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## METHOD OF MODIFYING CELLULOSE PULP FOR PAPER MAKING PURPOSES

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In making paper from any grade of papermaking pulp, the object is to produce a compact, closely formed sheet with a smooth surface as is characterized by the ordinary papers now in commercial use.

An object of the process of the present invention is to so treat or modify cellulose pulps that the resultant paper made therefrom will have very open texture, felt-like characteristics, and porous surface, thus imparting to the paper more absorbent properties than would be obtained otherwise.

It is a further object to use commercial cellulose pulps now on the market and to modify them in such a way that the pulp will not deteriorate in storage and can be easily handled and shipped.

We are aware that absorbent papers are made from soft rag stock. These require lengthy preparation in order to render them suitable and, furthermore, are rather expensive.

While the process of this invention applies principally to treating wood-pulps to render them absorbent, it may also be applied to rag pulps if so desired. In this case, however, the rag pulp is rendered much more absorbent than it would be if made by the regular method of running off into paper or sheet material. In other words, regardless of the nature of the cellulose pulp treated by this method, the absorption or porosity is increased.

The following is a description of the method which we employ, according to the invention, to modify pulp to produce an absorbent paper. The first step is to allow ordinary commercial sheets of cellulose pulp, such as wood pulp, to soak in a mercerizing solution of caustic soda, for example, a 15% to 20% solution of caustic soda at ordinary room temperatures until completely saturated, which requires only a few seconds' time. When the sheets of pulp are introduced into the caustic soda solution, they immediately swell to a thickness of five to six times the original caliper, and, as the caliper of the pulp increases, the other dimensions of the sheets decrease and the sheets shrink. This increased caliper and swelling of the pulp may be called puffing, which is practically curling or crinkling of the fibers in the pulp, due to the action of the caustic soda. In order to properly puff or curl the fibers, it is necessary to use a large excess of caustic soda solution of a strength not much less than 10% concentration. After the pulp is puffed to its fullest extent, the excess caustic soda used in the process is no longer necessary, and, as a feature of the invention, this excess containing lignin and other substances originally in the pulp which are soluble in alkali is removed by subjecting the sheets to mechanical pressure without materially decreasing the curling or crinkling of the fibers, the sheets of treated pulp being placed flatly and evenly in piles, one upon another, in a suitable press and then subjected to pressure, and the excess caustic liquor being reclaimed. The treated sheet is smaller in area than the original sheet, greater in thickness, and its crinkled fibers, of course, have maintained their original relative positions.

The following is one example which has been carried out in practice: 250 pounds of commercial kraft pulp in sheets was saturated in individual sheets with a 20% solution of caustic soda. This required about thirty seconds for each sheet, which was the time necessary to complete the swelling or puffing of the kraft fibers. These sheets were then piled one upon another and subjected to pressure. The type of press used was the ordinary commercial press commonly used to squeeze excess water from ordinary commercial fiber board. Practically two-thirds of the original caustic soda used was reclaimed, and was suitable to use over again for treating more pulp.

The time required for pressing to remove this excess was about twenty minutes. The amount of the original caustic soda remaining in the sheets was about 15% of the weight of the dry pulp. These sheets were in such condition that they could be easily handled similar to ordinary commercial pulp in the wet state.

For purposes where it is undesirable to wash the stock in a washing engine and thereby reduce the caustic soda content, a partial washing may be carried on in the press. Thus, the stock containing 15% NaOH on the basis of dry fiber weight may be completely rewet with water while remaining in the press and then repressed. One washing in this manner reduces the caustic soda content to one-third to one-fourth of the previous caustic soda content. This pulp, with NaOH content of 3 to 6% is suitable for storing, may be used without further washing and will not lose its characteristic properties. It is understood, of course, that the washings are sufficiently concentrated to permit the caustic soda to be reused and the process is much less wasteful than previous methods of making curled or crinkled fibrous pulps or sheets.

These sheets of pulp thus prepared were introduced into a beater engine of the Holland type,

such as is ordinarily used in making paper, together with sufficient water to allow the stock to properly circulate. As soon as the stock in the beater engine was thoroughly separated, it was partly washed to reduce the alkali content. This washing was accomplished by commercial washing apparatus attached to the beater engine. When the stock was washed to the point of a pH of about 11, which test showed upon analysis that the stock contained about 10% of caustic soda based upon the weight of the fiber, a quantity of aluminum-sulphate was added to bring the pH to 5.5. The stock was then dumped into a stock chest and run off on a paper machine in the usual manner. The resultant product was a very soft, open, and feltlike paper, very absorbent and easily saturated, capable of taking on more saturation than would be possible with ordinary kraft paper, it having an absorption four to five times greater.

In carrying out the invention it is not necessary to use aluminum-sulphate to neutralize the caustic soda in the beater engine, as the washing may be carried to a point where the stock becomes neutral and then it may be run off on the papermaking machine. However, there is an advantage in adding the aluminum sulphate other than neutralizing the alkali, as it causes the stock to flocculate, that is, prevents large clots of stock which interfere with the formation on the paper machine. It is the effect of precipitating aluminum-hydroxide on the stock which causes the advantageous flocculation.

