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COMPOSITION FOR AND METHOD OF PAPERMAKING

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Cellulose fiber as found in nature or as liberated from various raw cellulosic materials, such as wood, is composed of fibers of widely varying lengths, some being above and some below the average fiber length of the fiber as a whole. It has been my observation that the short fiber portion or fraction of a pulp, including the fiber fragments and collodial cellulose, carries most of the impurities present in the pulp. This observation may be readily made under the microscope or when the long fiber portion or fraction is separated from a pulp, for this portion is much freer from specks and is of better color than the original pulp or the short fiber residue. The separated long fiber is accordingly an excellent raw material for the manufacture of high grade papers.

I have found that, while the long fiber portion or fraction of a pulp may have excellent papermaking qualities, nevertheless, it is far more difficult to gelatinize or hydrate it to papermaking slowness than the original pulp from which it has been separated. The characteristic of difficult hydratability associated with the long fiber portion is quite undesirable from the papermaker's standpoint, as it means that much more energy and a much longer beating period is necessary to condition the fiber for papermaking. While this trouble arises in the case of long fibers separated from pulps of various origins, it is especially serious in the case of a wood pulp refined to high alpha cellulose content, such pulp being originally as difficultly hydratable as a high grade new rag stock. In order to gelatinize the long fiber portion of such pulp to papermaking slowness, it is necessary to beat for such a long period that the length of the fibers is greatly reduced and a comparatively large amount of energy expended. Even though the desired gelatinization may be realized after a long-time beating, such excessive beating may result in finished papers which have no better, or even less, strength and tear resistance than when the original pulp is used as a raw material, particularly when good sheet formation is desired. When pulp consisting of selected or separated long fibers is being marketed by a pulp mill as a papermaking raw material, not only are there these serious objections to meet, but also the objection that the beater capacity of the paper mill may be insufficient to handle pulp of this character and yet maintain the desired output of paper.

According to the present invention, the foregoing difficulties may be overcome by mixing or blending with the separated long fiber portion or fraction before marketing it, gelatinized cellulose in sufficient amount to render such fibers easily hydratable to papermaking slowness. This enhances the utility of separating or selecting the long fibers from pulps of various types, including kraft pulp, sulphite pulp, and especially refined wood pulps, and using the separated long fibers in the manufacture of papers. By separating the long fibers from wood pulp refined to high alpha cellulose content, for instance, and then mixing with the separated long fibers sufficient gelatinized cellulose to reduce materially the beating necessary for papermaking, it is possible to preserve the length of the fibers to a large extent and to produce papers having characteristics similar to those of high grade rag papers.

The method of the present invention may be practised either at a pulp mill or at a paper mill. Let us assume, for instance, that a pulpmaker wishes to market the long fiber portion of a refined wood pulp in a condition such that it will respond readily to hydration when used at the paper mill. In such case, the long fiber portion may be separated from the rest of the pulp and then mixed with gelatinized cellulose in sufficient amount so that when the mixture is subsequently put into a beater engine and beaten, it will be found to acquire papermaking slowness quite readily and at the same time result in papers having the characteristics of high grade rag papers. The facility or readiness of hydration of the mixture depends on the amount of gelatinized cellulose mixed with the long fiber portion, and in some cases sufficient gel may be mixed therewith to produce a composition which upon beating acquires papermaking slowness as readily as ordinary sulphite pulp. The mixture of long, refined

wood fiber and gelatinized wood pulp produced at the pulp mill may be shipped in any suitable form, for instance in a wet, pressed condition or as baled drier sheets. If the mixture is being used for paper manufacture at the pulp mill, gelatinized cellulose may be added in sufficient amount to the long fiber portion to slow it down sufficiently so that little beating of the mixture will be required.

