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[54] **PREPARATION OF CORRUGATING LINERBOARD**

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[58] **Field of Search**.....117/156, 157, 158; 156/307, 156/327, 328, 332, 336, 318; 161/137, 238, 246, 266, 125, 268; 162/163, 175, 181 A

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[57] **ABSTRACT**

A corrugating linerboard is prepared from a paperboard made from waste paper fiber by surface sizing the paperboard with an aqueous solution of 5 to 30 weight percent solids concentration of an alkali metal borate treated mixture of lignosulfonate and starch. The starch is present in the mixture in an amount of from 15 to 25 weight percent of the lignosulfonate solids and the mixture is treated with the alkali metal borate in an amount of from 1 to 5 weight percent of the lignosulfonate solids.

10 Claims, No Drawings

PREPARATION OF CORRUGATING LINERBOARD

A relatively large amount of waste paper and other low-quality cellulosic fiber is available and is repulped and used in the preparation of low-grade paper products. Only limited use has been made of the reprocessed waste paper available in the preparation of paperboard and paper sheet from which a large segment of higher grade paper products such as containers and other packaging materials is made. While the paperboard and paper sheet made from waste paper pulp may meet many requirements such as tensile strength, stiffness, printability, and appearance required for the higher grade uses, these materials have found limited acceptance in these areas mainly due to the difficulties encountered in the use of these products in high-speed machines. The high speeds desired for increased production cannot be maintained unless the products have a high degree of uniformity and the proper working properties such as gluability, porosity, moisture retention characteristics, and others. These properties and characteristics of the paperboard and paper sheet become more critical with increased speeds. For example, in the manufacture of corrugated paperboard, high-speed machinery is employed which performs the complete operation of moisture conditioning the linerboards and corrugating medium, fluting the corrugated medium, and bonding it to the linerboards at speeds in the range of 200–600 feet per minute. When a linerboard made from waste paper is used, the corrugating machine has to be operated at the lower speeds reducing the production capacity of the machine.

Various surface sizings, sizings, and fillers have been proposed for treatment of paper and paperboard. Most of the materials are not suitable for the treatment of linerboard made from waste paper to improve the high-speed machine operation. In addition to cost, many of the coatings, while materially changing the properties of the board, may have little effect upon the operability of the board in the machine operation. For example, a surface treatment of the paperboard with starch may substantially decrease the porosity and improve the surface uniformity but will have only a limited influence upon the speed that it may be used in a corrugating machine. Spent sulfite liquor or lignosulfonates, and salts thereof, have been suggested for coating and surface sizing of paper to stiffen the paper or to improve the flexural strength. However, such treatments of paperboard made from waste paper will likewise have only a limited effect upon the paperboard with respect to speed of its use in a corrugating machine.

Therefore, it is an object of this invention to provide a process for the preparation of a linerboard made from pulp slurries substantially of waste paper having properties which would permit it to be used in high-speed machine operation. A further object is to provide a process for treatment of paperboard and paper sheet to enhance the properties of the products to permit their use in high-speed machine operations. A still further object is to provide a corrugating linerboard made from substantially waste paper pulps.

The above and other objects are attained according to this invention by applying to the substantially dry paper sheet made from waste paper pulp an aqueous solution containing from 5 to 30 weight percent concentration of a borate treated mixture of lignosulfonate and starch. The starch is present in the mixture in an amount of from 15 to 25 weight percent of the lignosulfonate solids and the mixture is treated with the alkali metal borate in an amount, on a water of hydration free basis, of from 1 to 5 weight percent of the lignosulfonate solids. The aqueous solution is applied to the substantially dry paperboard in an amount such that the solids content of the solution applied is from 0.1 to 3 weight percent, preferably from 0.5 to 1.5 weight percent of the dry weight of the cellulosic fiber or pulp.

While the film or coating on the so-treated surface of the paper sheet is hygroscopic and may increase the moisture absorption and retention of the sheet upon long exposure to high levels of moisture, the so-treated surface is not materially affected by variations in moisture on contacts of short duration. Thus, the paper maintains a more uniform distribution and retention of moisture which alleviates many of the difficulties

encountered in high-speed operations, especially in operations involving changes in moisture content, such as that obtained in corrugated paperboard manufacture. The treatment also imparts a more uniform surface to the paperboard which likewise improves high-speed operations.

