

UNITED STATES PATENT OFFICE

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PROCESS OF INCREASING THE STRENGTH AND RESISTIBILITY AGAINST MOISTURE OF HIGH MOLECULAR CARBOHYDRATES

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This invention refers broadly to the art of stiffening and of increasing the resistibility of cellulose, starch and similar highly-molecular carbo-hydrates and of articles manufactured therefrom, such as paper or the like, particularly against the action of moisture and other injurious agents; and of thereby widening the range of applicability of such substances and articles and of producing other important objects and advantages which will appear, as the specification proceeds. The increased resistibility in accordance with my invention is obtained by treating the substances and articles with formaldehyde and an acid and exposing them to high temperature. In its main features the new process is based upon the observation that formaldehyde in the presence of acid and at high temperatures acts upon highly molecular carbo-hydrates in such a manner that an increased strength and very high resistibility against the action of moisture is imparted by this treatment to the carbo-hydrates, such as for instance cellulose, starch and similar substances. Thus it has been ascertained that paper for instance which has been treated according to the new process retains its stiffness and strength when soaked in water, while starch becomes insoluble, and a starch-paste treated in accordance with this invention hardly loses its stiffness by immersion in water.

It has been ascertained as a result of my experiments that for the purpose of producing the best results which the invention contemplates, that is to say for the purpose of increasing the resisting qualities of highly molecular carbo-hydrates against water, three elements should be combined, that is to say the presence of an acid and the use of a higher temperature along with the treatment with formaldehyde, while the result has not been obtained by the employment of any two of these elements only in any combination whatever.

In view of increasing the resisting qualities of cellulose-products it has already been suggested, to first treat the cellulose with formaldehyde and an organic acid followed by drying in vacuo. In accordance with my invention the drying in vacuo is not necessary, which constitutes a highly important industrial and economic advantage, because the treatment of paper and similar web-like products in vacuo is very difficult and necessitates complicated methods and apparatus. In the process of my invention, however, it is only required to cause the paper or the like to pass through the solution of chemicals, whereupon it is squeezed and conducted over hot rollers; and the apparatus employed for this purpose may be readily combined with the moving means of the paper machine. The treatment with acid according to the invention may be carried out simultaneously with or after the treatment with formaldehyde. As a suitable acid I may use nitric acid, sulphuric acid, oxalic acid, bi-sulphates or any other suitable acids. Whenever it is desired to somewhat reduce the stiffness of the product obtained, additions, such as glyc erine, may be made, and such additions may also be made for other purposes. On the other hand, formaldehyde and acid may be used as vapors. The temperature employed is preferably not below one hundred (100°) degrees centigrade, and in the case of paper for instance the temperature may be raised up to the admissible limit that may be used without singeing the paper.

Example:—Filtering paper is impregnated with a mixture of 100 parts by volume of 40% formaldehyde and 2 parts by volume concentrated nitric acid, the liquor is squeezed off and the paper is dried at 120° centigrade upon heated rollers. As a result of this treatment the paper retains its stiffness and tearing strength substantially unchanged upon being wetted or being immersed in water, while a piece of paper of the same kind, but

not submitted to the treatment, immediately becomes flappy and collapses in water and is easily injured and torn.

It should, of course, be understood that the invention has been described in its broad features only and that it is susceptible of modification without deviating from its spirit and scope, except as otherwise appears from the appended claims. A modified form of execution of the invention may consist in that an addition of water is provided to formaldehyde or acid or both. For instance in the example given 100 parts by volume of water may be added, but of course also more or less water can be employed.

I claim:—

1. The process of increasing the strength and resistibility against moisture and similar agents of high molecular carbo-hydrates, which consists in submitting said carbo-hydrates to the action of formaldehyde and of acid and to the action of a temperature lying in the range of about 110 to 120 degrees centigrade.
2. The process of increasing the strength and resistibility against moisture and similar agents of high molecular carbo-hydrates, which consists in submitting said carbo-hydrates to a drying at a temperature of about 120 degrees centigrade after having treated said material with formaldehyde and acid.
3. The process of increasing the strength and resistibility against moisture and similar agents of high molecular carbo-hydrates, which consists in submitting said material to the action of formaldehyde and acid finally drying it at about 120 degrees centigrade.
4. In a process of increasing the strength and resistibility against moisture and the like of high molecular carbo-hydrates by the treatment with formaldehyde and acid, the subsequent drying of said material at a temperature of about 120 degrees centigrade.
5. The process of increasing the strength and resistibility of high molecular carbo-hydrates against moisture and the like which consists in treating said material with vapors of formaldehyde and of acids and submitting it to temperatures of about 120 degrees centigrade.
6. The process of increasing the strength and resistibility of high molecular carbo-hydrates against moisture and the like, which consists in submitting said carbo-hydrates to the action of formaldehyde, acid and glycerine and the like and then drying them at temperatures of about 120 degrees centigrade.
7. As a new product of manufacture, carbo-hydrates of highly molecular constitution produced by treatment with formaldehyde and acids and by drying at temperatures of about 120 degrees centigrade.
8. As a new product of manufacture, paper combined and impregnated with formalde-

hyde and acid and dried at a temperature of about 120 degrees centigrade.

9. The process of increasing the strength and resistibility against moisture and similar agents, of high molecular carbo-hydrates, which consists in submitting said material to the action of a solution of formaldehyde containing a quantity of acid being small in comparison to the amount of formaldehyde and to the action of a temperature of about 110 to 120 degrees centigrade.

In testimony whereof I affix my signature.

JULIUS KANTOROWICZ.

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