

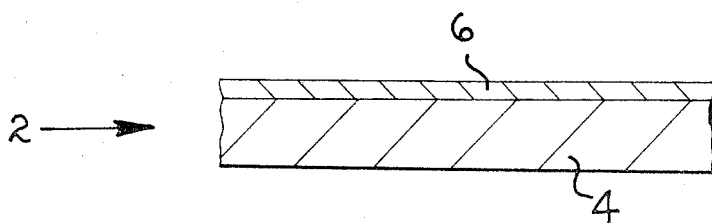
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PROCESS FOR MAKING WET-STRENGTH PAPER AND PRODUCT THEREOF

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PROCESS FOR MAKING WET-STRENGTH PAPER AND PRODUCT THEREOF

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3 Claims

ABSTRACT OF THE DISCLOSURE

A paper web containing 1–20 percent of a thermosetting resin such as phenol or urea formaldehyde and 0.1–4 percent of a chromium coordination complex of a fluorohydrocarbon which is dissolved in a solvent is immersed in a bath of molten wax. From 5–40% of the wax is picked up on the paper web; the heat of said wax also helps to cure the thermosetting resin. The fluorohydrocarbon is added to the web containing the resin at any stage in the papermaking process prior to the wax impregnation. The fluorohydrocarbon addition generally imparts to the paper web the ability to limit the wax pick-up and control its distribution on the paper web.

BACKGROUND OF THE INVENTION

This invention is concerned with a wet-strength paper which generally contains a thermosetting resin, a fluorohydrocarbon, and a wax impregnated portion.

More specifically, this invention is concerned with a paper structure which contains a thermosetting resin, a fluorohydrocarbon and a wax impregnation wherein the heat of the molten wax impregnation is used to cure the thermosetting resin and the fluorohydrocarbon is used to control the wax pick-up.

Wet-strength papers are generally known in the prior art. Likewise, the addition of waxes and thermosetting resins to paper compositions to improve their wet-strength properties is commonly known in the art. However, the prior art wet-strength papers, wherein a wax is used in combination with a thermosetting resin, are disadvantageous in that the fold qualities of the paper are often adversely affected, and the resulting paper product tends to have a dirty, brown color as a result of the wax impregnation.

The fold qualities of a paper product are extremely important in that paper, when used as a packaging medium, must be folded to form useful articles, such as boxes, cartons, etc. In the formation of these articles, it is conventional to score the paper and to subsequently apply mechanical pressure to the paper in such a way that it folds on the score line. If the paper is extremely brittle due to chemical treatment, for example, treatment to impart water-resistant properties, the paper will tend to crack as opposed to bending evenly on the score line. In accordance with this invention, this problem is overcome.

Likewise, the outward appearance of the paper product is extremely important in that the general appearance of the paper tends to relay an image to the recipient or customer as to the contents contained in articles made from the paper. This appearance factor is particularly important in the wet-strength paper area as large quantities of wet-strength paper are used to form food containers. It is imperative that a container relay immediately to the recipient or customer an image of cleanliness. The dirty brown containers of the prior art are not capable of conveying this image of cleanliness. In order to overcome this dirty, brown color, which was generally inherent in the prior art, it is often common to pigment the paper surface in such a way as to whiten said surface. By

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means of the subject invention, a wet-strength paper having outstanding folding qualities and excellent color is obtained, without the use of a pigment, thereby eliminating the problems of the prior art.

The primary object of this invention is a superior paper product having outstanding foldability properties.

Another object of this invention is superior paper which has outstanding wet-strength properties.

Still another object of this invention is a paperboard sheet having superior aesthetic properties.

The objects of this invention also include the process whereby the superior paper of this invention is produced.

Finally, the objects of this invention include all the other novel features in the specification and claims at hand.

The paper product as produced in accordance with this invention is generally illustrated in the cross-sectional view as shown in the drawing.