The lignosulfonates used in the preparation of the surface-size may be obtained by sulfonation, by the various known methods, of lignin obtained from any source. Lignin is a polymeric substance of substituted aromatics found in plant and vegetable tissue associated with cellulose and other plant constituents. Thus, vegetable and plant tissue are lignin-containing materials which are the principal sources of lignin.

One of the main sources of lignosulfonate is the residual pulping liquors from the pulp and paper industry where lignocellulosic materials, such as wood, straw, corn stalks, bagasse, and the like, are processed to separate the cellulose or pulp from the lignin. In the sulfite pulping process, the lignocellulosic material is digested with a sulfite or bisulfite to obtain a sulfonated residual pulping liquor commonly referred to as "spent sulfite liquor" in which the sulfonated lignin is dissolved. In other pulping processes, the residual pulping liquor as obtained from the process may not be a sulfonated product. However, the residual liquors or products containing the lignin portion of the lignocellulosic materials from the other processes and also from the sulfite process may be treated by the various known methods to sulfonate the product to the degree desired. For example, the residual liquor obtained from alkali pulping processes such as kraft, soda, and others may be sulfonated and used.

The lignosulfonate product obtained from the sulfite pulping process or by sulfonation of other residual pulping liquors or lignin-containing material may contain other constituents besides sulfonated lignin. For example, spent sulfite liquor may contain from 60 to 70 percent sulfonated lignin with the remainder of the solids being carbohydrates, degradation products of carbohydrates, and resinous materials as well as other organic and inorganic compounds. While all or part of these materials may be removed, it is not necessary to do so. The liquor may be fermented to remove the carbohydrates or fractionated by dialysis, solvent extraction, or other means used to obtain not only a substantially purified lignosulfonate product but a product of a particular molecular weight range.

Thus, the terms "lignosulfonate" or "lignosulfonates" as used herein, as commonly used, include the purified sulfonated lignins as well as the unpurified sulfonated lignin products such as spent sulfite liquor and sulfonated residual pulping liquors.

The starch ingredient in the surface-size composition is generally a modified starch commonly used in surface sizing of paper. The starch may be a cornstarch or other starches such as tapioca, potato, sorghum, wheat, and the like. These starches are generally chemically modified such as by oxidation, hydroxyethylation, or enzyme conversion to have products which would give aqueous solutions having lower viscosities simplifying the application to the paper sheet or paperboard. The starch is used in amounts of from 15 to 25 percent of the lignosulfonate solids. This amount of starch gives sufficient penetration of the lignosulfonate-starch solution, and the film or coating obtained on the surface of the sheet, while hydrophilic, is sufficiently resistant to moisture to permit the paper to be stored and handled under normal atmospheric conditions without becoming tacky.

In the preparation of the lignosulfonate-starch solution, the starch is generally intermixed with water at a temperature in the range of 85° to 120° C. to swell the starch prior to intermixing it with the lignosulfonate. The alkali metal borate is most conveniently added to the mixture of lignosulfonate and starch but may be added at any point. After the addition of the borate, the pH of the solution is adjusted to a pH in the range of 7 to 10 with an alkali metal hydroxide such as sodium or potassium hydroxide. The mixture treated with the borate has a good pot life and is not corrosive to the application equipment. Borax, which is most readily available, is usually used.

The various known methods used for the surface sizing or coating of paper may be used for the application of the lignosulfonate-starch mixture to the sheet. Calender sizing may be conveniently used. The lignosulfonate-starch mixture may be applied at a point in the drier roll assembly sufficiently back from the end to obtain the desired moisture content in the product upon leaving the drier assembly. The concentration of the solution is generally maintained in the range of from 5 to 30 weight percent of the total solids content, preferably 15 to 20 percent solids. The solution at the above concentrations has the proper consistency to be readily applicable to the surface in the amounts normally used, in the range of from 0.1 to 3 weight percent of the lignosulfonate-starch solution solids, based upon the dry paper stock or material. The amount of the solution applied varies to a certain extent upon the porosity and other properties of the particular cellulosic material or stock used. Generally, the solution is applied in amounts such that the solution solids are in the range of from 0.5 to 1.5 percent of the paper sheet or paperboard on a dry basis. When expressed on the basis of surface area, the amount will vary from about 0.1 to 1.5 pounds of the solids content of the solution per thousand square feet. In the preferred range, the amount used is generally in the range of 0.25 to 0.5 pounds per thousand square feet.

