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⑤④ **A process for preserving paper sheets or webs and a device for carrying out that process.**

⑤⑦ This invention relates to a process for preserving paper sheets or webs, in which a solution of a deacidification agent and of a polymeric strengthening agent for the paper in an organic solvent or in a mixture of organic solvents is sprayed onto one surface of the paper, and in which a strong sucking action is exerted on the other surface of the paper so as to draw the solution through the entire thickness of the paper and also dry the treated paper at least partly. The invention also relates to a device for preserving paper sheets or webs according to the above defined process.

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A process for preserving paper sheets or webs and a device for carrying out that process.

This invention relates to a process for preserving paper sheets or webs and to a device for carrying out that process.

US patent 3,676,182 discloses a process for treating paper sheets or webs throughout their thickness with a solution of a deacidification agent in an organic solvent or in a mixture of organic solvents and then drying same. The object of this known treatment is to neutralize the acid components contained in the paper and thereby to render the paper more resistant to prolonged storage in archives. Moreover, a polymeric strengthening agent for the paper can be included in the solution. The use of an organic liquid medium instead of an aqueous medium has the advantage that more rapid drying can be obtained while the time of contact with the printed matter present on the paper can be kept so short that this printed matter sustains no visible damage owing to the treatment conducted. The paper can be impregnated or sprayed with the solution and then be dried.

US patent 3,939,091 also discloses a liquid mixture on the basis of organic solvents designed for deacidifying paper. In this known mixture the employed agent effecting deacidification or, in other words, providing an alkaline component is methoxy magnesium methyl carbonate, called in the patent methyl magnesium carbonate.

There has now been found a simple, efficient and inexpensive method of simultaneously deacidifying, strengthening, and at least partly drying paper sheets or webs.

Accordingly, this invention is characterized in that a solution of a deacidification agent and of a polymeric strengthening agent for the paper in an organic solvent or in a mixture of organic solvents is sprayed onto one surface of the paper, and that a strong sucking action is exerted on the other surface of the paper so as to draw the solution through the entire thickness of the paper and also dry the treated paper at least partly.

As compared with the prior art, the process now claimed offers a number of important advantages: the solution can be more uniformly distributed throughout the thickness of the paper; the amount of solution can be more optimally dosed; and the process can be carried out more rapidly, partly because subsequent drying usually need not take place. The process claimed leads to an excellent total preservation and is eminently suited for the mass preservation of archives and library material which threatens to be lost forever without a timely appropriate treatment.

Suitable polymeric strengthening agents for use in the present solution are known per se adhe-

sives for fibrous materials of cellulose or derivatives thereof. Suitable strengthening agents may be cellulose or starch ethers, such as hydroxyethyl cellulose and preferably hydroxypropyl cellulose. The latter product is sold by Hercules Powder Company under the name of Klucel L in the form of fine granules. The amount in which the strengthening agent is used is as a rule 5-40 g and preferably 5-30 g/l solution.

It is of essential importance that the polymeric strengthening agent be present in the solution in the dissolved state. This is in fact necessary to obtain a uniform distribution of the strengthening agent throughout the thickness of the paper to be treated. If the strengthening agent were not dissolved, it would only be deposited on and near the paper surface, so it would not be able to penetrate into the interior of the paper material so that more damage than advantage would be caused to the material to be preserved which is very vulnerable as it is. So when selecting the polymeric strengthening agent and the solvent or the solvents therefor, but also when selecting the other constituents and their mutual ratios, one should always bear in mind that the final preserving liquid has to be a real solution.

Preferably, a suitable agent for preventing disintegration or decay of the polymeric strengthening agent is also dissolved in the treatment solution. Such agents may be bactericides and fungicides as well as agents for preventing enzymatic decomposition of the strengthening agent. Thymol is an example of a suitable agent preventing the development of bacteria and fungi in the case of using a cellulose ether as the polymeric strengthening agent. As a rule only a minor amount of such an agent is added against disintegration or decay.

Suitable examples of deacidification agents to be used in the present solution are to be found in US patents 3,676,182 and 3,939,091 discussed above. Preferably, inorganic deacidification agents are used, and the following compounds may be mentioned as examples thereof: magnesium methoxide, magnesium methyl carbonate, magnesium ethyl carbonate, methoxy magnesium methyl carbonate, and ethoxy magnesium ethyl carbonate. In particular, methoxy magnesium methyl carbonate has proved to be eminently suitable. The deacidification agent is usually employed in an amount of 0.7-2.5 g and preferably of 1.0-2.0 g/l solution. Such a concentration is sufficient to adjust the pH of the paper to a value of 8-8.5 and further to provide a sufficient additional amount to ensure a prolonged buffer effect at that pH. A number of the above-mentioned inorganic deacidification

agents is commercially available, usually in the form of a solution in a lower alcohol or in a mixture of a lower alcohol and a chlorofluorohydrocarbon.