One of the advantages of the method of the present invention is that the short fiber portion remaining after the long fibers have been separated therefrom may be used as the raw material for furnishing the gelatinized cellulose for mixing with the long fiber portion. The short fiber portion gelatinizes very readily, being initially quite slow, as it contains most of the fiber fragments and colloidal cellulose associated with the original pulp. By first separating the long fiber portion from a pulp, gelatinizing the remaining pulp, and mixing the gelatinized cellulose with the long fiber portion, it is possible to produce paper having much better characteristics than would result if the pulp as a whole were beaten to the same slowness and made into paper. In other words, the present invention makes possible the preservation to a large degree of the length of the long fibers of a pulp when making paper, the short fibers being used to furnish most or all the gel necessary for bonding the fibers of the paper together. When papers of very high whiteness and permanence are desired it is preferable to use long refined fibers as the source of the gelatinized cellulose, the long fibers being relatively free from resins, specks, and other impurities which impart color to the fiber and cause yellowing under the action of heat, air and light.

An example of procedure which may be followed at a pulp mill in producing a high grade papermaking composition suitable for marketing and which will hydrate to papermaking slowness quite readily, may be substantially as follows. The pulp produced as a raw material at the pulp mill may be a wood fiber refined to high alpha cellulose content and to the whiteness of new cotton fiber. This pulp may be passed through apparatus such as described in patent application Serial No. 206,477, filed July 18, 1927, by Robert A. Webber, (now Patent No. 1,786,973, issued December 30, 1930). An apparatus of this type serves to separate or divide the pulp into a long fiber portion and a short fiber portion. The long fiber portion may then be mixed with a relatively small amount of gelatinized cellulose, say about 6%, which may be prepared from either the short fibered portion or from long fibers. The gelatinized pulp is preferably prepared in beaters of the stone-roll type, such as employed in the glassine paper industry, as beaters of this general type yield better gels and may be operated more economically for this kind of work than the usual paper mill beaters. Preferably, the stock is cooled while being gelatinized, as described and claimed in patent application, Serial No. 224,427, filed October 6, 1927, as this makes possible more economical operation and the production of high grade gels. The mixing or blending of the gel and the long fibers may be conveniently carried out in the usual beater engines, the gel and unbeaten fiber preferably being mixed at a consistency of about 3% to 3½%, as under these conditions homogeneous mixing may be readily effected.

The following table gives the characteristics of the original pulp, the separated long fiber, and the mix or blend of the separated fiber and gel, after each had been beaten for a definite period of time.

	Original pulp	Separated long fiber	6% gel and 94% separated long fiber (gel prepared from long fiber)
Slowness	10–14	7–9	20–40
Strength	100–105	100–105	105–110
Tear	280–290	300–330	390–330
Breaking length*	6,000–8,000	7,000–9,000	7,000–9,000
Fiber length (mm)	.6–.8 mm.	1.3–1.8	1.5±**
Color	105–107	107–109	107–109
Specks (in given weight of pulp)	30	20	20

*Breaking length is the length of paper which if freely suspended would break as result of its own weight.

** It is impossible to ascertain accurately the average fiber length of the mixture owing to the fact that a portion of the fiber exists in the form of gel and fiber fragments.

The foregoing is representative of cases involving the use of a wood pulp refined to high alpha cellulose content as the raw material but this is illustrative of what happens to a greater or less degree with fibers of other origins. It is to be noted that by adding only about 6% gel to the separated long fiber, the mixture acquired a much greater slowness after a given period of beating than the original pulp or the separated long fiber and resulted in papers having greated strength, tear resistance, and breaking length than the original pulp, even equalling the separated long fiber in these characteristics. The mixture also had a better color and a lower speck content than the original pulp, but were the gel prepared from the short fiber portion, the color and speck content would of course be higher but the other characteristics would be similar to those given.

