This invention relates to foldable, highly water resistant, stiffened textile sheet material of very high dimensional stability, which can be printed by means of lithographic printing methods, and to a process for the production thereof.

"Dimensional stability," i.e. in the sense of stability against reversible changes in dimensions of sheet material caused by changing degrees of humidity, is of high importance even relating to the actual use of maps, drawings, and like, but also in lithographic multicolor printing itself, since even small dimensional changes caused physically by the printing inks or mechanically by the printing treatment prevent the print from being accurate. In use, maps and drawings should remain substantially unaffected as to areas of drawings or lengths of lines under different degrees of humidity and under different temperatures. Sheet material useful for maps, drawings, paper money or documents of all kinds should further be extremely resistant to abrasion, to folding and other forms of mechanical wear. Sheet material should also be capable of being printed in the form of single sheets in contrast to printing methods almost exclusively used in the textile industry, where printing is performed not on sheets of relatively low area but on the full length of the pieces as woven on the loom.

The influence of this water take-up on dimensional stability has been known in the field of plastics, but it has not become manifest to any important degree in the textile field, since in the case of fabrics dimensional changes of the fibre material itself caused by changes of the relative humidity of the surrounding atmosphere are dwarfed in comparison by the total influence on fabric dimensions, i.e. by factors related to spinning, twisting, fabric construction, tightness of the weave, and the like. For example, although cellulose swells if wetted, i.e. the dimensions of the material itself increase, it is generally known that a yarn spun from rayon staple may be governed by structural factors as mentioned that structural influences reverse the dimensional change brought about by the water take-up by the material itself.

The term "dimensional stability" meaning stability against reversible changes of dimensions caused by changing degrees of humidity is, therefore, not known in the textile industry. It is therefore used for changes of dimensions caused by wet treatments, such as washing and steaming, or by wear. This kind of dimensional stability, which is in the textile trade also known as "fastness to shrinking," "shrinkage control," and so on, is basically different from that mentioned above, i.e. water take-up on dimensional stability of the fibre material itself, which is manifest by the fact that it is impossible to predetermine shrinkage properties of a fabric merely by selecting from a strictly chemical point of view the fibre material to be used, disregarding spinning, throwing and weaving factors.

Attempts have been made to produce printed matter from textile material such as fabrics, which during use is subjected to weathering, humidity and strong mechanicalwear. This applies to sheet material used for drawings, maps, documents, paper money, and the like. Prints on ordinary textile material, however, due to the ease of movement between individual fibres and between groups of fibres, never can provide a dimensional stability sufficient for use as maps or drawing paper. This is particularly true when the textile material is in a wet state. On the other hand, mechanical properties of paper are much inferior to those of textiles of comparable weight.

It has also been proposed to coat glass fibre fabrics with resinsious material such as alkyd resins in order to obtain drawing material of high dimensional stability. Glass fibre fabrics have, however, some serious disadvantages. First, glass fibres have very high rigidity and a tendency rather low for forming a fabric, unless the fabric is almost exclusively governed as to areas of drawings or lengths of lines under different degrees of humidity and under different temperatures.

Thus, according to this invention there is provided a process for producing textile sheet material having high dimensional stability and high resistance to mechanical wear and capable of being printed by lithographic methods comprising treating a textile sheet material formed predominantly of organic fibres having a water take-up of less than about 5% and having a dimensional stability in the sense of stability against reversible changes in dimensions of the sheet material caused by changing degrees of humidity, high resistance to mechanical wear, and capable of being printed by lithographic methods comprising sheet material formed predominantly of organic fibres having a water take-up of less than about.
3,044,891

1.5%, by weight, at 20° C. and 65% relative humidity, the surface of said fibres having been freed from substantially all adhering impurities, having a coating resulting from a composition comprising (1) a pre-condensate of a thermosetting resin, (2) a cross-linking agent capable of reacting with at least two hydroxyl groups, (3) a polymeric compound capable of being rendered substantially water-insoluble by reaction with said cross-linking agent, and (4) a catalyst capable of catalyzing the curing of said thermosetting resin pre-condensate and the cross-linking action of said cross-linking agent.