The selection of a suitable organic solvent or mixture of organic solvents is very important, since, as stated before, all the components of the preserving liquid must dissolve therein. Methanol is a very suitable solvent, either alone or even better in combination with one or several other solvents which, for instance, may be selected from aliphatic or aromatic hydrocarbons, halogenated hydrocarbons, ethers, esters and ketones. A mixture of a major amount of methanol and a minor amount of acetone has proved to be very suitable, especially a mixture of methanol and acetone in a volume ratio of about 4/1.

The present preserving liquid can be easily prepared by combining the different components in the appropriate amounts and, if required, stirring same with moderate heating until the solids have dissolved. The deacidification agent is then mostly added in the form of a concentrated solution in an organic solvent. If necessary, the resulting solution may be filtered to remove all the undissolved residues. The preserving liquid may also be prepared in the form of a concentrate diluted for use as far as necessary. Both the concentrate and the ready-for-use preserving liquid are very stable and can be stored for extended periods of time.

A formulation of a ready-for-use preserving liquid with which excellent results have been obtained has the following composition:

-methanol 78 vol. %
-acetone 20 vol. %
-methoxy magnesium methyl carbonate (0.5 M in methanol) 2 vol. %
-Klucel L (hydroxypropyl cellulose from Hercules Powder Co.) 2 wt. %
-thymol 0.2 wt. %

The preserving liquid is applied by spraying to one surface of the paper sheet or web and a strong sucking action is exerted on the other surface of the paper. Preferably, the paper is supported by a carrier allowing the passage of liquid, and the liquid is sprayed onto the free paper surface while a strong sucking action is exerted through the supporting carrier so that the paper is uniformly impregnated with the liquid throughout its thickness and is also at least partly dried. If necessary, further drying can be effected by suction drying for an extended period of time or by using any mild drying technique, e.g., with a hot air stream. The amount of preserving liquid to be applied depends on different factors, such as the nature, condition and thickness of the paper. On the average, however, it has turned out that excellent preservation is obtainable with an amount of preserving liquid of 0.2-0.5 g/dm² paper area.

This invention also relates to a device for carrying out the above described preservation of paper sheets or webs. This device is characterized in that it contains a treatment chamber provided in the lower part with a paper feed opening in one end wall and with a paper discharge opening in the opposite end wall, with a suction receptacle being arranged between the feed and discharge openings and comprising at the top a large number of perforations, there being provided a conveyor belt allowing the passage of liquid, which conveyor belt is capable of moving around the suction receptacle and is positioned against the top thereof, at least one liquid sprayer being present in the upper part of the treatment chamber near the feed opening.

The treatment chamber proper may be composed of aluminum sections with aluminum sheeting and with one side wall in the direction of transport consisting of a transparent material, such as a polycarbonate sheet, so that the progress of the treatment may be monitored.

The treatment chamber may be placed as a superstructure on a substructure, and the latter can be utilized to accommodate the operating and auxiliary mechanisms, such as an electronic and pneumatic control unit, a storage tank for the preserving liquid, a pressure bottle containing propellant gas (e.g., CO₂), a compressor, an exhaust fan, a motor, the required conduits and connecting pieces etc.

A slot for inserting the paper to be treated is provided at the feed end of the treatment chamber. When paper is inserted, a sensor which may be provided near that feed end will transmit a signal which causes the liquid sprayer(s) to function. When paper is no longer inserted, the sensor in question can stop the spraying of liquid by means of a signal.

Also provided near the feed opening may be sensors recording the thickness, nature and/or sizes of the paper inserted and transmitting, as a function thereof, signals controlling the speed of the conveyor belt, the amount of spray liquid and/or the area of the surface to be sprayed.

Through the feed slot the paper comes to rest on a conveyor belt which is capable of moving around a suction receptacle in the lower part of the treatment chamber and is positioned against the perforated top of the suction receptacle.

Provided in the upper part of the treatment chamber, near the feed opening, is at least one liquid sprayer for atomizing the preserving liquid in the direction of the conveyor belt. As a rule, two liquid sprayers are present, and preferably, both the height and the width of the liquid sprayer(s) are adjustable so as to exactly control the area to be sprayed. This can be effected automatically by means of a sensor near the feed opening, as stated before.

The suction receptacle is provided, e.g., in a side wall in the direction of transport, with a plurality of suction nozzles, e.g., three, which ensure a proper suction and exhaustion during the entire transport throughout suction and exhaustion during the entire transport through the treatment chamber. The preserving liquid is thereby uniformly distributed throughout the thickness of the paper to be treated, and the paper is also at least partly and usually even completely dried. This can be carried out by a skilled worker in a rather simple and precise way. The exhausted vapours can be collected and processed further.