It should be understood that the method of the present invention may also apply directly to papermaking operation. That is, assuming a papermaker is supplied with unbeaten separated long fiber such as described, and raw material suitable for making the gel, as for example short fiber, the procedure to be followed at the paper mill according to the present invention, would be to gelatinize

the short fiber or other suitable raw material to a slimy consistency, then to mix a relatively small proportion, say 5% to 15% of the gelatinized cellulose with the unbeaten long fiber, and then to beat the mixture to papermaking slowness. The beaten mixture yields papers having high strength and tear resistance, the length of the long fibers having been preserved to a large degree. One could not produce papers having such high tear resistance by beating the original pulp to the same degree of slowness, for by so doing the length of fiber of the pulp as a whole would be reduced to a greater degree, owing to the much longer time of beating necessary. By beating a pulp mixture wherein the major portion exists as long unbeaten fiber, and a relatively small portion of which exists in highly gelatinized condition, the mixture as a whole need be beaten for a much shorter period to reach the desired papermaking slowness. In certain cases, sufficient gelatinized cellulose may be added to the unbeaten long fiber to eliminate the necessity of substantial beating of the mixture. That is to say, one may add sufficient gelatinized cellulose to the unbeaten long fiber to attain papermaking slowness without further beating except that necessary to effect a homogeneous dissemination of the gelatinized cellulose throughout the long fiber. This results in papers in which a very high proportion of the long fibers exist in their original length, such papers having exceptionally high tear resistance.

Having thus described certain embodiments of this invention, it will be evident to those skilled in the art that various changes and modifications might be made therein without departing from the spirit or scope of invention as defined by the appended claims.

What I claim is:—

1. A papermaking composition comprising only the separated and cleaner long fiber fraction of a cellulose pulp of the character of pre-liberated wood pulp mixed with gelatinized cellulose.

2. A papermaking composition comprising only the unbeaten separated and cleaner long fiber fraction of cellulose pulp of the character of pre-liberated wood pulp mixed with gelatinized cellulose.

3. A papermaking composition comprising only the unbeaten long fiber fraction of cellulose pulp of the character of pre-liberated wood pulp mixed with the gelatinized short fiber portion of the pulp.

4. A papermaking composition comprising unbeaten cellulose pulp of the character of pre-liberated wood pulp freed from its short fiber portion including fiber fragments and colloidal cellulose, and gelatinized similar pulp.

5. A papermaking composition comprising unbeaten wood pulp refined to high alpha cellulose content and freed from its short fiber portion including fiber fragments and colloidal cellulose, and gelatinized cellulose.

6. A papermaking composition comprising unbeaten wood fiber refined to high alpha cellulose content and freed from its short fiber portion including fiber fragments and colloidal cellulose, and gelatinized pulp refined to high alpha cellulose content.

7. A papermaking composition comprising unbeaten wood fiber refined to high alpha cellulose content and freed from its short fiber portion including fiber fragments and colloidal cellulose, and gelatinized similar pulp.

8. A method which comprises removing the long fiber portion of cellulose pulp like pre-liberated wood pulp from the rest of the pulp, and mixing gelatinized cellulose with said removed portion.

9. A method which comprises removing the long fiber portion of cellulose pulp like pre-liberated wood pulp from the rest of the pulp, mixing gelatinized cellulose with said removed portion, and forming into paper.

10. A method which comprises removing the long fiber portion of cellulose pulp like pre-liberated wood pulp from the rest of the pulp, gelatinizing the rest of the pulp, and mixing the gelatinized pulp with the removed long fiber portion.

11. A method which comprises removing the long fiber portion of cellulose pulp like pre-liberated wood pulp from the rest of the pulp, mixing gelatinized cellulose with said removed portion, beating the mixture, and forming into paper.

12. A method which comprises removing the long fiber portion of cellulose pulp like pre-liberated wood pulp from the rest of the pulp, and mixing gelatinized long fibers with the removed long fiber portion.

13. A papermaking composition comprising only the separated long fiber portion of a cellulose pulp mixed with mechanically gelatinized cellulose.

14. A method which comprises removing the long fiber portion of cellulose pulp from the rest of the pulp and mixing mechanically gelatinized cellulose with said removed portion.

In testimony whereof I have affixed my signature.

GEORGE A. RICHTER.