It has been found that sheet material consisting of organic fibres with low water take-up such as 1.5% and preferably 0.5% or less gives much higher dimensional stabilization than those produced of fibres which take up a greater quantity of water such as 4% or more of water. A fabric woven from hexamethylenediamine/dipate, water take-up of 4.5%, after being treated according to the present specification gave for instance in warp and weft directions a dimensional change more than ten times higher than that of an identically treated fabric made of polyethylene-terephthalate, water take-up of only 0.4%, when both fabrics were first conditioned in 60%, then in 80%, relative humidity. The dimensional stability to changes of humidity occurring in actual use of sheet material obtained by the process according to the present invention is so high that this coated material to temperature changes occurring in actual use.

Textile sheet materials suitable for the treatment according to the present invention are fabrics such as those woven from single yarns, or twisted yarns spun from filaments or cut staple fibres, or sheet material produced by bonding fibres together by means of polymeric materials such as polymers of acrylic compounds, these fibres being either randomly distributed or oriented. The latter type sheet material is usually referred to as "unwoven fabric" and will be thus termed throughout the present specification. This sheet material, i.e. woven and unwoven fabrics, consist wholly or predominantly, e.g. about 75% or more, by weight, of organic fibres having at 20° C. and 65% relative humidity a water take-up of less than about 1.5%, preferably not more than 0.5%.

Typical of the materials from which the fibres may be made, as for example by spinning, are polymeric esters of a polyhydric alcohol such as polyethylene glycol and a polybasic acid such as terephthalic acid. Polyethylene terephthalate is a preferred fibre material having a water take-up of only about 0.4% at 20° C. and 65% relative humidity.

Other fibre materials include acrylic polymers, such as polyacrylonitrile, and vinyl polymers such as vinyl chloride, polyvinyl alcohol, polyvinylidene chloride, polyethylene, polyisopropylene, and the like. Copolymers of acrylic compounds and vinyl compounds are also suitable for forming fibres of the sheet material, among which may be mentioned copolymers of acrylonitrile with vinyl chloride, and vinyl acetate, and polyvinylidene chloride—polyvinyl chloride copolymers.

Other polymeric materials suitable for forming the fibres of sheet material according to this invention are modified cellulose, for example cellulose modified with acid such as cellulose triacetate, polycrylamides having at least ten methylene groups in the main polymer chain between recurring carbamide groups, such as polymeric omega-amino-undecylic acid and polyurethane; polycrylamides produced from glycols having at least four methylene groups between hydroxy groups, and disocyanates having at least six methylene groups between isocyanate groups.

Organic fibres such as mentioned above are much less rigid than glass fibres and have much higher folding endurance. They provide much higher adhesion to waterborne improving agents, and adhesion of coatings such as described hereinafter is very good, even if the coating does not form a continuous film, i.e. with low or only moderate amounts of coating agents.

It has been found that best results are obtained by removing impurities adhering to the fibres as completely as possible before applying the coating composition. This composition not only contains a composition comprising (1) a pre-condensate of a thermosetting resin, (2) a cross-linking agent capable of reacting with at least two hydroxyl groups, (3) a polymeric compound capable of being rendered substantially water-insoluble by reaction with said cross-linking agent, and (4) a catalyst capable of catalyzing the curing of said thermosetting resin pre-condensate and the cross-linking action of said cross-linking agent.

Impurities which are removed by the cleaning step are: sizes, spinning oils, softeners, antistatic agents, wetting agents, humidifying agents, insufficiently polymerized fibre material, secondary reaction products formed in polymerisation, in spinning or in processing of the fibre material, or extraneous matter or soil of any kind which adheres to the textile sheets.

Such impurities are usually and incompletely removed by scouring treatments which in textile finishing usually precede dyeing or bleaching. Thus, in order to get complete removal one may either apply usual scouring methods under more severe conditions, such as at higher temperatures, for prolonged periods and/or with higher concentrations of washing agents than usual, or applying the bath repeatedly to avoid redeposition of the impurities removed from the fibres, or one may increase the scouring action by mechanical means such as strong agitation of the bath and/or the textile material, or physically by the action of sonic or ultrasonic waves.

