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CELLULOSE FIBER PULP SHEET IMPREGNATED WITH A LONG CHAIN CATIONIC DEBONDING AGENT

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ABSTRACT OF THE DISCLOSURE

A pulp sheet impregnated with about 0.25% to 1.0%, and preferably about 0.25% to 0.5%, based on the weight of the dry pulp, of a cationic long chain fatty alkyl compound debonding agent having at least 12 carbon atoms in at least one alkyl chain such as di-hydrogenated dimethyl ammonium chloride derived from a tallow oil, and drying the impregnated pulp to form a pulp sheet that can be easily mechanically fiberized.

This application is a continuation-in-part of our application Ser. No. 739,641, filed June 25, 1968.

In accordance with this invention, it has been discovered that a pulp sheet formed on a conventional paper machine of the cylinder or Fourdrinier type and which sheet is normally difficult to fiberize, may be rendered exceedingly easy to fiberize (by mechanical action) if the pulp sheet or furnish for same is impregnated with critical amounts of certain types of chemical compounds, discussed below. We have found that these particular types of chemicals when used in suitable amounts, are unusually and markedly effective in debonding the pulp or pulp sheets treated therewith such that when the pulp sheet is dried and subjected to mechanical abrasive action, the fibers composing the sheet will substantially completely separate and produce a very fluffy fibrous material. The loftiness of this material is 33⅓% or higher than the same type of material which has not been chemically treated before being subjected to the fiberizing operation.

It appears that the selected highly effective chemicals function to eliminate or break down the usual bond that exists between the fibers and thereby act as a debonding agent. The evidence of this debonding effect is shown by the tensile strength of the treated pulp sheet which is only about one-third to one-fourth of the tensile strength of the same sheet untreated. For example, the treated sheet may typically have a tensile strength of about 2 pounds per inch for a sheet having a basis weight of 80 pounds per 3000 square feet in contrast to the untreated sheet which will typically have a tensile strength of 6 to 8 pounds per square inch.

The chemicals which we have found effective for obtaining this markedly lower tensile strength of the pulp sheet, comparable ease of debonding by mechanical action and comparable increase in loftiness of the fiberized material, may be generically classified as cationic long chain fatty alkyl compounds having at least 12 carbon atoms in at least one alkyl chain. One of the important characteristics of these compounds is their cationic nature which attracts them chemically to the anionic fibers. It also appears that the highly efficient debonding action of these chemicals is allied with long chain fatty type chemical compounds. Also, from the standpoint of effective debonding, it is important that these chemical compounds

have at least 12 carbon atoms in the alkyl chain or in at least one of the alkyl chains if a dialkyl type compound is used.

The effective chemicals may also be classified subgenerically into the following groups, quaternary compounds, tertiary, secondary and primary amine salts. Some of the quaternary compounds have been found more advantageous than some of the amines from the standpoint of lowering the tensile strength of the sheet from the usual 6, 7 or 8 pounds per inch down to 2 or 3 pounds per inch. However, a number of the primary amines of the long chain type having about 16, 18 or more carbon atoms have proven very effective for debonding purposes.

Illustrative but non-limiting examples of the chemicals in the above mentioned four categories are as follows:

QUATERNARY

mono cottonseed oil trimethyl ammonium chloride
mono coco trimethyl ammonium chloride
mono stearyl trimethyl ammonium chloride
mono oleyl trimethyl ammonium chloride
mono soya trimethyl ammonium chloride
dilauryl dimethyl ammonium chloride
di hydrogenated dimethyl ammonium chloride derived from a tallow oil
dimethyl ammonium chloride derived from soya oil
N-alkyl ($C_{12, 14, 16}$) dimethyl benzyl ammonium chloride
coco dimethyl benzyl ammonium chloride

TERTIARY

mono stearyl dimethyl amine chloride

SECONDARY

di coco amine chloride
di hydrogenated tallow amine chloride
di oleyl amine chloride

PRIMARY

dodecylamine chloride
palmitylamine chloride
coco amine chloride
coco amine acetate
stearyl amine chloride
stearyl amine acetate
oleyl amine chloride
oleyl amine acetate
soya amine chloride
tallow amine chloride

Any one or more of the selected chemicals above identified may be introduced into the pulp or pulp sheet at a number of different places or steps in commercial pulp sheet forming operations. For example, the chemicals may be added to the pulp slurry contained in a stock chest prior to the paper or paperboard machine and this is of advantage where it is desired to permit the chemical to remain in contact with the cellulose fibers for some period of time, e.g., 5–10 minutes, before the slurry is fed to the paper machine. Where prolonged contact with the slurry prior to sheet formation is not necessary or desired, the chemical may be added at the head box of the paper machine.

