This invention relates to finishing agents for textile yarns or fabrics, and to methods of treating yarns or fabrics therewith.

It is a primary object of this invention to treat yarns or fabrics for the purpose of providing them with an improved finish and to provide an agent for this purpose which is not only capable of imparting exceptional slip resistance to fabrics, but is adapted to give to fabrics a soft, full hand and a substantially dust-free finish.

The above and other purposes of the invention are obtained by applying on the yarn or fabric by any suitable means, such as spraying, immersion or padding, a silica aqusual containing from 1 to 20% by weight of a water-soluble polyhydric alcohol such as glycerine, diethylene glycol or sorbitol. These aqusuals, or alco-aqusuals, may contain silica in amounts varying from about 0.5 to 30% by weight, and may be prepared in a wide variety of ways. It is important, however, for the sol to be applied in such amounts and concentrations as to supply from 0.1 to 5% silica on the fabric based on the dry weight of the fabric. Moreover, the amount of polyhydric alcohol employed should preferably be not more than about twice as great as the amount of silica applied on the fabric.

After being applied, the sol or solution on the yarn or fabric is dried, which may or may not require special drying equipment, depending on whether subsequent treatment of the yarn or fabric involves subjecting the material to drying conditions. Preferably, the yarn or fabric is passed over steam heated dry cans or infra red heated tenter frames maintained at a temperature of about 200° F. or higher, but not high enough to damage the fabric. By treating the fabric in this manner, the organic resinous film is applied, as indicated by the fact that the resulting material is substantially dust free, relatively wash fast, and appreciably firmer and fuller than prior to treatment. In this respect, the treated fabrics of this invention differ decidedly from the gel treated fabrics of the prior art. In some cases it is possible to dry the yarns or fabrics at lower temperatures, and even as low as room temperature.

The silica aqusual used in accordance with the invention is preferably made by reacting an acid, such as a mineral acid or any other acid capable of forming salts by reaction with silicates, with a water-soluble silicate in the manner customarily employed to form silica gel, washing the resulting gel with water to remove the electrolytes formed during the reaction, covering the gel with a weak aqueous solution of a substance capable of forming hydroxyl ions and, after removing the gel from the solution, heating the gel, while avoiding evaporation of water, until substantially all of the gel is converted to a sol. A more complete description of the manufacture of the above type of sol may be obtained in U. S. Patent No. 2,375,738 to John F. White.

Solutions prepared in the above manner are preferred, since they are stable for an indefinite period of time. Moreover, the silica contained therein has a larger particle size than the silica in other types of sols, and since they are usually prepared in a neutral or slightly alkaline state, they are admirably adapted for the purposes of this invention. Other types of colloidial solutions or sols of silica may also be used, however, including the sols prepared by reacting water-soluble silicates with an acid and subjecting the acidified silicate to treatment with alcohol and/or to cooling to remove the electrolytes formed, as described in the U. S. patent to Morris D. Marshall, No.2,285,449 and in the U. S. patent to John F. White, No. 2,285,477. It is also possible to use sols prepared by treatment of an alkali silicate with ion-exchange material, as described in the U. S. patent to Paul G. Bird, No. 2,344,325.

The concentration of the colloidal solution or sol used is relatively unimportant, as it is possible to employ a wide variety of solution strengths depending upon the type of apparatus used or the degree of pick-up which is possible in the particular apparatus employed for applying the sol. Generally, however, it is preferable to employ solutions having an SiO₂ concentration between 0.1 and about 10%, although concentrations as high as 30% can be used.

The alco-aqusuals used in accordance with this invention may be readily prepared from the aqusuals made by any of the above methods by merely mixing glycerine or other suitable polyhydric alcohol with the sol in appropriate proportions. Other suitable polyhydric alcohols include such water-soluble polyhydric alcohols as diethylene glycol and sorbitol. Alternatively, and anhydrous glycerol-sol or other polyhydric alcohol sol can be prepared in any desired manner, after which water is added in appropriate amounts to make an alco-aqusual.

In applying the alco-aqusual to the fabric to be treated, the fabric is first immersed or otherwise coated or treated with the sol, after which the treated fabric is passed through squeeze...
rolls and dried in any suitable manner well known to the art. The resulting fabric not only possesses exceptional qualities of slip control, but is also very desirable soft and full hand and is substantially free of dusting.

Other features and advantages of the invention will be apparent from the following examples:

**Example I**

A colloidal solution of silica was prepared as follows:

Seventy-three pounds of 66° Bé. H₂SO₄ were diluted with 358 pounds of water and charged to a mixing tank. Four hundred and seventy-two pounds of a sodium silicate solution containing 8.9% Na₂O and 29% SiO₂ were diluted with 377 pounds of water and added with stirring to the acid solution. The mixture set to a gel a few minutes after the mixing was completed. After 15’s the gel was stirred and the supernatant liquid was siphoned off and the gel crushed to one inch lumps. These lumps were washed with a continuous flow of water for 16 hours. The washed gel was then covered with 750 pounds of water containing 0.9 pound of NaOH. After standing 6 hours the supernatant solution was drained off and a portion of the gel was charged to an autoclave. The gel was heated to 35°C. hours, using steam at 215 pounds per square inch absolute pressure in the jacket of the autoclave. The contents of the autoclave were then blown out and the small amount of residual undisposed gel was removed by filtration. The solution so produced contained about 12.5% SiO₂ and was diluted with water until it contained only 0.5% SiO₂.