Fibre particularly free of impurities are obtained by subjecting the textile sheet material to the action of agents capable of dissolving, degrading or very strongly swelling the fibre material under conditions as to concentration of the agent, temperature and duration of the treatment, which cause only superficial changes of the fibres without substantial loss of fibre strength. Impurities are thus removed very efficiently and rapidly without seriously affecting the mechanical properties of the fibre material and without making fibres stick together. Adherence of the composite improving agent applied subsequently to the textile sheet is thus prevented to the high eroding action of the treatment. Examples of such treatments are: treatment of polyester fibres with aqueous solutions of alkali hydroxides, treatment of poliamide fibres with acids or acidic compounds, treatment of acrylic fibres with compounds capable of dissolving such fibres. These compounds may be applied in the form of solutions and emulsions, or in vapor phase. The application of solvents of course is not limited to acrylic fibres, but may be extended to all fibres suitable for the process according to the present specification. Other treatments include superficially saponifying triacetate fibres or other fibres with saponifiable end groups with compounds of alkaline reaction, and strongly swelling polyester or acrylic fibres with phenolic compounds. All these agents should be subsequently removed from the textile material by thoroughly rinsing, neutralizing or other suitable means.

Such agents as mentioned above may be added to the scouring bath, to bleaching liquors or any other wet treatment bath, or they may be applied in separate baths. Nonionic, anionic or cationic surface active agents may be used in scouring and/or rinsing operations, and solutions or emulsions or dispersions of compounds having a solvent action on impurities may be used. These cleaning operations may be combined with bleaching or dyeing.
ing, i.e. a superficial dissolution may for instance be effected either in an alkaline bleaching bath or prior to or subsequently to bleaching or any other pretreating operation usually applied to synthetic textile material.

As stated above, the coating composition employed in the present invention, i.e. a superficial dissolution may for instance be effected either in an alkaline bleaching bath or prior to or subsequently to bleaching or any other pretreating operation usually applied to synthetic textile material. Substantially insoluble by reaction with said cross-linking agent, and (4) a catalyst capable of catalyzing the completion of the pre-condensate form condensation and cross-linking of the cross-linking agent. Suitable heat-setting resins, used in form of soluble pre-condensates, are for instance reaction products of amides with aldehydes, for example reaction products of melamine, urea, substituted urea, dicyandiamide, and hydantoin with formaldehyde, glyoxal, and acrolein. Other thermosetting resin pre-condensates which may be employed are reaction products of aldehydes with ketones or with phenolic compounds; however these pre-condensates tend to discolor on storage or on exposure to light. Thus, the amide-aldehyde pre-condensates are preferred.

Polymeric compounds capable of being rendered insoluble by the action of the cross-linking agent and hence suitable for incorporation into the composite improving agent comprise, for example, oligomers thereof, polyvinyl alcohol or derivatives thereof, polyesters having hydroxy end groups, other polymeric bodies carrying a plurality of hydroxy groups or other functional groups capable of reacting with the cross-linking agent.

Ratios between pre-condensate of heat-setting resin, cross-linking agent and polymeric compound capable of being rendered insoluble vary depending on the particular ones selected, the structure and kind of the fibre material, and the textile goods used, and the effects desired. Generally speaking, the ratio between the combined dry weights of the resin pre-condensate plus the cross-linking agent and the polymeric compound may vary from 1:2 to 2:1, 2:3 being a preferred ratio, while the ratio between resin pre-condensate and cross-linking agent may vary in wider range, i.e. from about 1:10 to about 10:1. All the ratios given above apply to the dry weight of the materials.

Expressed in terms of weight percent, the pre-condensate may comprise from about 20 to about 34%, the cross-linking agent from about 10 to about 45% and the polymeric compound capable of being rendered substantially water-insoluble by reaction with the cross-linking agent from about 20 to about 60%.

The composite improving agent or coating composition may be applied to the textile material thus pretreated by padding, spraying, printing or by any one of the known coating methods, either in one or several steps. It may be applied as an aqueous or non-aqueous solution, as an emulsion or as a dispersion.

