

1

3,301,680

METHOD OF IMPREGNATING PAPER TO REDUCE CURLING TENDENCY AND RESULTANT ARTICLE

Oscar Bertil Otto Nycander, Sundasen, and Svenning Natanael Carlsson, Ludvika, Sweden, assignors to Mo Och Domsjö Aktiebolag, Örnsköldsvik, Sweden, a corporation of Sweden

No Drawing. Filed Feb. 7, 1964, Ser. No. 343,229
11 Claims. (Cl. 96—85)

The present invention relates to an impregnating composition for reducing the tendency to curling of paper and paper-like materials, in particular photographic paper, a paper or paper-like material impregnated with the composition and a method of impregnating paper and paper-like materials with the composition.

A problem of many cellulose sheet materials, in particular paper and paper-like material, is that under storage they show a strong tendency of curling on account of variations in air moisture. In particular papers coated with light-sensitive or thermosensitive materials, such as photographic papers, exhibit this tendency. This curling involves great difficulties in storage and handling of the materials, e.g. in the case of drawings, which are stored at a work place or in copying such materials.

Many attempts have been made to solve this problem, e.g. by impregnating the paper with low molecular weight alcohols or mixtures thereof. Such impregnations have initially given a relatively good resistance to curling, but the effect has disappeared already after a short time for various reasons, among them the volatility of the impregnating agent. Attempts have also been made to use higher polyalcohols, which on account of their greater molecular weight are not so volatile, and such substances have been shown to give a very good and lasting effect, but they show a tendency of being absorbed very slowly or not at all in the materials to be impregnated.

An object of the present invention is to provide an impregnating composition for reducing the curling tendency of paper or paper-like materials, which composition is free from the aforementioned disadvantages. Another object is to provide an impregnating composition for the purpose referred to, which is readily absorbed by paper and paper-like materials and provides a lasting resistance to curling of paper and paper-like materials treated therewith. A further object is to provide an improved method of treating paper and paper-like materials, in particular such materials coated with photosensitive or thermosensitive substances, by which method such materials can be made resistant to curling in a more efficient way. A still further object is to provide paper and paper-like materials which have a lasting resistance to curling.

The impregnating composition of this invention comprises one or more water-soluble polyalkylene glycols having a molecular weight of 100 to 6000 and a substance enhancing the absorption of the polyalkylene glycol in paper, said substance consisting of a water-soluble polyhydric alcohol having from 2 to 15 carbon atoms, the composition being also optionally diluted with water.

It is highly surprising that the addition of a water-soluble polyhydric alcohol having from 2 to 15 carbon atoms accelerates the absorption of the polyalkylene glycol into paper, since it might be expected that water would be the most suitable agent for that purpose. With water

2

alone, however, a lower rate of absorption is obtained than with the additives referred to.

The polyalkylene glycol or glycols employed should have a molecular weight such that they do not vaporize too readily from the paper, but on the other hand they should not have too high molecular weight, since then the impregnation of the paper is rendered difficult by the high viscosity and decreasing ability of penetration of the polyglycol. It is preferable to use a polyalkylene glycol or mixture of polyalkylene glycols having a molecular weight of between 500 and 1000. The most preferred polyalkylene glycol is polyethylene glycol, although polypropylene glycol, polybutylene glycol etc. in suitable molecular weights are also useful. It is also possible, in accordance with this invention, to use mixtures of different polyalkylene glycols wherein the alkylene groups are different e.g. polyethylene glycol and polypropylene glycol, or mixtures of the same polyalkylene glycol in different molecular weights.

Suitable water-soluble polyhydric aliphatic alcohols having 2 to 15 carbon atoms are dihydric, trihydric and higher aliphatic saturated or unsaturated alcohols, such as ethylene glycol, glycerol, propylene glycol, polyalkylene glycols having a molecular weight of not above 250, sorbitol, mannitol, pentaerythritol, 1,4-butanediol, 2,3-butanediol, 1,3-propanediol, 1,2-pentanediol, 1,4-pentanediol, 1,5-pentanediol, 2,3-pentanediol etc.

A suitable formulation of the composition according to the invention is from 0.2 to 5 parts by weight of the water-soluble polyhydric alcohol per part by weight of the polyalkylene glycol component having a molecular weight of between 100 and 6000. For use such a composition is suitably diluted with from 0.2 to 50 parts by weight of water per part by weight of the polyalkylene glycol component, e.g. so that the composition contains from about 5 to about 30% by weight of the polyalkylene glycol component, based on the whole composition.