To the aquosol prepared as described above was added sufficient glycerine to provide, as sol containing 1.0% glycerine by weight. Viscose fiacre cloth was immersed in the resulting sol, and after passing through the sol was run through a pudder adjusted for 100% pick-up. The fabric was then dried and framed on a conventional tenter frame at a temperature of 130°C. In comparison with the untreated cloth of the same type, the treated fabric had more fullness of hand and greater slip resistance and tensile strength. Moreover, it had an exceedingly soft feel and was substantially free of dusting.

**Example II**

A silica aquosol containing about 12.5% SiO₂ was prepared as described in Example I. This was diluted with water until it contained only 3% SiO₂. To 98 pounds of the resulting aquosol was added 2 pounds of glycerine. Satin finished cotton lining was immersed in the resulting sol, and after passing through the sol was run through a pudder. The fabric was then dried on a conventional tenter frame at a temperature of 220°F. and, upon completion of the drying was found to contain about 2.5% SiO₂ on the dry weight of the fabric. The treated fabric showed a reduction in slippage of 82% as compared with the slippage displayed by the same fabric in the absence of treatment and had, in addition, a marked deplumeter effect. The fabric also possessed an exceedingly soft and full feel and was substantially free of dusting.

Equally effective results as those obtained in the above examples were obtained by employing other water-soluble polyhydric alcohols including diethylene glycol or sorbitol in the sols instead of glycerine in the proportions hereinbefore stated.

In the examples, reference is made to the treatment of viscose and cotton fabrics. It should be understood, however, that equally good results can be obtained with all types of textile materials, including in addition to those named above, cellulose materials, such as cellulose nitrate, cellulose acetate, cuprammonium rayon (Bemberg) and high tensile strength rayon (Fortisan); protein materials, such as natural silk and fibers made from the cassein in milk (Aralac); synthetic materials, such as fibers made of the copolymer of vinyl chloride and vinylidine chloride (Saran), the copolymer of adipic acid and hexamethylene diamine (polyamides), the copolymer of vinyl chloride and vinyl acetate (Vinyon), and glass fibers; and yarns and fabrics containing mixtures or blends of any two or more of the above materials.

The sols described herein may be applied either by spraying or by immersion, either with or without the assistance of padding or squeeze rolls or other types of extracting equipment. As a wide choice may be made in the strength of the solution used, it is possible to use all types of apparatus in applying the sols. Thus, the desired amount of silica may be applied to the yarns or fabrics by adjusting the concentration of the solution in accordance with the amount of pick-up possible with the particular apparatus employed. The per cent pick-up referred to herein is a measure of the amount of solution by weight picked up or retained by the fibers. For example, 100% pick-up means that the fibers have picked up an amount by weight of the sol or solution equal to the weight of the fibers.

The preferred sols for the purposes of this invention usually have, as initially prepared, a pH ranging from about 7 to 10. It is possible, however, to employ the sols at a somewhat lower pH, if desired. as for example where an acid reacting sol is desired. Thus, the sols may be applied to the fabrics within the range of 4 to 10 pH, depending on requirements and the most suitable pH for the particular fibers being treated.

Yarns and fabrics treated with the sols of this invention possess a fullness which is retained after washing, and when large enough amounts within the stated range are employed have a deplumetered appearance without added opaqueness. The sols also impart to yarns and fabrics a greater coefficient of friction or slip resistance than similar untreated yarns possess. This, in turn, results in yarns or fabrics of greater tensile strength. Fine knitted goods, such as hosiery, show a markedly increased wear, run and snag resistance, when treated with the sols made in accordance with the processes described herein. Moreover, the treated fabrics possess an exceptionally soft hand, and are substantially free of dusting.

The unusual advantages obtained as a result of the application of the sols described herein are believed to be due to the sub-microscopic roughness imparted by the deposit of exceedingly small particles of silica in the form of an inorganic resinous film. The silica films deposited have markedly different properties and effects on the yarn or fabric as compared with depositions of silica gel. The exceptional softness and freedom from dusting are, however, due primarily to the presence of the glycerine or other suitable polyhydric alcohol in the sol.

What I claim is:

1. A finishing agent for textile yarns or fabrics
consisting of a colloidal solution of silica in water containing from 0.5 to 30% by weight of silica and from 1 to 20% by weight of a water-soluble polyhydric alcohol selected from the group consisting of glycerine, diethylene glycol and sorbitol, said solution having a pH ranging from 7 to 10.

2. A finishing agent for textile yarns or fabrics consisting of a colloidal solution of silica in water containing from 0.5 to 30% by weight of silica and from 1 to 20% by weight of glycerine, said solution having a pH ranging from 7 to 10.

3. A finishing agent for textile yarns or fabrics consisting of a colloidal solution of silica in water containing from 0.5 to 30% by weight of silica and from 1 to 20% by weight of diethylene glycol, said solution having a pH ranging from 7 to 10.

4. A finishing agent for textile yarns or fabrics consisting of a colloidal solution of silica in water containing from 0.5 to 20% by weight of silica and from 1 to 20% by weight of sorbitol, said solution having a pH ranging from 7 to 10.

DONALD H. POWERS.

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