The cure of the resin pre-condensates and the insolubilization of the polymeric compounds is affected by catalysts, usually at elevated temperatures. Particularly suitable as catalysts are acidogenic compounds, i.e. compounds showing acidogenic reaction or potential acid reaction. Such catalysts have been known for a long time. In cases where isocyanates are used as cross-linking agents adding nitrogenous compounds as catalysts for the reaction of the isocyanate groups with hydroxy groups may prove advantageous.

In addition to the resin pre-condensate, the cross-linking agent, the polymeric compound and the catalyst, the composite improving agent may also contain other known agents such as fillers, pigments, abrasives giving "tooth" to the surface, i.e. improving the reception of the graphite markings from drawing pencils, softening agents, dyes, substantive dyeing agents, plastifying agents, silicones, flameproofing agents, compounds sensitive to light or to other sources of radiation.

The stretching step mentioned before may be effected in the pretreatment or in any subsequent phase, but prior to the curing step. It prevents unevenness of the end product, formation of creases and wrinkling. It is preferably effected in combination with drying, padding, coating, calendering, either in wet state or dry, either by stretching in both a longitudinal and transverse direction simultaneously or at different times.

To modify the surface to make it smooth or provide a pattern such as for instance fine parallel lines, or to give it "tooth," the textile sheet material may be subjected to mechanical deformation, in particular to calendering, schreinerling or embossing, in any phase after the precleaning step, but prior to the final curing step, preferably at elevated temperatures, which are, however, at least 20°C. below the softening point of the thermosetting fibre material, i.e. at least 20°C. below the temperature where the thermoplastic properties of the material become manifest, in order to avoid fusing together of the yarns at their intersections, which would severely affect the tearing strength of the sheet material.

Not only mechanical deformation involving heat is, according to the present specification, to be effected under conditions as to temperature and/or pressure which prevent the fusing together of yarns at yarn intersections.

The sheet material treated according to the present invention may, after the curing step, be cut into sheets of any desirable dimensions and then printed, or it may be printed in full length prior to cutting. Also, the sheet material may be treated, in full length or after cutting, with known agents, such as agents sensitive to light or other kinds of radiation, with slightly abrasive agents to improve the reception of graphite markings from the drawing pencil, and the like.

The following are examples of this invention.

**Example 1**

A cretonne fabric made of 70 denier filament yarn spun from polyethylene terephthalate, water take-up of 0.4% at 20°C. and 65% relative humidity, is scoured for one hour at 80°C. in the presence of a nonionic detergent, the bath being dropped twice. It is then dried on a stenter frame to grey width by exerting weftwise tension. The fabric is then coated by means of a doctor blade, which is mounted in front of a drum of 95° in diameter heated to 100°C. The fabric passes under the knife cutter and then around the drum, where it is dried. Warpwise tension is applied during the coating treatment. The coating composition used for coating consists of:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Grams per liter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimethylolmelamine (thermosetting resin pre-condensate)</td>
<td>60</td>
</tr>
<tr>
<td>Formaldehyde (cross-linking agent)</td>
<td>60</td>
</tr>
<tr>
<td>Polyvinyl alcohol (polymeric compound)</td>
<td>180</td>
</tr>
<tr>
<td>Ammonium sulfate (acidic catalyst)</td>
<td>20</td>
</tr>
<tr>
<td>Titanium dioxide (pigment)</td>
<td>50</td>
</tr>
</tbody>
</table>

The fabric is coated once on one side and twice on the other, the fabric being dried on the drum after each coating. It is then calendered under 40 tons pressure at 120°C., and finally heat-treated for 4 minutes at 130°C. to obtain curing of the resin and insolubilization of the polyvinyl alcohol by reaction with formaldehyde.

The fabric thus treated is rather stiff and can be printed in the form of sheets on lithographic printing equipment.
used for printing of paper. Dimensional stability and resistance to mechanical wear are good. No appreciable deterioration takes place if the fabric is buried in soil for several weeks.

**Example II**

The process of Example I is repeated with the exception that the pre-treatment (scouring) described in the previous example is intensified by the addition of caustic soda to the scouring bath.