Impregnation of paper with this composition can be carried out by well-known methods such as dipping or spraying methods. In the case of a paper or paper-like material coated with a photosensitive or thermosensitive layer, the composition can be introduced either before or after application of the photosensitive or thermosensitive coating.

The invention is illustrated by but not limited to the following examples, which show various compositions within the scope of the invention as well as the results obtained therewith as regards the absorption of polyalkylene glycol by photographic paper. Percentages are by weight.

Example 1

Impregnating baths were prepared which contained each 108 g. of polyethylene glycol (molecular weight 600) and 730 g. of water together with (a) 110 g. of ethylene glycol and 84 g. of glycerol, (b) 194 g. of ethylene glycol, (c) 194 g. of glycerol, and (d) 194 g. of propylene glycol. For comparison, a bath (e) was also prepared which contained 108 g. of the same polyethylene glycol and 924 g. of water.

Sheets of Kodak Projection Document Paper, Medium Weight, Statefile 84, in A5 size were developed 1 minute, dipped in water, fixed for 10 minutes and thereupon immersed without prior rinsing in the polyglycol impregnating bath for 10 minutes. When the sheets were taken up from the polyglycol bath they were allowed to drain for 30 seconds, whereupon they were dried in a photodrier.

3

Thereupon, the amount of polyglycol taken up by each sheet was determined in the following manner: The sheet was extracted in a Soxhlet apparatus with chloroform for 2 hours, the apparatus being emptied 10 to 15 times. The major portion of the chloroform was evaporated from the extract, whereupon water was added and the remaining chloroform evaporated. The aqueous solution was filtered and diluted to 100 ml. In this solution the amount of polyglycol was determined by precipitation with potassium ferrocyanide, filtration and back-titration with cerium ammonium sulfate.

The following results were obtained—

Bath:	Polyethylene glycol taken up by paper in mg. Average of 4 sheets
(a) -----	159
(b) -----	163
(c) -----	183
(d) -----	178
(e) -----	103

The results show that the aliphatic alcohols considerably increase the absorption of the polyalkylene glycol by the paper.

Example 2

The following impregnating baths were prepared.

(a)	Percent
Polyethylene glycol (molecular weight 1000) -----	10
Glycerol -----	20
Water -----	70
(b)	
Polyethylene glycol (molecular weight 1000) -----	10
Water -----	90
(c)	
Polyethylene glycol (molecular weight 1000) -----	30
Polyethylene glycol (molecular weight 200) -----	20
Water -----	50
(d)	
Polyethylene glycol (molecular weight 1000) -----	30
Water -----	70

In each test, there were used two photopapers Kodak Projection Document Paper, Medium Weight, Statefile 84 of A4 size which were divided in two to obtain four A5 size sheets for each test. The four sheets were developed 1 minute, dipped in water, and fixed for 10 minutes. Without prior rinsing, each sheet was then immersed in 250 ml. impregnating bath for 10 minutes. After the sheets were taken up from the baths, they were run through a wringing machine and then dried for 20 minutes on a photodrier at about 100° C. The amount of polyethylene glycol of molecular weight 1000 taken up by each sheet was determined by the technique described in Example 1. The following results were obtained.

Bath:	Amount of polyglycol (mol. w. 1000) absorbed, in mg. Average of 4 sheets
(a) -----	43
(b) -----	26
(c) -----	208
(d) -----	184

The table shows that both the polyethylene glycol of molecular weight 200 and the glycerol considerably increased the absorption of polyethylene glycol.

Example 3

By the procedure described in Example 1, the absorption of polyethylene glycol (molecular weight 600) from baths containing varying amounts of ethylene glycol was

4

determined. The composition of the impregnating baths and the results obtained are shown in the following table.

	Bath Composition, percent			Absorbed amount of polyethylene glycol in mg. Average of 4 sheets
	Polyethylene glycol	Ethylene glycol	Water	
5	30	20	50	217
10	30	70	204	
	50	30	385	
	50	50	346	
	10	80	65	
	10	90	55	
	10	20	70	68
15	10	90	51	
	10	30	60	71
	10	90	54	
	10	40	50	66
	10	90	51	

It is clearly seen from the table that in every case, the addition of ethylene glycol resulted in a significant increase of the amount of polyethylene glycol absorbed as compared to impregnating baths without this addition.

Example 4

To determine the time to be gained by adding a polyhydric lower aliphatic alcohol in accordance with this invention, the following tests were made.