Depending upon the type of paper or board making machinery used, the desired speed of operation, and the desired degree of impregnation of the fibers with the chemicals, the chemicals may be introduced into the sheet at the wet press section of the paper machine by suitable conventional equipment, such as a size press or the like. At this point, the chemical will be introduced into the previously formed pulp sheet or board while it is still relatively wet, and before the sheet or board is finally dried on the machine.

A suitable type of Fourdrinier paper machine and the process of forming paper thereon is disclosed in G. L. Bedwell Pat. No. 2,488,700, issued Nov. 22, 1949; and a suitable type of cylinder machine is disclosed in Jacob Edge Pat. No. 2,005,839, issued June 25, 1935. And reference may be had to those patents for disclosures of paper machines and processes of operation suitable for use in the present invention.

The amount of chemical or chemicals to be added to the pulp furnish, slurry, or pulp sheet is important and may vary within the critical range specified below, with the type of pulp used and the desired extent of debonding property. The amount should be above 0.1% by weight based on the dry pulp. In most cases, the chemicals are highly effective within the range of 0.25% to 0.5%. A minute amount of 0.1% may produce some limited softening of the pulp but an amount of not less than 0.25% is required for substantial improvement in fiberizing properties. In commercial practice, employing sulfite process wood pulp, an amount of 0.3% to 0.5% of the chemical should be used for best fiberizing results. When using pulp produced by the sulfate process which is harder and more difficult to fiberize, the amount of chemical needed may be 0.5% or slightly higher. Amounts of 1% or above are not normally required and although they may be used to give some further improvement in fiberizing properties, the additional chemical cost is usually not justified.

The effectiveness of the chemical treatment of the pulp in accordance with this invention for rendering the pulp sheet more easily fiberized is substantially proportional, with a given pulp and a given chemical, to the amount of chemical used within the above range of 0.25% to 0.5%. We have found, for example, with a sulfite pulp, chemical added in amount of 0.3% based on dry weight of pulp will lower the tensile strength to about ⅓ that of the same pulp sheet without the chemical treament. And the use of 0.5% of chemical applied to the sulfite pulp will lower the tensile strength to about ¼ that of the same pulp without the chemical treatment. This dramatic lowering in tensile strength of the pulp sheet is accompanied by a corresponding improvement in the fiberizing properties of the pulp sheet such that it fiberizes remarkably easy and produces the much loftier, cleaner and more uniform long fiber material.

The present invention is applicable to practically all conventional types of pulps made in conventional manner by the well-known kraft, soda, sulfite, or neutral sulfite processes.

The raw material, that is, the fibers to be pulped, impregnated and sheeted in accordance with the present invention, may be any one or more of the various types of pulp materials commercially used in paper and paperboard manufacture. Illustrative examples are wood, cotton, linters, flax, hemp, ramie, bagasse, and esparto fiber pulps. Generally speaking, it is desirable to use relatively

long fiber material for ultimate individual fiber strength and for high resistance to breaking, powdering or dusting when subjected to the fiberizing treatment.

After incorporation of the chemicals in the pulp sheet or board at any of the desired points mentioned above, the formed and impregnated wet sheet is then passed over conventional drying cylinders normally used in a paper machine to provide a fairly dense substantially dried, e.g., moisture of about 5%–10% by weight, sheet which may typically have a thickness of about 1/16–⅛ of an inch, and the dried sheet wound in a conventional manner on rolls for storage or shipment and ultimately for fiberizing by mechanical action to produce the above-described lofty fluffy fiberized material. The final fluffy material may be used for any desired purposes such as, for example, in diapers, napkins or other sanitary products, or for bulking or padding purposes, particularly where a lofty material is needed. The lofty fiberized properties of this material are also of advantage from the standpoint of efficiency of absorption of body fluids.

Various modifications may be made in the above-described materials, chemicals, process conditions, etc., without departing from the scope of this invention as set forth in the appneded claims.

We claim:

1. A cellulose pulp sheet characterized in that the bonding between the fibers is reduced by a surface-active agent, in amount of about 0.25% to 1.0% and in the form of a cationic long-chain fatty alkyl compound which contains at least 12 carbon atoms in at least one alkyl chain.

2. A cellulose pulp sheet having improved fiberizing properties in which the bonding between the fibers is reduced by a surface-active agent, in amount of about 0.3% to 0.5% and in the form of a cationic, long-chain fatty alkyl compound which has at least 12 carbon atoms in at least one alkyl chain, and the tensile strength of the sheet is about ⅓ to ¼ of the normal tensile strength of the same pulp sheet without the surface-active agent.

3. A cellulose pulp sheet as defined in claim **2** and in which the pulp is sulfite pulp.

4. A cellulose pulp sheet, as defined in claim **1**, in which the amount of surface-active agent is 0.25% to 0.5%.

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