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# ALIEN PROPERTY CUSTODIAN

## TREATMENT OF YARNS

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This application is a division and continuation in part of my copending application Ser. No. 245,791 of Dec. 14th, 1938, and refers to the treatment of yarns with cuprammonium cellulose solution. More especially the invention refers to the use of such cellulose solutions which are readily fluid. Ordinarily the solutions of cellulose within copper-oxide ammonia are rather thick like a paste or a syrup; in contradistinction thereto according to my present invention cuprammonium cellulose solutions are used of a fluidity like machine oil at ordinary (room) temperature, that is a viscosity of about 500 to 3,500 and preferably between 700 and 1,700 on the Saybolt scale.

The fluidity in question can be obtained in different ways, for instance by a protracted stirring of the solution, preferably in the presence of oxygen or an oxygen containing gas like air, or by means of an increased content of ammonia or by a reduced content of cellulose or by a number or all of these steps. I prefer, however, a two step process in which firstly a paste-like solution with about 8% air dry cellulose that is about 7.2% totally dry cellulose is manufactured which is then diluted with aqueous ammonia to the consistency of machine oil and a cellulose content of 3 to 4% calculated on totally dry cellulose. A mixture of equal parts of concentrated ammonia solution of the specific weight 0,930, and of water is a suitable solution for diluting. I found that this method provides a cellulose solution which is very useful for the purpose in that it has the suitable fluidity and can readily be stored and managed without spontaneous decomposition and its cellulose remains relatively unattacked.

Suitable copper sources are all the neutral and basic copper salts or copper hydrate. I, however, prefer solutions of neutral copper sulphate in aqueous ammonia to which alkali hydroxide for example soda lye is added in a quantity approximately sufficient to transform the copper sulphate present in the solution to copper hydrate. The amount of the ammonia in the first solution calculated as pure $NH_3$ may be approximately or near half the quantity of the copper sulphate in the form containing water of crystallisation.

Any source of cellulose may be used for instance wood cellulose, cotton and cotton linters, but I prefer to use waste of vegetable fibres for instance the waste fibres obtained in teasing or shearing fabrics, or the waste in spinning mills. Such waste has the character of dust and consists of very short cut or torn cellulose-fibres or fragments thereof which are practically worthless but which I found very suitable since the fragments of fibres dissolve more easily than the intact fibres.

The waste may be bucked and/or bleached to remove dirt, size and undesired colour.

The mixture of the ingredients mentioned above is well cooled preferably to about the freezing point but not beneath —10° C, and stirred and kneaded until a homogeneous mass is obtained which can be stored at will, and diluted with aqueous ammonia before use as herein before described. The quantity of cellulose should be preferably so calculated that the copperoxide ammonia present in the solution is entirely or approximately saturated with cellulose so that the solution has practically no etching properties.

With this diluted solution I impregnate threads or yarns consisting of vegetable or artificial fibres, but remove the excess solution from the threads or yarn. This removal should be as complete as possible since the interstices between the individual fibres in the yarn should be kept empty to avoid adhesion of the fibres as far as possible, and to retain the filling and covering power of the yarns. This can be secured by squeezing or centrifuging or by other mechanical methods which are well known in the art for removing an excess of a readily fluid material, so that the single fibres are merely coated by a thin film of cellulose solution. Then follows a treatment with a precipitating medium like water, alkali lye and the like, say soda lye from 4 to 20° Bé, and subsequently with a decoppering solution like an acid salt or an acid for example diluted sulphuric acid, e. g. from 2 to 15% $H_2SO_4$. Precipitation and decoppering may also be performed by one and the same suitable substance in a single process; diluted acids preferably sulphuric acid are suitable media for this purpose. I found that precipitation by a medium which is not acid, and decoppering with an acid substance provides a lustrous product, whilst the one step process in which precipitation and decoppering is obtained at once by a single acid solution, provides a mat product.

The decoppered yarn is neutralised, washed and dried in usual manner.