Photopaper sheets of the same type as in Example 1 were divided in two, developed for 1 minute, dipped in water and fixed for 10 minutes. One half was immersed in a bath (a) comprising 10% of polyethylene glycol (molecular weight 600) and 90% of water, the other half in a bath (b) comprising 10% of polyethylene glycol (molecular weight 600), 20% of ethylene glycol and 70% of water. The test was repeated with varying times of immersion. After the sheets had been removed from the baths, they were run through a wringer and then dried for 20 minutes in a photodrier at about 100° C. The amount of polyethylene glycol absorbed by each sheet was determined by the technique described in Example 1. The results are set forth in the following table, wherein each value is an average of two tests.

Bath	Immersion time, minutes	Absorbed amount of polyglycol, mg.
a -----	5	45
b -----	5	56
a -----	10	58
b -----	10	62
a -----	15	54
b -----	15	60

The table shows that the polyglycol is taken up more rapidly from a bath containing ethylene glycol. In the latter case, practically the same amount of polyglycol is taken up in 5 minutes as is taken up in 10 minutes when no ethylene glycol is used.

We claim:

1. A method of reducing the curling tendency of paper and paper-like materials and photographic paper, which comprises applying to the paper an impregnating composition consisting essentially of a water-soluble polyalkylene glycol having a molecular weight within the range from 100 to 6000, and a water-soluble polyhydric aliphatic alcohol facilitating the absorption of the polyalkylene glycol in the paper, and having from about two to about fifteen carbon atoms, the polyhydric alcohol being in an amount within the range from 0.2 to 5 parts by weight per part by weight of the polyalkylene glycol.

2. A method in accordance with claim 1, in which the polyalkylene glycol is a polyethylene glycol having a molecular weight of from 100 to 1000.

3. A method in accordance with claim 1, in which the water-soluble polyhydric aliphatic alcohol is selected from the group consisting of glycerol, ethylene glycol,

5

propylene glycol and polyethylene glycols having a molecular weight of not over about 250.

4. A method in accordance with claim 1, in which the composition comprises a mixture of polyalkylene glycols.

5. A method in accordance with claim 1, in which the composition comprises from 0.2 to 50 parts by weight of water per part by weight of the polyalkylene glycol.

6. A method in accordance with claim 1, which comprises applying the composition to the paper by dipping.

7. A process in accordance with claim 1, which comprises applying the composition to the paper by spraying.

8. Paper having a reduced tendency to curl and impregnated with a composition consisting essentially of a water-soluble polyalkylene glycol having a molecular weight within the range from 100 to 6000, and a water-soluble polyhydric aliphatic alcohol facilitating the absorption of the polyalkylene glycol in the paper, and having from about two to about fifteen carbon atoms, the polyhydric alcohol being in an amount within the range from 0.2 to 5 parts by weight per part by weight of the polyalkylene glycol.

9. Photographic paper having a reduced tendency to curl and impregnated with a composition consisting essentially of a water-soluble polyalkylene glycol having a molecular weight within the range from 100 to 6000, and a water-soluble polyhydric aliphatic alcohol facilitating the absorption of the polyalkylene glycol in the paper, and having from about two to about fifteen carbon atoms, the polyhydric alcohol being in an amount within the range from 0.2 to 5 parts by weight per part by weight of the polyalkylene glycol.

6

10. Paper coated with a photosensitive material and impregnated with a composition consisting essentially of a water-soluble polyalkylene glycol having a molecular weight within the range from 100 to 6000, and a water-soluble polyhydric aliphatic alcohol facilitating the absorption of the polyalkylene glycol in the paper, and having from about two to about two to about fifteen carbon atoms, the polyhydric alcohol being in an amount within the range from 0.2 to 5 parts by weight per part by weight of the polyalkylene glycol.

11. Paper coated with a thermosensitive material and impregnated with a composition consisting essentially of a water-soluble polyalkylene glycol having a molecular weight within the range from 100 to 6000, and a water-soluble polyhydric aliphatic alcohol facilitating the absorption of the polyalkylene glycol in the paper, and having from about two to about fifteen carbon atoms, the polyhydric alcohol being in an amount within the range from 0.2 to 5 parts by weight per part by weight of the polyalkylene glycol.

References Cited by the Examiner

UNITED STATES PATENTS

25	Re. 24,011	5/1955	Ericks	117 156 X
	748,179	12/1903	Fowler et al.	117—156 X
	2,577,734	12/1951	Brinker	260—27
	2,823,138	2/1958	Hoffman	106—311
	2,865,792	12/1958	Gray	117—34
30	2,875,055	2/1959	Griggs et al.	96—85

MURRAY KATZ, *Primary Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,301,680

January 31, 1967

Oscar Bertil Otto Nycander et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 7, for "about two to about two to about fifteen" read -- about two to about fifteen --.

Signed and sealed this 17th day of October 1967.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents