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## MANUFACTURE OF CELLULOSE PULP

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This invention relates to the manufacture of cellulose pulp; more particularly it concerns, and includes among its chief objects the production of cellulose pulp of improved character, and also, improved arrangements for making such pulp, the resulting product being capable of use in the manufacture of sized paper, cardboard and like articles.

As is commonly recognized, the general procedure of converting raw fibre into finished paper and paper products comprises two successive processes, which in commercial reality are distinct arts. The first of these usually includes breaking up the raw fibrous material, such as wood of various sorts, other vegetable substances, or rags, and producing by grinding or by suitable chemical digestion, a liquid suspension of the fibres and masses of fibre. Concentration of the suspension in many cases involves reducing it to a non-fluid state, i. e., a dried or semi-dried condition; the resulting product, cellulose pulp, may thus be stored, shipped, or otherwise commercially handled without inconvenience. As will be understood, the second general process is that of actual paper manufacture, a distinct art, frequently practised, for important economic reasons, at places distant from the remote localities where pulp is more conveniently produced. Cellulose pulp, in dried or semi-dried condition, is accordingly an important commercial product for the paper manufacturer, who subjects it to the several steps of beating, refining, and other mechanical or chemical treatment, together with ultimate fabrication of a Fourdrinier, vat, or like machine, to produce paper and board of various sorts.

An important requirement of most such paper products is that they are suitably sized and resistant to the spread of ink or the like, so as to be useful for general printing, wrapping and writing purposes. Heretofore it has been the usual practice for paper manufacturers to provide the sizing effect by carrying out certain sizing operations during the course of the paper-making process itself, and these operations have customarily followed one or the other of two general methods. One method, known as surface sizing or tub sizing, comprises carrying the finished sheet of paper, or the web partially completed in the paper machine, through an impregnating bath of suitable sizing material; in general, substances such as gelatin, casein, starch, glue, or the like have been commonly employed for surface impregnation of the sheet or web. For these processes, special apparatus is necessi-

tated, requiring careful attention and regulation, and involving a constant possibility of waste.

The second method, of more general adoption, is aptly characterized as "beater sizing". In general, beater sizing carried out during paper manufacture, comprises the treatment of pulp in the beaters or refiners with one or usually more applied substances. The sizing agent most commonly used is rosin, although beater sizing with emulsified waxes or oils, along with resin and in some cases without the latter, has been proposed. It is usually required, however, that further material be added, in order to effect the desired precipitation of the sizing agent on the fibres; in the case of resin or sizing treatments including resin, for instance, aluminum sulfate or alum is almost universally employed as a precipitating agent. These beater sizing operations are a source of continual difficulty for the paper manufacturer, in many respects; not only must the various added materials be carefully prepared, in fine dispersions or scrupulously regulated solutions, before addition to the pulp in the beaters, chests or refiners, but unceasing care must be observed in maintaining in the pulp those chemical characteristics which are suitable for the delicate precipitating operation. In effecting precipitation with acid substances,—for example, with aluminum sulfate,—the acidity or pH of the stock must be rigidly supervised and continually adjusted, in order on the one hand to produce a strong fixation of the precipitate on the fibres, and on the other hand to avoid injuring the fibres or the machinery employed.

In these and other respects disadvantages have been involved in the sizing methods followed by paper manufacturers. Many sizing agents, such as gelatin and more notably resin, cause the ultimate paper product to turn slightly yellow, instead of preserving a commercially desirable pure white color. Furthermore, the various dispersions and solutions for sizing and fixation must be carefully prepared, and the application of such materials during beating or refining must be accurately timed, in order to obtain satisfactory results. In many cases, the necessary acidity of the stock is particularly inconvenient: it is detrimental to machinery, and often likely to cause actual damage; it seriously interferes with the beating of the pulp, a step more effectively and satisfactorily performed if the suspension is neutral or alkaline. If the acidity is accidentally increased, damage may also be caused to the quality of the finished paper, while on the other hand the presence of alkaline impurities in the pulp, or of

alkalinity or other impurities in the waters used may render fixation of the sizing agent very uncertain and irregular.

Accordingly, a paramount object of the present invention is to minimize one or more of the above-mentioned and other difficulties incidental to sizing operations now used in paper manufacture; and a further important object is to eliminate sizing operations from the general process of actual paper manufacture, while at the same time providing for the production of satisfactory sized paper and like articles. The invention thus seeks to avoid the careful supervision which paper manufacturers must exercise over the usual sizing operations, as well as to avert detrimental effects of the latter on machinery and/or on the quality of the finished and sized paper product. Other objects include the reduction of expense, time and/or labor in the production of sized paper; the provision of sizing operations of a more convenient and fool-proof character than heretofore available; the provision of sizing arrangements whereby sized paper products of improved quality, color, texture, strength and/or durability may result; the provision of arrangements whereby paper-making operations and the characteristics of the resulting sized paper will not be undesirably impaired by acidity of the stock or by the effect of sizing, and/or whereby satisfactorily sized paper of desirable quality may be conveniently made from cellulose pulp, even if the stock used in such paper manufacture be neutral or alkaline.

To these and hereinafter apparent ends, an important feature of the invention resides in the provision of a new article of manufacture, comprising an improved form of unbeaten and unrefined cellulose pulp, which, for example, in non-fluid condition particularly convenient for commercial handling and use according to present practice in the industry, has incorporated with it certain material or materials found to have suitable sizing properties. An essential characteristic of such pulp is that the sizing substance or substances will remain affixed to the fibres during working of the pulp in paper manufacture,—i. e., during the various steps of breaking up, beating, refining, and diluting, as well as fabrication on the Fourdrinier or vat machine,—all without close supervision or attention on the part of the paper manufacturer. As will now be understood, the purposes of the invention are effectively served by providing a new article of manufacture of the sort described, and likewise by providing simple, satisfactory, and economical procedure for introducing compositions of sizing character during pulp-making operations.

It has been found, for example, that pulp of an unbeaten and unrefined character—i. e., pulp which although cooked and digested, and in some instances bleached, has not been subjected to the beating, refining, or other mechanical working incidental to paper manufacture,—may have incorporated into it during its passage through the pulp machine a small quantity of paraffin, in such way as to provide, in effect, a size for the pulp itself, whereby the resulting product is capable of subsequent use in making paper which will thus automatically carry a sizing of extremely desirable nature. It has further been found that this treatment of the pulp is satisfactorily effected by applying melted paraffin to the formed sheet of pulp as the latter passes through the drying cylinders or rolls of the pulp machine. The melted paraffin may conveniently be poured on

the surface of one of the first drying cylinders, so as to dispose it uniformly thereon; the sheet of pulp then receives a layer of paraffin as it passes the cylinder, and the action of subsequent drying cylinders further serves to distribute the paraffin uniformly and to incorporate it into the body of the pulp sheet,—in fact, it is believed, into the individual cellulose fibres. Procedure of this character, as will now be appreciated, obviates the use of carefully regulated dispersions, precipitating solutions, and the like, in paper manufacture; in fact, the paper manufacturer need employ no sizing operation whatever. The resulting new product comprises a body of unbeaten and unrefined cellulose pulp, conveniently in non-fluid sheet form, having paraffin incorporated therein as a sizing composition. This pre-sized pulp can be readily shipped, stored, or otherwise handled, and it may be employed by the paper manufacturer for making sized paper of particularly strong, white and thoroughly satisfactory character. Stock made from the pulp can within reasonable limits be acid, neutral or alkaline, without affecting the quality of the ultimate sizing on the paper, and in fact, mechanical working of the pulp, such as beating and refining as well as subsequent dilution of the stock, serves automatically to improve and enhance not only the distribution of paraffin throughout the material, but also its association in proper sizing relation with the cellulose fibres.

Following the procedure just outlined, pre-sized pulp has satisfactorily been made containing, for example, 5 parts of paraffin with 100 parts of cellulose pulp. If paper is to be made from this pulp, it is generally necessary to employ a quantity of ordinary unsized pulp along with the sized product, so that the resulting paper will contain the proper amount of paraffin for efficient and satisfactory sizing. In this case, the two pulps, when broken up and put in water suspension, will be thoroughly mixed during the processes of beating and/or refining, and also during subsequent dilution of the stock and operation of the paper machine, it having been found that a thorough impregnation of all fibres as needed for sizing is thereby effected. For ordinary strong high grade papers of fine white color, as made from pre-sized pulp, there should be present from 0.5 to 2 parts of paraffin for each 100 parts of paper, depending, as will now be readily understood, on the kind of paper manufactured and the sizing degree required. The ratio of pre-sized material to ordinary unsized pulp may thus be easily adjusted for the result desired; for example, use of 1½ to 9 parts of the ordinary pulp with each part of pre-sized pulp would be proper in the above circumstances.

Although the pre-sized pulp may be usefully made with paraffin in smaller proportions, for instance, as will be directly needed in the paper to be manufactured, it is particularly advantageous to introduce paraffin into the pulp in quantities of the order noted, or in some cases somewhat more; on the one hand, such amounts of paraffin can be effectively incorporated into the fibres, and on the other hand, since unsized pulp may be added as needed, the sizing operations can be restricted, if desired, to certain batches or certain kinds of pulp. Thus, for instance, where paper is to be made from a mixture of long and short fibres, or of mechanical and chemical pulps, or of otherwise differing materials, only one variety of pulp, or part of it, need be of pre-sized character.

Although paraffin has been found peculiarly satisfactory as a pre-sizing material for pulp according to the present invention, by reason, for example, of its durability, whiteness, cheapness, and capacity for remaining affixed to the cellulose fibres, other substances may be used in many cases, either alone or in combination with paraffin. Such other substances are generally waxes, and include the various hydrocarbons, other similar waxes, and in some instances materials such as stearic acid, and the like. For many purposes, good results can be had with waxes and like substances which have the following properties: a good white color or lack of other color, insolubility in water and substantial water-resistance, a melting point below about 100° C., and preferably between 40° and 90° C., and adhesiveness, conveniently affording sufficient adherence to cellulose fibres so that the sizing substance remains affixed thereto if the pulp is thereafter put in suspension in water.

Other procedures for pre-sizing may sometimes be followed, to good advantage. The paraffin or like material can be applied, for example, in the state of an emulsion,—prepared according to any well-known method of producing an aqueous paraffin emulsion,—which may be added to the pulp as it goes through the pulp machine, or conveniently, before it is brought to such machine. In some cases, sizing compositions of the character contemplated by the invention may be pulverized or otherwise comminuted, and thoroughly mixed with the pulp during or prior to its passage through the pulp machine. As will also now be understood, in procedures where no pulp machine or like apparatus is used to reduce the cellulose suspension to a non-fluid form, pre-sizing methods may often be employed to great practical advantage, as by applying the paraffin or like material at a corresponding stage in pulp-manufacturing operations,—conveniently, for instance, by introducing an aqueous emulsion of paraffin into the pulp at or before the time that the latter passes through such concentrators or concentrating devices as are used to receive the cellulose from a chemical or other digesting treatment and reduce it to pulp of suitable consistency for paper-making operation.

It has further been found that the new commercial product of the invention, i. e., pre-sized unbeaten and unrefined pulp of non-fluid nature, is of a particularly superior character when made with cellulose suspensions that have been directly prepared from wood or like vegetable substances, as by one of the chemical processes; and that pre-sizing methods are likewise eminently practical and valuable as performed on such cellulose. Other pulps, however, can be produced in pre-sized form, with highly satisfactory results in a

number of cases, and the procedures described are useful in the manufacture of many kinds of cellulose pulp, to be employed ultimately in making any of a wide variety of sized papers and sized paper products.

It is to be understood that the invention is not limited to the specific embodiments hereinabove set forth but may be carried out in other ways without departure from its spirit as defined by the following claims.

I claim:

1. In a process of manufacturing unbeaten and unrefined cellulose pulp wherein the same is reduced to non-fluid form on a pulp machine, the step of applying a small quantity of melted paraffin to the drying sheet of unbeaten and unrefined fibres as the said sheet passes through the pulp machine.

2. The process of claim 1, in which the melted paraffin is firmly pressed into the mass of pulp fibres, to incorporate the same uniformly therein.

3. In a process of treating cellulose pulp for manufacture of paper and the like, the steps of pre-sizing the mass of unbeaten and unrefined fibres by incorporating into said mass a small quantity of water-resistant wax-like sizing material capable of adhering to said fibres, and of subsequently subjecting the pre-sized pulp to paper-making operation and thereby producing ink-receptive paper containing said fibres and sized with the aforesaid sizing material incorporated in the latter.

4. In a process of treating cellulose pulp for manufacture of paper and the like, effecting pre-sizing of the pulp by introducing into the digested mass of unbeaten and unrefined fibres a small quantity of sizing material consisting of a colorless, water-resistant, adherent wax-like substance, and by distributing the sizing material throughout the mass of such fibres, and subsequently subjecting the pre-sized pulp to paper-making operation and thereby producing ink-receptive paper containing the aforesaid fibres and sized with the aforesaid sizing material incorporated in the latter.

5. In a process of treating cellulose pulp for manufacture of paper and the like, introducing into the digested mass of unbeaten and unrefined fibres a small quantity of sizing material consisting of a colorless, water-resistant, adherent wax-like substance, and distributing the sizing material throughout the mass of such fibres, for converting said mass of fibres into pre-sized pulp which is thereby capable of inclusion in ink-receptive paper manufactured therefrom and sized with the aforesaid sizing material introduced into the said mass of fibres.

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