United States Patent Office 2,704,736 Patented Mar. 22, 1955

2,704,736

PROCESS FOR MAKING HARD, ABRASION-RESISTANT PAPERBOARD

Norman Greenberg and Walter S. Greenberg, Denver, Colo., assignors to Kiddy Case Mfg. Co., Inc., Denver, Colo., a corporation of Colorado

No Drawing. Application April 16, 1951, Serial No. 221,320

4 Claims. (Cl. 154—138)

Our invention refers to an improved paper base sheet material and to a method for processing such material.

An important object of our invention is the provision of a process for treating lignocellulose sheet material such as paper in such manner as to yield a sheet material of exceptional strength, hardness, and resistance to abrasion, and which is highly resistant to fire.

Another primary object of our invention is the provision of a product having the above-described characteristics.

A further object of our invention is the provision of a sheet material and a process for treating such material which permits the formation of complex shapes with a minimum of difficulty.

Additional objects of our invention will be disclosed in the following detailed description.

Although our invention is applicable to various types of lignocellulose sheet materials, it is most directly applicable from an economic standpoint to the treatment of ordinary commercial cardboard or chipboard. The following detailed description will therefore be confined to the treatment of such material and the product resulting therefrom, it being understood that the invention is applicable to other similar materials.

Our improved sheet material is prepared by immersing sheets of cardboard and the like in an aqueous solution of acetic acid for about twenty-four hours to thoroughly saturate the fibers and thereafter drying the cardboard at room temperature for about a day. The acetic acid solution is prepared by adding from three to four parts water to one part commercial acetic acid by weight and permitting the resulting solution to reach room temperature prior to use. The dried, treated cardboard is next immersed for about twenty-four hours in an urea resin solution containing both dimethylol urea and urea, after which it is dried at room temperature for about twelve hours. The exact proportions of the ingredients of the resin solution may be varied, but in general a mixture containing about four parts of dimethylol urea to about one part urea will be found highly satisfactory. One part by weight of the resin solution should be diluted with two parts of water prior to use, thus yielding a solution containing about 10 parts water, 4 parts dimethylol urea, and one part urea by weight. A small quantity of a suitable buffer, such as borax should be added to the solution to prevent premature hardening of solution, the quantity of buffer employed being that required to maintain a pH value of approximately 7.

When the resin-impregnated sheets have been dried in the manner described, they may be stacked in superposed relation and subjected to heat and pressure to form a laminated board or sheet product; or if desired, single sheets may be similarly treated. The temperature required to effect the desired reaction is approximately 300° F., but the pressure may be varied over wide limits. In general, the pressure should exceed twenty-five pounds per square inch and the density of the resulting product will be generally proportional to the pressure exerted in forming the object. No adhesive is required in this process, since the material adheres with great strength to the adjacent sheets of similarly treated material.

The sheets, usually in superposed relation, may be cut

for folding into a pre-determined shape, such as a box, allowance being made for overlapping of the edge portions, as in the construction of a glued container. The folded sheet may then be placed in a suitable die and subjected to heat and pressure as above described, which will result in the formation of a sealed container or other object having unusually high strength and resistance to abrasion.

It will be found that objects formed by the process above-described are virtually flame proof and fire proof, incapable of supporting combustion, and having a high smoldering temperature. The most notable characteristics, however, are the exceptionally high strength of the material with respect to its unit weight and its resistance to abrasion. These and other related characteristics make the material particularly suitable for the production of strong, inexpensive luggage, containers, floor covering, cabinets, and the like.

It should not be understood from the foregoing that it is necessary to process the sheet material after impregnation with the resin solution promptly upon the expiration of twelve hours, since the dried material can be stored for considerable periods of time without adverse effect. If allowed to dry, however, the material should be again dipped in the resin solution and partially dried prior to forming. While the characteristics of the material make it particularly suitable for use in instances where resistance to abrasion is of paramount importance, it should not be understood that it is incapable of other use. For example, the material is substantially water proof and exhibits a high order of dielectric strength, thereby making it suitable for use in the preparation of electric insulating material, or for the formation of containers intended for housing electrical components. If color is required, suitable dyes may be added to the impregnating solution.

We claim:

1. The process for fabricating a strong, abrasion-resistant sheet material which comprises the steps of saturating a sheet of cardboard substantially free from material acids with a solution containing approximately one part of acetic acid to three parts of water by weight to attain a uniform acid distribution through the sheet, drying the sheet, saturating the dried sheet with an aqueous resin solution including an intermediate polymerization product of urea so as to react with the acid in the sheet, drying the sheet for the second time, then pressing the sheet at a temperature of approximately 300° F.

2. The process for fabricating a hard, strong, abrasion-resistant sheet material which comprises the steps of first saturating a sheet of cardboard substantially free from natural acids with dilute aqueous acetic acid to attain a uniform acid distribution through the sheet, drying the sheet, saturating the dried sheet with an aqueous urea resin solution containing dimethylol urea and urea so as to react with the acid in the sheet, drying the sheet a second time, and then pressing the sheet at a temperature of approximately 300° F.

3. The process for fabricating hard, strong, abrasion-resistant sheet material which comprises the steps of saturating a sheet of cardboard substantially free from natural acids with a solution consisting principally of one part of acetic acid mixed with three parts of water to attain a uniform acid distribution throughout the sheet, drying the sheet, saturating the dried sheet with urea resin solution containing approximately four parts dimethylol urea, about one part urea, and about ten parts water by weight so as to react with the acid in the sheet, again drying the sheet, and then subjecting the sheet to a pressure of not less than twenty-five pounds per square inch at a temperature of approximately 300° F.

4. The process for fabricating a hard, strong, abrasion-resistant sheet material which comprises the steps of saturating a plurality of cardboard sheets substantially free from natural acids with an aqueous solution consist-

ing principally of one part of acetic acid dispersed in three parts of water to attain a uniform acid distribution throughout the sheet, drying the sheets for about twenty-four hours, saturating the dried sheets with a urea resin solution containing approximately four parts of dimethylol urea, about one part of urea, and about ten parts water by weight so as to react with the acid in the sheet, drying the sheets for about twelve hours, superposing the sheets and then subjecting the superposed assembly of sheets to not less than twenty-five pounds per square inch pressure at a temperature of approximately 300° F.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 23,174	Kvalnes	Nov. 29, 1949
2,059,947	Hollingworth	Nov. 3, 1936
2,313,953	Loughborough	Mar. 16, 1943
2,329,051	Hunsicker	Sept. 7, 1943
2,398,649	Kvalnes	Apr. 16, 1946
2,495,043	Willey et al.	Jan. 17, 1950