**Example III**

The process of Example I is repeated with the exception that the following coating composition is employed:

<table>
<thead>
<tr>
<th>Parts by weight</th>
</tr>
</thead>
</table>

| Dimethyl-ethylene urea (thermosetting resin pre-condensate) | 3 |
| Glyoxal (cross-linking agent) | 2 |
| Starch (polymeric compound) | 6 |
| Triethanolamine hydrochloride (acidic catalyst) | 6 |
| Diatomaceous earth (mild abrasive) | 5 |

**Example IV**

A fabric (toile) made of polyethylene terephthalate fibres (filament, 80 denier in warp, 60 denier in filling) is pre-cleaned by treating with aqueous solutions of sodium hydroxide at 20° C, with caustic soda of 25 to 30° Baumé strength until the fabric has lost 6 to 8% of its weight (the caustic soda reacting superficially with the polyester fibre and thus removing surface impurities very thoroughly). After neutralizing and rinsing the fabric is coated as described in Example I with the coating composition described in said example. The sheet material thus obtained is much stiffer and the adhesion of the coating to the fabric much better than in the case of the same fabric washed with water instead of being pre-treated with alkali. Dimensional stability is 2 to 3 times higher than that of high quality lithographic paper.

**Example V**

A fabric (taffeta) made of fibre spun from polyacrylonitrile (Orlon 81 manufactured by Du Pont) is thoroughly pre-cleaned by superficially modifying the fibre chemically and eroding it at the surface by treatment for 10 seconds with the solution of 10%, by weight, of sodium hydroxide in ethylene glycol at 150° C, followed immediately by neutralization in dilute hydrochloric acid and rinsing until the fabric shows neutral reaction. The fabric is then bleached with sodium chlorite in the presence of phosphoric acid, and dried under wetwise tension. Prior to applying the composite improving agent the fabric is calendered under 30 tons pressure at 140° C. in order to obtain a smooth surface. The fabric is coated with the following composition:

<table>
<thead>
<tr>
<th>Grams per liter</th>
</tr>
</thead>
</table>

| Dimethyl urea (thermosetting resin pre-condensate) | 60 |
| Quaker Reactant SC, polymeric condensation product of formaldehyde and acetol (cross-linking agent) | 90 |
| Oxy-ethyl starch (polymeric polyhydroxy compound) | 150 |
| Silicone hydrophobing agent | 30 |
| Magnesium chloride (acidic catalyst) | 20 |
| Organic pigment (blue) | 3 |

Each side of the fabric is coated once under tension warpwise. The fabric is then heated to 140° C. for 5 minutes for curing.

**Example VI**

A fabric (sateen) made of cellulose tricacetate fibres is pre-cleaned by treating it with an aqueous emulsion of methyl isobutyl ketone. It is then dyed, thoroughly rinsed and dried. The following composite improving agent is applied by padding:

| 50 parts dimethyl ethylene urea (resin pre-condensate) |
| 30 parts polyvinyl alcohol (polymeric compound) |
| 10 parts zinc fluoroborate (acidic catalyst) |
| 500 parts (water) |

The fabric is dried under tension in warp and weft and then heat-treated at 160° C. for 3 minutes without tension.

**Example VII**

An unwoven fabric sheet material consisting of "Rilsan" polyamide fibres, in which the polyamide has ten methylene groups in the main polymer chain between recurring carbamide groups and produced from omega amino-undecanolic acid (water take-up under normal conditions 1%) treated with Chemigum Latex, a copolymer of acrylonitrile and an acrylic acid ester (manufactured by Goodyear Chemical Corp.) is treated for 10 to 15 seconds with hydrochloric acid (13% strength) at 50 to 80° C. to obtain superficial degradation of the polyamide fibre and hence complete removal of impurities, and to make the fibre surface more receptive to the composite improving agent by slight surface erosion. The unwoven fabric is immediately afterwards neutralized and rinsed thoroughly. After drying it is sprayed with the composite improving agent described in Example I, dried and heat-treated to cure the resin.

