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METHOD OF PRODUCING HIGHLY ABSORBENT CELLULOSE

Lars-Henrik Forssblad, Iggesund, and Per Jerkeman, Gavle, Sweden, assignors to Korsnas-Marma Aktiebolag, Gavle, Sweden

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ABSTRACT OF THE DISCLOSURE

Highly absorbent cellulose is produced by adding to the pulp an organic anionic or nonionic agent and a cationic retention agent while regulating the amount of the cationic substance in such a way that the Z-potential of the pulp approaches zero.

BACKGROUND OF THE INVENTION

It is known to produce highly absorbent cellulose, so-called fluff, by dry defibration of dried pulp in the form of sheets or endless webs. To be suitable for fluff, the pulp should be of such a texture that the fibres can be separated from each other without being shortened to any noticeable extent, and it should be possible to carry out the separation of fibres at a low consumption of energy. Further, the fluff obtained should exhibit properties being of decisive importance to its use in hygienic products, for which it is intended, such as high bulk, good elasticity, great absorption capacity and absorption rate.

The requirement that the pulp should be easy to defibrate presupposes and intentional reduction of the natural tendency of the fibres to adhere to each other on drying. To achieve said reduction of the binding capacity it has previously been proposed to add a cationic organic agent to the pulp in the cellulose mill immediately before or on the wet machine.

By the addition of neutral compounds, such as nonionic or anionic substances, it is possible to obtain the desired reduction of the binding force of the fibres in an effective and reliable manner independently of the substantivity of the substance in question. The adhesion of high-molecular, organic substances to cellulose fibres is determined by colloid chemical factors which will be mentioned briefly. In aqueous suspension, a natural, pure cellulose fibre assumes a negative electric charge which is localized to the fibre surface in the boundary layer between the fibre and the water. In its immediate proximity in the aqueous phase this charge fixes an immovable and sharply defined layer having a positive charge, and said positive layer induces, in turn, in the water outside it a diffuse, negatively charged layer which is movable and moves with the water, if the latter is caused to flow. The difference in potential between said diffuse charge layer and the main mass of the suspension water has been designated as Z-potential and can be determined by means of electrokinetical measuring methods. The Z-potential which has the same character as the charge of the fibre surface, grows and diminishes numerically with the charge, when the latter is changed by charged particles (ions) supplied

from outside. The Z-potential and the fibre charge reach the value zero simultaneously, and thus the Z-potential gives a valuable indication of the state of charge of the fibre.

SUMMARY OF THE INVENTION

Now it has turned out that the negative, electrostatic surface charge of the fibre can be reduced, wholly eliminated or changed to a positive charge, so that the defibration of the dry pulp is facilitated and a highly absorbent cellulose or fluff is obtained. The new method consists in that two different kinds of substances are added to a pulp immediately before or on the wet machine, Whereupon the pulp is dried and the dried pulp is defibrated in a manner known per se. One of these substances is a nonionic or anionic, finely dispersed, high-molecular, organic substance having a molecular structure containing hydrophobic parts, and the other substance is a cationic retention agent which is added in such an amount that the Z-potential of the pulp approaches zero.

If the retention agent is added in a suitable amount, it changes the state of charge of the fibres, so that the fibres are capable of retaining nonionic and anionic substances on their surfaces. To retain the nonionic or anionic substance on the walls of the fibres to such a degree that the desired effect is obtained it is necessary to proportion the amount of retention agent such that the charge of the fibres and thus the Z-potential assumes a very low value, i.e. in the proximity of nought. By adjusting the Z-potential of the fibres it is thus possible to achieve that sufficiently large molecules of a substantially hydrophobic character are caused to adhere to the walls of the fibres so that the force of the binding fibre-to-fibre is reduced at the drying of the pulp. The Z-potential may be determined by an electrokinetical measurement as known per se.

A number of substances are known as retention agents in other connections. Examples of such agents are several metal salts with polyvalent cations, such as Al^{3+}, Ce^{3+}, La^{3+}, Th^{4+}, Zr^{4+}, certain finely divided minerals such as chrysotil asbestos and certain nitrogenous organic substances such as alkyl amines, alkyl diamines, polyimines, alkoxylated derivatives thereof, and others.

DETAILED DESCRIPTION OF THE INVENTION

The method according to the invention will be illustrated by the following examples.

Example 1

A nonionic (neutral) paraffine emulsion (Mobilcer HM) containing 0.4 g. of paraffine was added, while agitating, to 5 liters aqueous suspension of a bleached pine sulphate pulp (2% concentration). After 10 minutes and while continuing the agitation, an aluminum sulphate solution (10 g. of $Al_2(SO_4)_3$ per liter) was added in portions, until a sample withdrawn showed that the Z-potential had assumed the value zero. For that 50 ml. of aluminum sulphate solution was needed, i.e. 0.5% Al-sulphate, calculated on the weight of the dry pulp. The Z-potential was determined by means of a "Streaming Current Detector" made by Waters Associate Inc., Framingham, Mass., U.S.A.