The resulting paper product 2 generally comprises a fibrous cellulosic web 4 which contains a thermosetting resin. The upper extremities of fibrous web 4 are impregnated with a fluorohydrocarbon to form an impregnated layer which is illustrated as layer 6. Layer 6 is likewise impregnated with a wax material. However, note specifically that the wax impregnation, hence the color of the resulting product, is carefully controlled by the fluorohydrocarbon addition. If desired, the resulting product can contain a slight wax overlay.

As is stated above, this invention is concerned with a paperboard sheet wherein the cellulosic substrate is treated with a thermosetting resin, a fluorohydrocarbon, and a wax impregnation.

The paper substrate of this invention can be formed from any conventional cellulosic material.

Cellulosic materials adapted for use in this invention include wood cellulose and pulps derived from hardwoods, softwoods, and woody annual plants such as balsam fir, Eastern hemlock, jack pine, Eastern white pine, red pine, black spruce, red spruce, white spruce, tamarack, cyprus, quaking aspen, American beech, paper birch, yellow birch, Eastern cottonwood, sugar maple, silver maple, yellow poplar, black cherry, white oak, bagasse, hemp, cotton and jute. Mixtures of cellulosic materials can also be used.

The preferred paper substrate for use in accordance with this invention is kraft paper which is produced from Southern pine.

As is commonly known in the art, cellulosic materials as described above are converted into a useful paper web or sheet by a paper-making process such as the Fourdrinier process. In the Fourdrinier process, a slurry of cellulosic fibers is converted into a wet sheet which is subsequently dried, calendered, etc., to produce a continuous paper web.

Prior to the formation of this continuous web, the cellulosic fibers, while in a slurry form, are mechanically agitated in what is generally described as a beater. This beating step fibrillates and frees the fibers in such a way that they are susceptible to web formation. The thermosetting resin as used in this invention can be applied at any convenient point in the paper-making process. However, it is preferred in this invention that the thermosetting resin be applied in the beating stage of pulp preparation. The thermosetting resin is generally added in a powdered or slurry form to the cellulosic fibers just prior to beating. The beating mixes the thermosetting material with the fibers in such a way that a desirable homogeneous mass is formed. The resulting thermosetting resin-fibrous mixture is then diluted to a convenient paper-making concentration and is delivered onto the continuously moving wire belt in such a way as to form

a continuous wet sheet. This wet sheet is then dried and calendered in a conventional manner.

The cellulosic mixture can contain from about 0.5 to about 20 percent of thermosetting resin. A more preferred range for the thermosetting resin is from about 5 to about 15 percent. The most preferred concentration is about 10 percent. The above percentages are based on the weight of the dry cellulosic fibers utilized.

Any thermosetting resin which is compatible with cellulosic materials can be utilized in accordance with this invention. Examples of suitable thermosetting resins are phenol formaldehyde resins, urea formaldehyde resins, melamine resins, alkyd resins, polyamide resins and acrylate resins, etc.

Subsequent to the formation of a cellulosic web, which contains a thermosetting resin as described above, the web is dried and calendered in a conventional manner. In accordance with this invention, a fluorohydrocarbon is added to the thermosetting resin-containing web at some stage prior to the drying of the paper product in question. In accordance with the most preferred aspect of this invention, the fluorohydrocarbon is added subsequent to the first calendering stage although it is understood by one skilled in the art that the fluorohydrocarbon can be added at any stage in the paper-making process prior to the wax impregnation. Specifically, it should be noted that the fluorohydrocarbon can be added during the beating stage or just prior to the formation of the wet sheet. The addition of the fluorohydrocarbon subsequent to web formation is extremely advantageous in that it is possible to concentrate the fluorohydrocarbon in the surface portion of the web in such a way as to maximize its usefulness.

From about 0.1 to about 4.0 percent of fluorohydrocarbon can be used in accordance with this invention. A more preferred range of fluorohydrocarbon is from about 0.2 to about 3.0 percent, with the most preferred concentration of the fluorohydrocarbon being about 2.0. The above concentrations are based on the dry weight of the paper web in question. Fluorohydrocarbons which are adapted for use in accordance with this invention generally have a polar head, which can interact with cellulose, and a non-polar fluorocarbon tail, which is both organophobic and hydrophobic.