**Example VIII**

A fabric (toile) made of staple fibre material spun from a copolymer of acrylonitrile and vinyl chloride (Dyneal manufactured by Union Carbon & Carhide) is pre-cleaned by first scouring in the presence of an anionic detergent and an emulsifying agent and then bleaching with sodium chloride. After rinsing the fabric is dried under light wetwise tension. It is then coated as described in Example I under warpwise tension, calendered at 50° C. and cured at 110° C. for 12 minutes.

**Example IX**

A fabric made of polyvinylidene chloride copolymerised fibre (Soran manufactured by Dow Chemical Company) is pre-cleaned by scouring in a bath containing a nonionic detergent and emulsified perchloroethylene. After drying it is coated with the following composition:

| 15 parts dibutyl ether of dimethyl urea (resin pre-condensate) |
| 5 parts polyisocyanate, pre-reacted toluene diisocyanate produced by reacting excess of toluene diisocyanate with a polyolefine (Imprefax TH manufactured by Bayer, Leverkusen, Germany) (cross-linking agent) |
| 30 parts polymeric polyhydroxy compound comprising an alkyl resin, i.e. a polyester with hydroxy end groups (Caloree CA manufactured by I.C.I., Manchester, England) |
| 5 parts Imprefax BE, tetra-alkyd titanate (catalyst, manufactured by Bayer, Leverk.) |
| 250 parts (ethyl acetate free of ethyl alcohol as solvent) |

Two coatings on the same side are applied. The fabric is dried after each coating and then heat-treated for 10 minutes at 130° C. to obtain curing of the resin pre-condensate and fixation of the polymeric polyhydroxy compound.
A fabric (taffeta) made of polyethylene fibres is pre-cleaned and coated as described in Example 1.

**Example XI**

The fabric pretreated and coated according to Example II, after the curing step is coated with an emulsion of compounds sensitive to light such as used for the production of paper used for taking photosets.

Sheet material obtained by the process according to the invention proved to be far superior to high quality paper in dimensional stability as well as mechanical properties, as is shown by the data given below:

A—Sheet material produced according to the present invention

B—Lithographic paper as used for high-quality map-printing

<table>
<thead>
<tr>
<th>Dimensional change per 1% change of relative humidity in the range of 50 to 80% relative humidity: longitudinal direction, percent</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.086</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>0.088</td>
<td>0.17</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensional change per 1% change of relative humidity in the range of 35 to 65% relative humidity: longitudinal direction, percent</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.088</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>0.086</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>0.088</td>
<td>0.13</td>
<td></td>
</tr>
</tbody>
</table>

A comprehensive table showing the dimensional stability is given below:

As is seen from the above table the product as obtained according to the present invention is far superior to paper. It also shows much more uniform dimensional stability, i.e. in the case of paper dimensional changes in longitudinal direction are distinctly different from those in transverse direction, while in the case of product A both directions give similar values.

The dimensional stability of product A in fact is in the same range with that of metal under changes in atmospheric conditions as are likely to occur in use. In the case of the product produced according to the invention such mechanical properties as tearing strength, tensile strength, and bursting strength can easily be predetermined, and can be varied at will in one or both directions, simply by using textile fabrics of suitable construction and composition and thus adapted to the requirements of the intended end use of the product without unduly increasing weight and thickness, while in the case of paper this is hardly possible.

Fabrics may be heat-set after the precleaning step or in any phase afterwards to get uniform appearance or resistance to creasing in subsequent wet treatments taking place prior to the application of the composite improving agent. It has, however, been found that heat-setting hardly improves dimensional stability of the end product.

Product A will be understood that dimensional changes and substitutions may be made of the materials and the method of their preparation and use without departing from the spirit of the invention especially as defined in the appended claims.