The conveyor belt may be a woven endless belt. Anyhow, it must allow the passage of liquid, and preferably it is of the self-discharging type, which means that the fine openings present in the direction of thickness of that belt are larger at the side facing the top of the suction receptacle than at the side for conveying paper, which prevents that belt from becoming easily clogged owing to solids from the preserving liquid sucked in.

The size of the treatment chamber in the direction of transport is preferably selected so that the distance to be traversed is sufficient to dry the treated paper. If required, however, the part of the treatment chamber closer to the discharge opening may comprise means for carrying out an additional thermal drying treatment. Such means may be means for effecting a hot air stream or infrared radiation.

Finally, the treatment chamber is provided with a discharge slot at the end of the conveyor belt. The treated paper discharged through that slot can be collected in a collecting receptacle.

Claims

1. A process for preserving paper sheets or webs, characterized in that a solution of a deacidification agent and of a polymeric strengthening agent for the paper in an organic solvent or in a mixture of organic solvents is sprayed onto one surface of the paper, and that a strong sucking action is exerted on the other surface of the paper so as to draw the solution through the entire thickness of the paper and also dry the treated paper at least partly.

2. A process as claimed in claim 1, characterized in that the polymeric strengthening agent is hydroxypropyl cellulose.

3. A process as claimed in claim 1 or 2, characterized in that the polymeric strengthening agent is present in an amount of 10-30 g/l solution.

4. A process as claimed in claims 1-3, characterized in that an agent for preventing disintegration or decay of the polymeric strengthening agent is also dissolved in the solution.

5. A process as claimed in claims 1-4, characterized in that the deacidification agent is methoxy magnesium methyl carbonate.

6. A process as claimed in claims 1-5, characterized in that the deacidification agent is present in an amount of 1.0-2.0 g/l solution.

7. A process as claimed in claims 1-6, characterized in that the solution is a solution in a mixture of organic solvents containing a major amount of methanol and a minor amount of acetone.

8. A device for preserving paper sheets or webs according to the process of claim 1, characterized in that the device comprises a treatment chamber provided in the lower part with a paper feed opening in one end wall and with a paper discharge opening in the opposite end wall, with an suction receptacle being arranged between the feed and discharge openings and comprising at the top a large number of perforations, there being provided a conveyor belt allowing the passage of liquid, which conveyor belt is capable of moving around the suction receptacle and is positioned against the top thereof, at least one liquid sprayer being present in the upper part of the treatment chamber near the feed opening.

9. A device as claimed in claim 8, characterized in that near the feed opening there are also provided sensors transmitting signals for controlling the belt speed, the amount of spray liquid and/or the area of the surface to be sprayed, depending on the thickness, nature and/or dimensions of the paper to be preserved.

10. A device as claimed in claim 8 or 9, characterized in that the conveyor belt allowing the passage of liquid is provided with fine openings which are larger at the side facing the top of the suction receptacle than at the side for conveying paper.



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
D,X	US-A-3 676 182 (R.D. SMITH) * Column 4, line 46 - column 8, line 18; column 9, line 65 - column 10, line 58; column 11, lines 33-65; examples 1,9; column 18, lines 29-33 * ---	1,3	D 21 H 5/00 D 21 H 3/26 D 21 H 3/02 B 05 D 1/02 B 05 B 13/02
X	US-A-3 862 916 (C.B. HAYWORTH) * Whole document * ---	1,3,4,7	
A	ABSTRACT BULLETIN OF THE INSTITUTE OF PAPER CHEMISTRY, vol. 54, no. 7, January 1984, page 785, no. 7288, Appleton, Wisconsin, US; N.G. GERASIMOVA et al.: "Study of some aqueous sizes and sizing media used in restoration of paper" & (Leningrad): 60-67 (1977). * Article * ---	1	
D,A	US-A-3 939 091 (G.B. KELLY, Jr.) * Whole document * ---	1,5	
A	FR-A-2 125 963 (F.-J. KNUBBEN) * Claims 1-5,9-13,15,16 * ---	1,8	
A	DE-A-2 112 997 (F.-J. KNUBBEN) * Whole document * ---	1,8,9	
A	US-A-3 899 439 (B.H. MAHIMAN) * Whole document * ---	2,4	
A	US-A-2 633 437 (E.W. DETJEN) * Figures 1-3; column 1, line 51 - column 4, line 19 * ---	8	
A	US-A-3 958 586 (C.W. SCHNELLE) * Figures 1,2; columns 1,2 * -----	8	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21-06-1988	Examiner NESTBY K.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			