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MANUFACTURE OF ALKALI CELLULOSE AND PULP SHEETS THEREFOR

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This invention relates generally to new and useful improvements in the manufacture of alkali cellulose and particularly seeks to provide novel duplex sheets of highly purified cellulose pulp, the individual sheets of which are secured together by an adhesive that is soluble in caustic soda, and a method of preparing and steeping such duplex sheets.

When dissolving pulps are used for the production of rayon, cellophane, cellulose esters or cellulose ethers the first step is generally a reaction with strong caustic soda solution (in the neighborhood of 18%) to produce alkali cellulose. This is frequently carried out by steeping pulp sheets in the solution. Not all pulps, however, behave satisfactorily when treated in this manner, and any inadequacies of the pulp are further accentuated by the crowded steeping conditions that are normally used industrially. For some reason wood pulps produced from hardwoods show poorer steeping than those from softwoods and, further, the greater the degree of pulp purification the poorer usually is the steeping. Unsatisfactory steeping is characterized by the sheets shifting erratically in the steeping press due largely to the sudden release of frozen stresses and the frequent trapping of large quantities of air. This trapped air can lead to incomplete reaction between the pulp and the caustic soda, resulting in the formation of so-called "brown spots"—areas having abnormally low caustic soda content. These brown spots react incompletely with CS_2 or other esterifying or etherifying agents in the ensuing processing, resulting in fibers in the solutions with consequent filtration trouble. Steeped and pressed hardwood pulps also tend to split or crack when removed from the steeping presses. Various attempts have been made in the past to overcome some of these difficulties, for example by giving an unequal surface (e. g., rippling, water-marking) to the pulp sheets. This reduces the frozen stresses induced in the sheet during drying and also results in channels through which air can escape and caustic enter during steeping. Such a scheme, however, lowers the drying capacity of pulp drying machines. Similarly, attempts to increase the weight of pulp sheets to confer more strength and stability on the sheet during steeping lead again to an uneconomical utilization of pulp drying capacity. Furthermore, there is a limit to the weight and thickness of a single sheet if adequate and even caustic penetration is to be secured during the steeping operation. A heavy pulp sheet that did not entail the disadvantages mentioned above would be very desirable.

Such a heavy sheet can be made without adversely affecting machine capacity by sticking together two dry sheets to form a duplex sheet having excellent steeping properties.

An object of this invention, therefore, is to improve the production of alkali cellulose by the preparation and steeping of duplex sheets of highly purified cellulose pulps.

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Another object of this invention is to provide a novel duplex sheet of highly purified cellulose pulp, the individual sheets of which are secured together by an adhesive that will dissolve in a caustic soda solution of mercerizing strength so that when a steeping press loaded with such duplex sheets is filled with caustic soda the individual sheets of each duplex sheet will separate to insure complete and uniform steeping of all sheets.

A further object of this invention is to provide duplex sheets of the character stated that remain steady in a steeping press, do not trap air, do not exhibit any "brown spotting," and which can be steeped under much more crowded conditions than conventional single sheets.

A further object of this invention is to provide duplex sheets of the character stated in which the adhesive is selected from the group consisting of methyl, ethyl, hydroxyethyl and carboxymethyl cellulose and their salts.

With these and other objects in view, the nature of which will become apparent, the invention will be more fully understood by reference to the accompanying detailed description and the appended claims.

There are probably many compounds that will effect the adhesion of dried pulp sheets. We have tried various resins, gums, starches, modified starches, dextrans, gelatines, cellulose derivatives and combinations of these. These are more or less successful in so far as they produce a strong flexibly bonded sheet that will separate readily in the steeping caustic and not interfere with subsequent viscose processing. It is, in addition, an advantage for an adhesive to be effective in small amounts and not require extreme manufacturing conditions. An example of an outstanding adhesive, fulfilling the above conditions, is a water solution of the sodium salt of carboxy methyl cellulose. Such a solution requires extremely small amounts to give a flexible, firmly bonded sheet that will withstand considerable handling. Carboxy methyl cellulose is, moreover, rapidly soluble in the steeping caustic. Thus as caustic rises in the steeping press the duplex sheets gradually split into their original single form while the dry upper portions of the duplex sheets maintain their rigidity in the steeping press. Carboxymethyl cellulose is very similar in composition to substances normally present in steeping caustic and would therefore present no problem in the re-use of such liquor. Carboxymethyl cellulose is also very close in composition to the pulp itself and even in amounts ten times in excess of those required by the present invention we have found no adverse effect on ultimate yarn strength.

The bonding agent can be applied to a dried pulp sheet in several ways; for example, by spraying or with an applicator roll. In any case, the adhesive may be applied to one sheet only, a second sheet placed over the first and both are then passed through nip rolls. With some adhesives this pressing operation requires heat but with carboxymethyl cellulose it can be done cold. Adhesion can be effected over the entire surface of the sheet or it may be done in a variety of patterns, for example, in strips. Such strips would preferably run in the machine direction of the pulp and would be vertical during a steeping operation. Any of these methods can readily be carried out continuously and lend themselves to a reel blending system.

