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PAPERMAKING COMPOSITION

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In the papermaking industry, a large number of the manufacturers depend upon pulp mills for all or part of their supply of raw material. This is particularly true in the branch of the industry handling the manufacture of high grade bond, ledger and writing papers. The pulp mills sometimes supply these paper manufacturers with pulp in bulk form, e. g., in a wet, pressed condition, or in the form of bales of comparatively thick sheets or laps of relatively dry pulp known in the trade as "drier sheet". Shipment of pulp in this latter form is sometimes considered preferable, for not only does it reduce freight charges, but the pulp is better preserved during shipment and storage.

At the paper mill, the pulp is partially hydrated or gelatinized before it is run off on the papermaking machines. Thus, the pulp is charged into beater engines along with sufficient water to ensure its circulation, and is broken up or disintegrated whereupon it is hydrated or gelatinized by the operation of the engines prior to formation into paper. To produce paper of the desired characteristics, beating must be carried on until the pulp has been gelatinized to a certain slowness value which has been found to result in paper having such characteristics.

It is quite evident that papermakers prefer as raw materials pulps which acquire a certain slowness value in a comparatively short time of beating, for if the pulp employed is difficultly hydratable, the papermaker must expend more energy and time in beating to reach this slowness value, thus increasing beating costs and reducing the beater output of the mill. On the other hand, pulps of an easily hydratable character are usually inferior in certain other papermaking characteristics to pulps of a more difficultly hydratable character. When pulp is difficulty hydratable, the fibers of such pulp are reduced in length by the longer beating treatment necessary in arriving at the slowness value desired, to a much greater extent than more easily hydratable pulp, so that it is an inevitable result that using satisfactory pulps having different hydratabilities but having the same fiber length and beating to the same slowness value, the tear resistance of paper made from the more difficulty hydratable pulp will be less than that of the more easily hydratable pulp.

There are some pulping or pulp-treating processes which yield pulps having certain highly desirable characteristics, but which at the same time are difficultly hydratable. For instance, when wood pulp is refined to high alpha cellulose content and then bleached, it acquires certain very desirable characteristics, such as high whiteness, softness and absorbency, high fiber length, and excellent ageing qualities, in these and other respects being comparable to high grade rag fiber. Such refined pulp is, however, much more difficult to hydrate to a given slowness value than the original pulp, for instance sulphite pulp, in this respect also being comparable to high grade new rags. This disadvantage of difficult hydratability inherent in many refined wood pulps, is accentuated when such pulp is marketed in the form of drier sheets, as pulp shipped in a dry condition hydrates less readily than when shipped in a wet condition.

In my application Serial No. 144,180, filed October 25, 1926, I have described a method of treating a difficultly hydratable pulp, such as refined wood pulp, to produce a product which may be hydrated or gelatinized to a given slowness value as readily as pulps of the character of sulphite. As described in that application, this is accomplished by preparing a product, such as a drier sheet, consisting of a homogeneous blend of an unbeaten pulp of a difficultly hydratable character, with pulp which has been hydrated or gelatinized, the gelatinized pulp preferably being present in subordinate proportion, so that when the blended product is beaten to papermaking slowness and formed into paper, the paper will possess maximum tear resistance, most of the fiber being beaten for a comparatively short period and thus preserved in length. The optimum procedure is to mix or blend about 5% to 10% of highly gelatinized pulp with about 90% to 95% of the unbeaten fiber, as this mixture or blend may be formed into drier sheets which, when

subjected to beater action, hydrate to papermaking slowness quite readily, the hydrated or beaten stock being composed of fibers of high average length, so that paper made therefrom is of high tear resistance. More specifically, the gelatinized pulp is prepared from unbeaten pulp similar to the unbeaten pulp with which the gelatinized pulp is thereafter blended.

According to the present invention, the pulp employed as the source of the gelatinized cellulose used in the blended pulp is an easily hydratable pulp of high potential Mullen strength, short fibered pulps such as those obtained from birch, for instance, being highly suitable for this purpose. Preferably also, such easily hydratable pulp is one containing a relatively high percentage of pentosans, especially when rattly, hard papers of optimum Mullen strength, maximum tear resistance and fold endurance are desired. The present invention thus makes possible the conditioning of a difficultly hydratable pulp with a minimum expenditure of energy and using short-fibered pulps which are relatively inexpensive. Apparently the pentosans in the hydrated or gelatinized pulp serve to bond together the fibers of the paper, augmenting the bonding effected by the gelatinized cellulose, and so increasing Mullen strength. Inasmuch as the characteristic of folding endurance is associated with the bonding together of the fibers or Mullen strength, an increase in Mullen strength is accompanied by an increase in folding endurance, so that paper made from the pulp blend of the present invention has very high Mullen strength, folding endurance and tear resistance.