We claim:

1. A process for producing textile sheet material having high dimensional stability and high resistance to mechanical wear and capable of being printed by lithographic methods comprising treating a textile sheet material formed predominantly of organic fibers having a water take-up of less than about 1.5%, by weight, at 20°C, and 65% relative humidity to remove impurities adhering to said fibers, applying to said textile sheet material a coating composition consisting essentially of (1) from about 20 to about 34%, by weight, of a pre-condensate of a thermosetting resin consisting of the reaction product of an amide with an aldehyde, (2) from about 10 to about 45%, by weight, of a cross-linking agent capable of reacting with at least two hydroxyl groups selected from the group consisting of aldehydes containing not more than three carbon atoms, polyisocyanates, and polyepoxides, (3) from about 20 to about 60%, by weight, of a polymeric compound capable of being rendered substantially water-insoluble by reaction with said cross-linking agent selected from the group consisting of starch, starch derivatives, polyesters having hydroxyl end groups, and vinyl compounds carrying a plurality of hydroxyl groups and (4) an acidic catalyst capable of catalyzing the curing of said thermosetting resin pre-condensate and the cross-linking action of said cross-linking agent, and heating said textile material to cure said thermosetting resin pre-condensate and to effect cross-linking of said polymeric compound by means of said cross-linking agent, said textile material being subjected to tension in both a longitudinal and transverse direction during said process and prior to said heat treatment.

2. The process according to claim 1 in which said textile sheet material comprises at least 75%, by weight, of organic fibres having a water take-up of less than about 0.5% at 20°C and 65% relative humidity.

3. The process according to claim 1 in which said textile sheet material is subjected to tension subsequent to said treatment for removing impurities adhering to said organic fibres.

4. The process according to claim 1 in which said textile sheet material consists substantially entirely of organic fibres having a water take-up of less than about 1.5% at 20°C and 65% relative humidity.

5. The process according to claim 1 in which said textile sheet material is subjected to mechanical deformation subsequent to said treatment for removing impurities adhering to said organic fibres and prior to said heat treatment, the temperature of said textile material during said mechanical deformation being at least about 20°C below the softening range of the organic fibres comprising said textile material.

6. A process for producing textile sheet material having high dimensional stability and high resistance to mechanical wear and capable of being printed by lithographic methods comprising treating a textile sheet material formed predominantly of organic fibers having a water take-up of less than about 1.5%, by weight, at 20°C, and 65% relative humidity to remove impurities adhering to said fibers, applying to said textile sheet material a coating composition consisting essentially of (1) from about 20 to about 34%, by weight, of a pre-condensate of a thermosetting resin consisting of the reaction product of an amide with an aldehyde, (2) from about 10 to about 45%, by weight, of a cross-linking agent capable of reacting with at least two hydroxyl groups selected from the group consisting of aldehydes containing not more than three carbon atoms, polyisocyanates, and polyepoxides, (3) from about 20 to about 60%, by weight, of a polymeric compound capable of being rendered substantially water-insoluble by reaction with said cross-linking agent selected from the group consisting of starch, starch derivatives, polyesters having hydroxyl end groups, and vinyl compounds carrying a plurality of hydroxyl groups and (4) an acidic catalyst capable of catalyzing the curing of said thermosetting resin pre-condensate and the cross-linking action of said cross-linking agent, heating said textile material to cure said thermosetting resin pre-condensate and to effect cross-linking of said polymeric compound by means of said cross-linking agent, said textile material being subjected to tension in both a longitudinal and transverse direction during said process and prior to said heat treatment.
3,044,891

Appendix

ble of catalyzing the curing of said thermosetting resin pre-condensate and the cross-linking action of said cross-linking agent, and heating said textile sheet material to cure said thermosetting resin pre-condensate and to effect cross-linking of said polymeric compound by means of said cross-linking agent, said textile material being subjected to tension in both a longitudinal and transverse direction during said process and prior to said heat treatment.

7. The process according to claim 6 in which said textile sheet material comprises at least 75%, by weight, of organic fibres having a water take-up of less than about 0.5% at 20° C. and 65% relative humidity.

8. The process according to claim 6 in which said textile sheet material is subjected to tension subsequent to said treatment for removing impurities adhering to said organic fibres.

9. The process according to claim 6 in which said textile sheet material consists substantially entirely of organic fibres having a water take-up of less than about 1.5% at 20° C. and 65% relative humidity.

10. The process according to claim 6 in which said textile sheet material is subjected to mechanical deformation subsequent to said treatment for removing impurities adhering to said organic fibres and prior to said heat treatment, the temperature of said textile material during said mechanical deformation being at least about 20° C. below the softening range of the organic fibres comprising said textile material.