It is to be understood that as soon as the sheets of pulp are treated with caustic soda and pressed, the product is a new modified commercial pulp in sheets and can be used in various ways as such.

It is not essential to use pulp in flat sheets, although this provides a convenient shape for handling, storing and shipping. If the pulp is in a looser form, as in coarse flakes or small broken sheets or similar distorted masses, it may be saturated in loose condition in a suitable filter press and may be pressed into a biscuit in situ and washed in the press if desired.

If desired, the entire operation may be carried on in sheets in a suitable filter press adapted to take the dry sheet. The press is loaded with dry sheets, closed partially, filled with caustic soda solution, opened to allow saturation and swelling, closed to press out the excess caustic, then wash water introduced to reduce the NaOH content of the sheets to the desired amount. The press is then opened and unloaded and the cycle repeated.

One very distinct advantage of this process is the reclaiming of the caustic soda, thereby greatly reducing the cost of treatment. The reclaimed caustic liquor may be used directly to modify fresh pulp or may be mixed with fresh caustic soda solution of the proper strength. Pulp prepared by this method readily disintegrates in the beater engine in the presence of water requiring only a few minutes' time, thereby reducing the cost of the beating operation.

In ordinary practice, the stock is ready for the paper machine in ten to fifteen minutes.

When ordinary rags or other pulps are used to make absorbent paper, the beating time necessary with them is much longer in order to properly separate the fibers and reduce them to the proper degree of fineness. Therefore, it can be readily seen that this process consumes less power and increases the output per beater engine.

In order to get the most absorbent paper from this modified pulp, it is found desirable not to hard beat the stock; that is, the stock should be circulated with the beater knives well above the bed plate. Since the stock easily and readily disintegrates and individualizes in the water in the beater engine, hard beating is not at all necessary, which is one of the important characteristics of this modified pulp. However, a moderate amount of hard beating refines the pulp and produces a smoother sheet which still retains the absorbent properties, although slightly denser.

Any kind or grade of commercial cellulose pulp now on the market can be modified by this treatment, thereby increasing its absorbent properties three to four times greater than would be obtained by making paper of the same stock without treatment. By the term pulp as used in the specification and claims, we intend to mean cellulose fibers in a slightly coherent mass characterized by being suitable for beating out and forming into paper.

Pulp modified by this method will keep indefinitely, that is, can be kept in storage for use as needed, and can be conveniently shipped to distant points in the same way as in the case of commercial wet pulp.

While the process of the present invention is particularly suitable for the manufacture of absorbent or porous papers, paper makers skilled in the art will appreciate that a pulp of this nature could be used to mix with other paper stocks to change the characteristics of the finished paper. For instance, the modified pulp made by the present invention could be used to render certain paper softer where such properties were desirable. Also this pulp is a freeing agent for slow stocks which has strength of its own to impart to the finished paper as against other freeing agents such as sawdust or celite which do not impart strength.

We claim as our invention:

1. The method of modifying cellulose pulp which comprises soaking said cellulose pulp in a mercerizing solution of caustic soda without disturbing the relation of the fibers during said soaking, and pressing surplus caustic soda solution from said pulp to form a free pulp characterized by being suitable for sheeting into absorbent paper.

2. The method of modifying cellulose pulp which comprises soaking said pulp in a mercerizing solution of caustic soda without disturbing the relation of the fibers during said soaking, pressing surplus caustic soda solution from said pulp, and thereafter washing said pulp to form a free pulp characterized by being suitable for sheeting into absorbent paper.

3. The method of modifying cellulose pulp which comprises soaking sheets of said pulp in a mercerizing solution of caustic soda without disturbing the relation of the fibers in said sheets during said soaking, and pressing surplus caustic soda solution from said sheets of pulp to form a free pulp characterized by being suitable for sheeting into absorbent paper.

4. The method of modifying cellulose pulp which comprises soaking said cellulose pulp in a mercerizing solution of caustic soda without disturbing the relation of said fibers until said pulp is substantially completely saturated and the pulp is puffed to substantially its fullest extent and immediately thereafter pressing a portion of the excess caustic soda solution from said pulp to form a free pulp characterized by being suitable for sheeting into absorbent paper.


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5. A method of manufacturing absorbent paper from cellulose pulp which comprises soaking said pulp in a mercerizing solution of caustic soda without disturbing the relation of said fibers during said soaking until said pulp is substantially completely puffed, pressing surplus caustic acid solution from said pulp to form a free pulp suitable for sheeting into absorbent paper and thereafter beating out and sheeting said pulp to form absorbent paper.

6. As a product of manufacture, a cellulose pulp in which the fibers are crinkled and puffed, made according to the process of claim 1 and characterized by being smaller in area and greater in thickness than the original pulp, that the fibers are in substantially their original relative positions and that the treated pulp has increased absorption or porosity as compared with the original pulp.

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