The yarn can be of any kind and in any form. The term "yarn" comprises every article of mainly one-dimensional extension which is composed of fibres or filaments arranged about lengthwise, and twisted together by a variable twist. The term "yarn" includes therefore ordinary yarns and threads as well as slubbings, rovings and similar intermediate stages of the spin-

ning process. The fibres or filaments may consist of natural cellulose, or of cellulose regenerate or derivative in the case of artificial threads or of mixtures thereof. The individual threads or filaments may be short (in the case of vegetable fibres or artificial wool) or practically endless (in the case of rayon).

The yarn can be loose in the form of hanks and the like, or may be wound in the form of bobbins, cheeses and the like.

By my process the individual fibres do not stick together so that, in the case of rovings or slubbings, the drawing and spinning process is not impeded, and, in the case of yarns, they retain their filling and covering power. The products treated according to my invention, get a pleasant and durable touch. If the fibrous material consists of cotton, the treatment increases the dyeing capacity more particularly in respect of substantive or vat dyes. Yarns of cellulose derivatives e. g. cellulose ester or ether are altered by the treatment in such a manner that they can be dyed with ordinary dyes which go on cellulose.

If fibres of regenerated cellulose or cellulose derivatives or mixtures of natural (vegetable) fibres with fibres of regenerated cellulose or cellulose derivative are treated in yarn form, the artificial fibres receive an increased resistance with respect to certain solutions employed in subsequent treatment. Thus for example yarns of artificial fibres alone or in mixture with other fibres are less damaged by bucking and bleaching if they are pretreated according to my invention than if the raw fibrous material were subjected to bucking and bleaching.

Particular advantages are obtained in treating warps. This process may be performed continuously while winding on the warp on the beam.

The warp is wound off from another beam or directly from the warp bobbins and led through the different solutions mentioned above, and finally dyed, before winding on the warp beam. The removal of the excess cellulose solution is performed for instance by a rubber coated pair of rollers.

In some cases it is advisable after the treatment with the cellulose solution, to dry the textile material wholly or in part by exposure to the outer atmosphere or by means of hot air.

In every case the yarn is finally neutralised, washed and dried in known manner.

*Examples*

1. A cheese of cotton yarn or a mixed yarn of cotton and artificial fibres is impregnated by the creel system with a cuprammonium cellulose solution containing 3% cellulose and of a viscosity of a machine oil at ordinary tempertaure; the excess solution is pressed out with a compressed gaseous ammonia containing mixture f. i. air and gaseous ammonia which can easily be obtained by leading air through concentrated aqueous ammonia. Then the thread is treated with soda lye. For this purpose the thread may be unwound and guided through a warp smoothing machine and then, perhaps after further partial drying, the cellulose is regenerated on the fibres by diluted sulphuric acid of 6% $H_2SO_4$.

The threads which are treated with the cellulose solution and freed from the excess thereof, may at once be treated with diluted sulphuric acid of about 4% $H_2SO_4$.

2. A mixed yarn consisting half of cotton and half of fibres of cellulose acetate (or cellulose nitrate or ethyl cellulose or benzyl cellulose) is impregnated with a cuprammonium solution having a fluidity of a motor oil at 20° C i. e. between about 1,500 to 2,500 on the Saybolt scale and containing 2½% cellulose (calculated in air dry condition), freed from the excess solution and treated with one or more solutions adapted to precipitate the cellulose and/or decopper the precipitate. The material can be treated firstly with a dilute alkali lye, e. g. NOH of 5° Bé, and subsequently with sulphuric acid of 3% Bé, or it can be treated in one step merely with diluted sulphuric acid of slightly less strength say 2° Bé. After neutralisation and washing, the material is dried.

The yarn can be dyed with dye stuffs which go on cotton with difficulty and do not go on cellulose derivatives.

When the yarn is in hank or in bobbin form, all or but a part of the steps of the process can be performed in this form, while other steps, preferably the precipitating and/or decoppering step can be performed on the free thread f. i. during unwinding.

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