Fluorohydrocarbons which are adapted for use in accordance with this invention are generally chromium coordination complexes of a fluorochemical dissolved in a solvent such as isopropyl alcohol, which contain about 3 percent chromium, or aqueous solutions of water soluble fluorochemicals. Complexes of this type are generally disclosed in U.S. Pats. Nos. 2,662,835; 2,642,416; 2,713,593; and 2,934,450.

Examples of specific fluorohydrocarbons which can be used in accordance with this invention, and which fall within the above-described generic definition, are Scotchban FC-805, which is a solution of a chromium salt of a fatty acid in which some of the hydrogen has been replaced with fluorine, such as perfluorocaprylic acid, as sold by the 3 M Company of Minneapolis, Minn.

The most preferred fluorohydrocarbon for use in accordance with this invention is the above-described FC-805 product. This product is generally disclosed in U.S. Pat. No. 2,662,835 issued to Reed, and is produced by reacting chromyl chloride with a saturated perfluoromonocarboxylic acid having from four to twelve carbon atoms in the molecule, such as perfluoro-octanoic acid, in an inert anhydrous or solvent vehicle and in the presence of an alcohol reducing agent or a hydrolyzed ammoniated derivative thereof.

The above-described fluorohydrocarbon addition generally imparts to the paper web in question the ability to control wax pick-up. This ability is extremely important if a resulting paper product having a desirable appearance is to be produced. For example, if too much wax is impregnated in the paper in question, the paper

tends to have a dirty brown color which makes it unsuitable for use in the food trade.

In accordance with this invention, it is possible to carefully limit the wax pick-up and control its distribution on the paper substrate, with the result that a paper having desirable aesthetic qualities can be produced.

The fluorohydrocarbon addition in accordance with this invention is likewise extremely useful in that it tends to make the resulting paper greaseproof. These grease-repelling properties are not lost, even subsequent to wax impregnation. This property is extremely desirable in containers which are used for the shipment of fatty meats which have a tendency to give paper products a greasy, dirty appearance.

Subsequent to the treatment of the paper web with the fluorohydrocarbon, the paper product is exposed to a molten wax bath. This wax impregnation can be accomplished at any convenient time. If the resulting paper product is to be used in a straight sheet form, the wax impregnation can take place in the papermaking sequence just prior to the final calendering operation. However, if the resulting paper product is to be converted into corrugated board, it is advantageous to form the corrugated board prior to the wax addition. This procedure is desirable because the wax impregnation tends to make the gluing of the liner materials to the corrugated web difficult. In contrast, if the wax impregnation is accomplished after the corrugated board is formed, these difficulties are not encountered.

The wax impregnation can be from about 5 to about 40 percent. A more preferred range for the wax impregnation is from about 10 to about 30 percent by weight. The most preferred concentration for the wax impregnation is about 20 percent. Examples of suitable waxes which can be used in accordance with this invention are microcrystalline and paraffinic waxes. Synthetic waxes, such as those based on aliphatic molecules, such as polyethylene, polypropylene, etc., can also be used in accordance with this invention. Mixtures of waxes can also be used. The general melting point for waxes for use in accordance with this invention is from about 130 to about 200° F.

As is stated above, the wax impregnation in accordance with this invention is accomplished by immersing the thermosetting resin and fluorohydrocarbon-containing paper material in a bath of molten wax. The heat of the molten wax is then utilized to effect a curing of the thermosetting resin. While the wax bath can be at any convenient temperature, the temperature should be sufficient to cure the thermosetting resin utilized to the desired degree in the resulting product. For use in most applications, a temperature range of from about 200° F. to about 300° F. can be utilized. A more preferred range is from about 225° F. to about 250° F. The most preferred embodiment of this invention is a kraft web which is impregnated with 10 percent of phenol formaldehyde resin and 2 percent of FC-805 fluorohydrocarbon. This combination is subsequently impregnated and cured by immersing in a bath of paraffin wax at a temperature of 250° F.