Any two sides can be joined together to give a good steeping duplex sheet. The reason for the good steeping properties is probably the enhanced strength and stability of the sheet under the stresses imposed by the caustic, the two sheets reinforcing each other and remaining steady in the press. In marginal cases, however (for example, if pulp density is on the low side), some advantage might be obtained by bonding two similar sides (such as two wire sides). It has been established that there are more

short fibers in the top side of a sheet than in the wire side, and this fines differential is much more pronounced in hardwood pulps than in softwood pulps. Due to this fines differential there are probably differing stresses set up in the two sides of a pulp sheet on drying. The relaxation of these unequal dried-in strains by the caustic solution causes a cockling of the sheet in the press. When two similar sides are placed together, however, the stresses will tend to be neutralized.

The following examples are offered to illustrate the principle of the invention:

Example I

The pulp used in this case was a dissolving grade intended for textile rayon and produced chiefly from hardwoods. Two samples were prepared: first, a single sheet control batch of sheet weight 60 grams per square foot, sheet size 23½" x 20", the shorter dimension being in the machine direction and vertical in the steeping press; second, a batch of duplex sheets of similar size made on a roll coating machine. A 5% water solution of carboxymethyl cellulose (Hercules 70M) was used as the adhesive and 0.05% C. M. C. (based on duplex sheet weight) was applied at a speed of 115 feet per minute to make the bond. Nip pressures of 150 pounds per lineal inch completed the treatment. In this case top side was bonded to top (or felt) side and adhesion was complete between the two sheets.

Steeping tests were carried out in a 60 ton commercial size press, using 5 compartments for each test pulp. The single sheet control was steeped at a filling rate of 3 inches per minute and under density conditions of 4.8 sheets per inch. This pulp exhibited twisting, laddering, bad air inclusion, cracking and excessive brown spotting. The duplex sheets were steeped simultaneously at the same filling speed and under conditions of crowding that ranged from 4.8 to 6.6 sheets per inch (calculated on a single sheet basis). In this case the sheets remained steady, there was no twisting or trapped air and no evidence of cracking or brown spotting despite the large sheet size and the crowded conditions.

Example II

Duplex sheets were prepared from a highly purified tire yarn pulp manufactured from softwood. Sheet size and details of preparation were essentially the same as set forth in Example I. In this case, however, wire side was bonded to wire side with complete adhesion between the two sheets.

Steeping tests in the 60 ton press showed perfect steeping for the duplex sheets with no sign or brown spotting even when the crowding was as high as 6 sheets per inch. The single sheet control on the other hand gave mediocre steeping results, inferior to the duplex sheets and it could not tolerate the more crowded conditions.

Example III

A pulp similar to that described in Example I was used. Two batches were prepared, including a single sheet control. The duplex sheets in this case were formed by bonding top side to top side with narrow strips of adhesive. 0.006% carboxymethyl cellulose (based on

weight of duplex sheet) was applied by spraying a 3% water solution of carboxymethyl cellulose. The application of 450 pounds per lineal inch pressure completed the treatment.

Here again the duplex sheet steeped perfectly and exhibited no brown spotting while the single sheet control twisted badly, trapped air, and showed a large number of brown spots.

Thus this invention has disclosed an improvement in the manufacture of alkali cellulose which includes the preparation and steeping of adhesively-secured duplex sheets of highly purified cellulose pulp, and has also disclosed a novel, adhesively-secured duplex sheet of highly purified cellulose pulp in which the adhesive is of such a nature as to be dissolvable in a solution of caustic soda so that when such sheets are steeped the individual sheets will separate to permit complete and uniform steeping.

We claim:

1. In a method of preparing alkali cellulose from highly purified cellulose pulp the steps of supplying a sheet of highly purified cellulose pulp, applying a caustic soda soluble adhesive to one face of said sheet, placing a second sheet of highly purified cellulose pulp against the adhesive-carrying face of said first mentioned sheet, passing the two sheets through pressure-applying means, cutting the adhered sheets to proper size for introduction into a steeping press, placing a predetermined number of the cut sheets vertically in the steeping press, and finally filling the steeping press with a caustic soda solution of mercerizing strength whereby to progressively dissolve the adhesive between each pair of sheets in the steeping press and to permit each sheet to become individually and completely steeped.

2. The method of claim 1 in which the adhesive is carboxymethyl cellulose.

3. The method of claim 1 in which the adhesive is a cellulose derivative selected from the group consisting of methyl, ethyl, hydroxyethyl and carboxymethyl cellulose and their salts.

4. In a method of preparing alkali cellulose from highly purified cellulose pulp the improvement which comprises placing vertically in a steeping press a predetermined number of cut duplex sheets of highly purified cellulose pulp, the individual sheets of which have been secured together by a caustic soda soluble adhesive comprising a cellulose derivative selected from the group consisting of methyl, ethyl, hydroxyethyl and carboxymethyl cellulose and their salts, and then filling the steeping press with a caustic soda solution of mercerizing strength whereby to progressively dissolve the adhesive between the sheets of each duplex sheet and to permit each sheet to become individually and completely steeped.

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