11. The process according to claim 6 in which said textile sheet material is printed by lithographic methods subsequent to said heat treatment.

12. A textile sheet material having high dimensional stability and high resistance to mechanical wear and capable of being printed by lithographic methods comprising sheet material formed substantially entirely of polyethylene terephthalate fibers having a water take-up of less than about 1.5%, by weight, at 20° C. and 65% relative humidity, said fibers being substantially free from adhering surface impurities, and having a coating consisting essentially of the acid catalyzed product of reaction between about 20%, by weight, of trimethylol melamine, about 20%, by weight, of formaldehyde, and about 60%, by weight, of polyvinyl alcohol.

13. Textile sheet material according to claim 12 having lithographic printing on a surface thereof.

14. A textile sheet material having high dimensional stability and high resistance to mechanical wear and capable of being printed by lithographic methods comprising sheet material formed substantially entirely of polyethylene terephthalate fibers having a water take-up of less than about 1.5%, by weight, at 20° C. and 65% relative humidity, said fibers being substantially free from adhering surface impurities and having a coating consisting essentially of the acid catalyzed product of reaction between about 3 parts, by weight, of dimethylolethylene urea, about 2 parts, by weight, of glyoxal, and about 6 parts, by weight, of starch.

15. Textile sheet material according to claim 14 having lithographic printing on a surface thereof.

16. A textile sheet material having high dimensional stability and high resistance to mechanical wear and capable of being printed by lithographic methods comprising sheet material formed predominantly of organic fibers having a water take-up of less than about 1.5%, by weight, at 20° C. and 65% relative humidity, said fibers being substantially free from adhering impurities, and having a coating consisting essentially of the acid catalyzed product of reaction between about 20% of an amide with an aldehyde, (2) from about 10 to about 45%, by weight, of a cross-linking agent capable of reacting with at least two hydroxyl groups selected from the group consisting of aldehydes containing not more than three carbon atoms, polyisocyanates and polyepoxides, and (3) from about 20 to about 60%, by weight, of a polymeric compound capable of being rendered substantially water-insoluble by reaction with said cross-linking agent selected from the group consisting of starch, starch derivatives, polyelectrolytes, vinyl polymers carrying a plurality of hydroxyl groups.

17. A textile sheet material having high dimensional stability and high resistance to mechanical wear and capable of being printed by lithographic methods comprising sheet material formed predominantly of organic fibers having a water take-up of less than about 1.5%, by weight, at 20° C. and 65% relative humidity and comprising a material selected from the group consisting of polymers of a polyhydric alcohol and a polybasic acid, acrylic polymers, vinyl polymers, modified cellulose, and polyamides having at least ten methylene groups in the main polymer chain between reoccurring carbamide groups, said fibers being substantially free from adhering impurities, and having a coating consisting essentially of (1) from about 20 to about 34%, by weight, of a pre-condensate of a thermosetting resin consisting of the reaction product of an amide with an aldehyde, (2) from about 10 to about 45%, by weight, of a cross-linking agent capable of reacting with at least two hydroxyl groups selected from the group consisting of aldehydes containing not more than three carbon atoms, polyisocyanates and polyepoxides, (3) from about 20 to about 60%, by weight, of a polymeric compound capable of being rendered substantially water-insoluble by reaction with said cross-linking agent selected from the group consisting of starch, starch derivatives, polyelectrolytes, hydroxyl end groups, and vinyl compounds carrying a plurality of hydroxyl groups.

References Cited in the file of this patent

UNITED STATES PATENTS

2,385,714 La Piana et al. .......... Sept. 25, 1945
2,504,587 MacIntyre .......... Apr. 18, 1950
2,661,312 Richardson .......... Dec. 1, 1953
2,762,719 Kleiner et al. .......... Sept. 11, 1956
2,779,684 Alles .......... Jan. 29, 1957
2,804,402 Williams .......... Aug. 27, 1957
2,826,167 Cohn et al. .......... Mar. 11, 1958

FOREIGN PATENTS

573,574 Great Britain .......... Nov. 27, 1945

OTHER REFERENCES