It is within the purview of this invention to add to the compositions of this invention compatible materials which do not affect the basic and novel characteristics of the composition of this invention. Among such materials are coloring agents, including dyes and pigments, fillers, and similar additives. Additives such as antioxidants, antistatic agents, stabilizers and anti-foaming, may also be added. The upper limit of the quantity of additives is usually about 1 weight percent of the product.

The following examples will illustrate the subject invention. These examples are given for the purpose of illustration and not for purposes of limiting this invention. All parts percent are given by weight unless otherwise specified.

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EXAMPLES 1-5

Examples 1 to 5 were prepared and tested in accordance with the following description:

Southern kraft liner pulp was refined in the laboratory Mead refiner to 450 Canadian Standard Freeness, de-watered, fluffed, bagged and moisture determinations made.

A solution of a urea formaldehyde resin sold under

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TABLE I

Example No.	Resin	Percent	Fluorohydro-carbon	Percent
1	Amres 1430	10		
2	do	10	FC-805	1
3	do	10		
4	do	10	FC-805	1
5	do	10	FC-805	1

TABLE II

Example No.	Wax	Percent	Wax temp., F.	Brightness	Fold endurance	Grease resistance
1				23	544	Poor.
2				21	678	Do.
3				22.5	541	Excellent.
4	1073 Paraffin	40	225	9.5	293	Good.
5	do	19	275	21.5	863	Excellent.

the trade name, Amres 1430, was prepared with water as the solvent medium.

Fifty (50) grams of pulp (ovendry basis) were diluted to 10 liters. Enough Amres solution to give 5 grams of active Amres was added to the slurry and the mix was agitated for complete mixing. This Amres-treated pulp was then ready for handsheet manufacture.

Each handsheet contained 5.2 grams of pulp (ovendry basis) and was made in a Williams sheet mold using standard procedures. The 7" x 7" sheets were pressed for five (5) minutes at 150 p.s.i. and dried in a Noble and Wood drum drier. Pressing and drying were done between blotters.

A 1 percent solution of Scotchban FC-805 was prepared. After the handsheets to be treated with Scotchban were manufactured and dried, the 1 percent solution was poured onto the sheets on a level surface. The excess Scotchban was then squeezed off the sheets by rolling a stainless rod (Meyer's rod) over the surface. The sheets were then re-dried on the Noble and Wood drum drier. The sheets were then immersed in the melted wax and then run through a hand squeegee to remove excess wax. The waxed sheets were air-dried.

In Examples 1-5, a 26 lb. sheet was prepared.

The brightness of the samples produced was tested in accordance with test ASTM D985-50.

The fold endurance of the resulting product was tested in accordance with TAPPI Test No. T423 m-50.

In testing the grease resistance, 1" x 2" samples were cut. One square inch of the specimen was completely covered with vegetable oil shortening sold under the trademark Crisco. The samples were then placed in a room at 80° F.—35% RH for a period of 72 hours. After the 72 hours, the samples were taken from the 80° F.—35% RH room and the amount of grease penetration and the amount of grease "wicked" onto the uncoated areas were observed.

The data for Examples 1-5 is expressed in Tables I and II:

20 Modifications may be resorted to within the spirit and scope of the appended claims.

What is claimed is:

1. As an article of manufacture, a fibrous paper product having improved wet-strength containing 1-20 percent of thermosetting resin uniformly distributed among the fibers, 0.1-4 percent of a chromium coordination complex of a fluorohydrocarbon, and having a surface impregnated with 5-40 percent wax.

2. As an article of manufacture, a paper product comprising a fibrous paper web containing approximately 10 percent of phenol formaldehyde resin uniformly distributed among the fibers and which contains approximately 2 percent of a chromium coordination complex of a fluorohydrocarbon, and the surface portions of said web are impregnated with approximately 20 percent of paraffin wax, said percents by weight based upon the dry weight of said paper.

3. A process for forming a paper product which comprises the steps of forming a fibrous paper web containing 1-20 percent of a thermosetting resin uniformly distributed among the fibers, applying 0.1-4 percent of a chromium coordination complex of a fluorohydrocarbon dissolved in a solvent to said web, and immersing the resulting paper web in a molten wax bath.

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117-92, 154; 162-158, 165, 172