The present invention may be applied in the production of papers having various characteristics. For example, if a hard, rattly, high grade paper is desired, the pulp blend may consist of a preponderant proportion of a high alpha cellulose wood fiber of comparatively poor hydratability and a subordinate proportion of a gelatinized, easily hydratable pulp of relatively high pentosan content. In certain types of pulp, the characteristics of high pentosan content and easy hydratability usually go hand in hand, so that various pulps are available for the desired purpose. Thus, one may employ as the easily hydratable pulp the short fibered pulp produced from wood of the character of birch, as such pulp, even when liberated by chemical processes of digestion, e. g., the sulphite process, has a relatively high pentosan content, usually being above 6%. One may also employ other pulps, such as spruce sulphite pulp, which usually has a pentosan content of about 3.5% to 4.5%. If, on the other hand, paper having high softness and flexibility is desired, the pulp employed as the source of the gelatinized cellulose is preferably a refined wood pulp which hydrates quite readily. Usually, pulps of the latter character have a comparatively high pentosan content, but even when quite high in pentosans, if they are blended with refined wood fiber which is low in pentosans, the blend results in papers of comparatively high softness and flexibility.

An example of procedure which may be followed in producing a blended product having the characteristics desired for the manufacture of high grade papers may be substantially as follows. A refined, unbeaten wood pulp of high average fiber length and low pentosan content, which hydrates with difficulty, is selected as the major portion of the raw material, because of its rag-like qualities and the excellent characteristics of papers made therefrom. With the refined, unbeaten pulp is mixed or blended a subordinate proportion of gelatinized pulp which hydrates readily. 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 with the unbeaten pulp may be conveniently carried out in the usual beater engines, the gel and unbeaten pulp preferably being mixed at a consistency of about 3% to 3½%, as under these conditions a homogeneous blending or mixing may be readily effected. Preferably, the gelatinized portion is exceedingly slow or well hydrated, as this permits the use of a larger relative proportion of unbeaten fiber of original length, and at the same time yields a pulp blend having good hydrating quilities. Thus, the addition to and blending with the unbeaten, refined wood pulp of a highly beaten birch sulphite pulp which has been gelatinized to a slimy consistency, yields a pulp blend which may be formed into thick, dry sheets or laps of pulp, which respond quite readily to hydration. When a pulp blend of this character, containing, say, 5% to 15% birch pulp gel, is hydrated or beaten to papermaking slowness, it yields hard, rattly papers of high Mullen strength, folding endurance and tear resistance, these characteristics being desirable in certain bond papers. The high Mullen strength and folding endurance of the resulting paper is attributable to the cementing together of the fibers, not only by the gelatinized cellulose but also by the pentosans furnished by the sulphite pulp.

If, in any case, it is undersirable to blend

pulps such as birch or spruce sulphite pulp with a high alpha cellulose wood pulp, the pulp used as the source of the gelatinized cellulose may also be one of high alpha cellulose content, but produced under conditions rendering it easily hydratable. Using a pulp blend consisting of only refined wood pulp, papers of high softness, flexibility, and having maximum strength, tear resistance and folding endurance may be produced, these characteristics being desirable in ledger, cover and coating papers. For instance, a refined wood pulp of relatively low pentosan content, say, 1% to 2.5%, which is difficultly hydratable and which by itself yields papers of high tear resistance but not very high Mullen strength, may be blended with a gelatinized refined wood pulp which is of higher pentosan content, say, 2.5% to 6%, and which by itself would yield harder, rattlier papers of much higher Mullen strength. Such higher pentosan-containing refined wood pulps may be of somewhat lower alpha cellulose content than refined wood pulps of lower pentosan content and at the same time have highly desirable papermaking characteristics. For example, such higher pentosan-containing refined pulp may be produced as described in my U. S. Patent No. 1,635,637, issued July 12, 1927, which describes the pulping of wood such as spruce in an acid sulphite liquor having combined and free SO_2 contents of approximately equal proportions of 3% to 4% each to produce a pulp especially high in pentosans, and the refining of such pulp by oxidative treatment, alkaline-digestion, and bleaching, to produce a refined product of comparatively high pentosan content. Preferably, the refined wood fiber of higher pentosan content is beaten or hydrated to a markedly gelatinous or slimy condition, so that when, say about from 5% to 15% by weight of such gelatinized pulp is blended with the unbeaten, refined pulp of lower pentosan content, a pulp blend results which upon beating hydrates readily to papermaking slowness. Such a blended product may be formed into drier sheets and marketed in this desirable condtion. When such sheets are beaten at the paper mill to papermaking slowness and the beaten pulp run off into paper, the resulting paper has practically the same softness and flexibility as the paper producible from a refined wood pulp of difficult hydratability and of low pentosan content, and possesses the advantage of higher Mullen strength.