The pulp suspension was drained on a suction filter to form a number of fibre sheets containing about 700 g. of dry pulp per sq. m. The sheets were drained by pressing to a dry content of 35% and were then dried to 93% dry

content. From another batch of the same bleached sulphate pulp without added chemicals fibre sheets were formed in the same way and dried to 93% dry content. Both kinds of fibre sheets were dry defibrated in a laboratory shredder equipped with means for measuring the consumption of energy during the dry defibration. In the following table the consumption of energy and the bulk of the fluff obtained are compared.

TABLE

	Without additions	With additions
Consumption of energy at dry defibration of the pulp sheets in laboratory equipment of the spiked-roller type, kwh./t	230	170
Bulk of the fluff, cb. cm./g	89	94
Absorption capacity, g. water/g. fluff	12.1	12.7

Example 2

While agitating, 0.06 g. of the retention agent Diaminacetat BG (Liljeholmens Stearinfabriks AB) was added to 5 liters aqueous suspension of bleached sulphite pulp (2% concentration), and after 10 minutes 0.45 g. of Tergitol Anionic 4 (sodium tetradecyl sulfate, produced by Union Carbide Corp.) was added, while continuing the agitation. Previously it had been ascertained by a preliminary test that the Z-potential zero was reached when adding 0.06% of the retention agent, calculated on the weight of the dry pulp.

In the same way as in Example 1 laboratory-made sheets were produced and fluff was made therefrom in a laboratory shredder. In the following table the consumption of energy at the dry defibration and the properties of the product obtained are compared with corresponding values for the same pulp without added chemicals. The so-called knot number was determined by causing an aqueous suspension of a certain amount of fluff to pass through an electronic counter, in which the number of particles above a certain size were counted by a photocell connected to a computer.

TABLE

	Without additions	With additions
Consumption of energy at dry defibration of the pulp sheet in laboratory equipment of the spiked-roller type, kwh./t	200	130
Number of undisintegrated knots per gram of fluff (knot number)	150	20
Bulk of the fluff, cb. cm./g	80	85
Absorption capacity, g. water/g. fluff	10.9	11.4
Absorption time, sec	8.0	2.5

Example 3

In the pulp vat of the pulp mill immediately before the wet machine, there was added to a bleached sulphate pulp of 2% concentration 0.4%, calculated on the weight of dry pulp, of nonyl-phenoxy-polyglycol ether (Berol EMU–04) emulsified in water, and 0.05% (calculated on the weight of dry pulp) of a retention agent consisting of an ethoxylated alkyl amine (Berol EMU–302). On the basis of Z-potential determinations in reference samples the amount of amine had been determined such that the Z-potential of the pulp was zero.

In the following table the consumption of energy at the dry defibration and the properties of the product obtained are compared with corresponding values for the same pulp without additions of chemicals.

TABLE

	Without additions	With additions
Consumption of energy at dry defibration of the pulp sheet in laboratory equipment of the spiked-roller type, kwh./ton	230	180
Number of undisintegrated knots per gram of fluff (knot number)	230	120
Long fibre fraction (retained on a screen of 18 mesh in a fibre grouping apparatus according to Bauer-McNett), percent	25	39
Absorption capacity, g. water/g. fluff	12.0	12.2

What we claim is:

1. A method of producing highly absorbent cellulose in the form of a fluff, comprising adding to a pulp, immediately before or on the wet machine, a finely dispersed high molecular weight substance containing hydrophobic parts and selected from the group consisting of an organic anionic agent and an organic nonionic agent, in an amount of 0.05–5%, calculated on the dry weight of the pulp, and a cationic retention agent consisting of a water soluble salt of a polyvalent metal selected from the group consisting of Al^{3+}, Ce^{3+}, Th^{4+}, Zr^{4+} and La^{3+} in an amount of 0.01–5% of the anhydrous salt thereof, calculated on the dry weight of the pulp, while regulating the amount of the added cationic substance in such a way that the Z-potential of the pulp approaches zero, drying the pulp, and then defibrating the dry pulp.

2. A method according to claim 1, wherein the high molecular weight finely dispersed substance is a nonionic paraffine.

3. A method of producing highly absorbent cellulose in the form of a fluff, comprising adding to a pulp, immediately before or on the wet machine, finely dispersed sodium tetradecyl sulfate in an amount of 0.05–5%, calculated on the dry weight of the pulp, and a cationic retention agent consisting of diamine acetate, in an amount of 0.01–0.10%, calculated on the dry weight of the pulp, while regulating the amount of the added cationic substance in such a way that the Z-potential of the pulp approaches zero, drying the pulp, and then defibrating the dry pulp.

4. A method of producing highly absorbent cellulose in the form of a fluff, comprising adding to a pulp, immediately before or on the wet machine, a finely dispersed nonylphenoxy polyglycol ether in an amount of 0.05–5%, calculated on the dry weight of the pulp and a cationic retention agent consisting of an ethoxylated alkyl amine in an amount of 0.01–0.10%, calculated on the dry weight of the pulp, while regulating the amount of the added cationic substance in such a way, that the Z-potential of the pulp approaches zero, drying the pulp, and then defibrating the dry pulp.

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S. LEON BASHORE, Primary Examiner

F. FREI, Assistant Examiner

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