To further illustrate the invention, a corrugating machine using a linerboard made on a cylinder machine from waste paper had to be operated at speeds of around 170 feet per minute in the preparation of corrugated board with B flutes. At higher speeds, the edges of the board became wet resulting in lack of adhesion and formation of the board in these areas. Apparently, the moisture vaporizing in the corrugating machine flowed to the edges or the coolest portion of the machine and condensed at these points resulting in the wet streaking. With the board treated with the lignosulfonate-starch solution, the difficulty was avoided and the machine was operated at a speed of around 300 feet per minute.

The paperboard used as the linerboard had a weight of about 85 pounds per thousand square feet and was made predominantly from old corrugated boxes with about 5 percent being bags, and 8 percent newspaper and other mixed waste.

The lignosulfonate-starch solution with which the board was treated was prepared by intermixing 12 pounds of modified starch with 50 gallons of water and heating the mixture at about 95° C. for about 20 minutes until the starch had swelled. Dry fermented calcium base spent sulfite liquor solids were added to the swelled starch solution in an amount of 75 pounds. Borax (sodium tetraborate hydrate) was then added in an amount of 4 pounds and the pH adjusted to a pH in the range of 8 to 9 by the addition of sodium hydroxide. The above solution was applied to the bottom surface of the board in the calender stack on roll 2 of a 7-roll drier. The amount applied was about 0.5 weight percent of the cry paper fiber or at a rate of about 10 pounds of the lignosulfonate-starch solution solids per ton of paper. No difficulty in the application was encountered and the rolls were operated without any evidence of corrosion or pitting of the calender stack or equipment.

When the board is coated with a starch solution in the calender rolls instead of the lignosulfonate-starch solution as above, the corrugating machine had to be operated at a speed of about 200 feet per minute. With the starch surface treatment, proper bonding between the linerboard and the medium could not be obtained at higher speeds.

Likewise, the treatment of a linerboard with a calcium base spent sulfite liquor in an amount of 0.5 or 10 pounds of spent sulfite liquor solids per ton of paperboard has only a limited effect upon the corrugating operation. The corrugating machine could be operated up to about 200 feet per minute. At higher speeds, wet streaks at the edges of the board were obtained which were similar to that obtained with the linerboard with no surface treatment.

I claim:

1. In a process for the preparation of a corrugating linerboard wherein the board is made from an aqueous slurry of cellulosic fibers obtained substantially from waste paper, the improvement which comprises applying to the substantially dry linerboard an aqueous solution consisting essentially of from 5 to 30 weight percent solids concentration of an alkali metal borate treated mixture of lignosulfonate and starch, and drying the treated linerboard, said starch being present in an amount of from 15 to 25 weight percent of the lignosulfonate solids, and said mixture being treated with the alkali metal borate in an amount of from 1 to 5 weight percent of the lignosulfonate solids.

2. A process according to claim 1 wherein the lignosulfonate is a spent sulfite liquor.

3. A process according to claim 2 wherein the aqueous solution of the mixture has a concentration of from 15 to 20 weight percent solids and is applied to the board in an amount such that the solids content of the solution applied is in a range of from 0.1 to 3 weight percent of the dry weight of the cellulosic fiber in the sheet.

4. In a process for the preparation of a corrugated board, wherein a linerboard made from substantially waste paper pulp is attached to the fluted papersheet, the improvement which comprises applying to the surface of the substantially dry linerboard an aqueous solution consisting essentially of from 5 to 30 weight percent solids concentration of an alkali metal borate treated mixture of lignosulfonate and starch, said starch being present in the mixture in an amount of from 15 to 25 weight percent of the lignosulfonate solids, and said mixture being treated with the alkali metal borate in an amount of from 1 to 5 weight percent of the lignosulfonate solids, drying the so-treated linerboard, and forming the corrugated board by bonding the corrugated papersheet to the treated surface of the linerboard.

5. A process according to claim 4 wherein the aqueous solution of the mixture has a concentration of from 15 to 20 weight percent solids and is applied to the linerboard in an amount such that the solids content of the solution applied is in the range of from 0.1 to 3 weight percent of the dry weight of the cellulosic fiber in the linerboard.

6. A process according to claim 5 wherein the lignosulfonate is a calcium base spent sulfite liquor.

7. A linerboard obtained by the process of claim 1.

8. A linerboard obtained by the process of claim 2.

9. A corrugated board obtained according to the process of claim 4.

10. A corrugated board obtained according to the process of claim 6.

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