naturally occurring fibers. The term "fiber" includes staple, yarn, filaments, card sliver, twisted continuous filaments, and the like. It includes materials intended for use in fabrics in any stage of processing. The term "fiber" includes reinforcing fibers intended for plastic laminates, tire cord, and the like. The term "yarn" includes not only those yarns for textile usage, but also those for reinforcing other materials such as those yarns used in tire cord, rubber, felting, conveyor belting and the like. The term "fabric" includes materials which are woven, knitted, felted, fused or otherwise constructed from fibers; for example, the term "fabric" includes pile fabrics and paper fabrics.

Examples of natural fibers include cotton, flax (linen), hemp, jute, ramie, sisal, abaca, pharmium, silk, wool, fur, hair of all types (such as goat and horse), animal bristles of all types (such as hog and camel), straw, asbestos and the like.