While the present invention has been described as having particular utility in producing a pulp blend at the pulp mill and then marketing such a blend as in the form of drier sheet to be used as a raw material for papermaking, it should be understood that the present invention may also be applied in papermaking where it is desired to produce high grade papers using different types of pulps such as hereinbefore described as raw materials. In other words, assuming that a papermaker is supplied with unbeaten pulp such as refined wood pulp of a difficultly hydratable character, and birch or spruce sulphite pulp or a refined wood pulp of a more readily hydratable character, the procedure to be followed at the paper mill in accordance with the present invention is to hydrate or gelatinize the more readily hydratable pulp, say, to a slimy consistency, then to blend a relatively small proportion, say, 5% to 15% of the gelatinized pulp with the unbeaten, more difficultly hydratable pulp, and to beat the pulp blend to papermaking slowness. The beaten blend yields papers having high Mullen strength and tear resistance, the length of fiber having been preserved to a large degree. One could not produce papers having such high tear resistance by beating a blend of the unbeaten pulps to the same degree of slowness, for by so doing the length of fiber of the blend as a whole would be reduced to a greater degree, owing to the much longer time of beating necessary. By beating a pulp blend wherein the major portion of fiber exists in unbeaten condition and a relatively small portion of which exists in a highly gelatinized condition, the blend 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 portion to eliminate a substantial beating of the blend. That is to say, one may blend sufficient gelatinized cellulose into the unbeaten fiber to attain papermaking slowness without further beating except that necessary to effect a homogeneous dissemination of the gelatinized cellulose throughout the unbeaten fiber. This results in papers in which most of the fibers exist in original length, such papers having exceptionally high tear resistance, particularly when the unbeaten portion is composed of fibers of high fiber length such as a refined wood fiber.

While I have dealt with certain specific instances in which my invention may be applied to produce products having certain characteristics, other applications of my invention will be evident to those skilled in the art without departing from the spirit or scope of invention as set forth in the appended claims.

What I claim is:

1. A papermaking composition containing at least two different kinds of pre-liberated, chemical pulps, one of said pulps being substantially unbeaten and of a difficultly hydratable character and the other being highly beaten and of an easily hydratable character.

2. A papermaking composition containing at least two different kinds of pre-liberated chemical wood pulps, one of said pulps being

substantially unbeaten and of a difficultly hydratable character and the other being beater-gelatinized and of an easily hydratable character, said unbeaten pulp preponderating in amount.

3. A papermaking composition containing at least two different kinds of pre-liberated chemical wood pulps, one of said pulps being a substantially unbeaten pulp having a pentosan content of less than 2.5% and the other being a beater-gelatinized pulp having a pentosan content greater than 2.5%.

4. A papermaking composition in the form of a "drier sheet" containing at least two different kinds of pre-liberated chemical wood pulps, one of said pulps being a substantially unbeaten refined pulp having a pentosan content of less than 2.5% and the other being a beater-gelatinized pulp having a pentosan content greater than 2.5%.

5. A papermaking composition in the form of a "drier sheet" containing at least two different kinds of pre-liberated chemical wood pulps, one of said pulps being a substantially unbeaten refined pulp having a pentosan content less than 2.5% and the other being a beater-gelatinized pulp having a pentosan content greater than 2.5%, said gelatinized pulp amounting to about 5% to 15% by weight of the composition.

In testimony whereof I have affixed my signature.

GEORGE A. RICHTER.