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PAPER AND PROCESS FOR THE MANUFACTURE OF PAPER

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3 Claims. (Cl. 91—68)

The invention herein described and claimed is especially useful for the preparation of relatively thin light weight papers, such as used in encyclopedic publications, magazines of wide circulations and publications, in which the reduction of bulk is obtained by the use of relatively thin book paper.

Such papers ordinarily contain a substantial proportion, say from 10% to 30%, of finely divided inorganic fillers. The fibrous furnish may consist of a mixture of sulphite and soda pulps and may also contain deinked paper. The following are specific examples illustrative of furnishes which may be employed, although, within the broad purview of my invention, any pulp suited to the manufacture of paper may be utilized:

Sulphite pulp..... 25%	Sulphite pulp..... 50%	Sulphite pulp..... 20%
Soda pulp..... 45%	Soda pulp..... 20%	Soda pulp..... 20%
Deinked paper..... 30%	Deinked paper..... 30%	Deinked paper..... 60%

In the practice of my invention, therefore, a paper stock is prepared by dispersing paper fibers, for example of the type described, in water in a beater or Hollander. Fillers of neutral mildly acidic or mildly basic character may also be introduced at this point. Such fillers include clay, agalite, asbestin and the alkaline earth metal sulphates. In the preferred practice, such fillers are introduced dispersed in a viscous starch suspension, as more fully described in my prior application Serial 622,318, filed July 13, 1932. Where clay, for example, is introduced, it may be added, for example, to the extent of from 5% to 20% by weight of the paper fibers, and preferably to the extent of about 15%. Where a size is added, it may also be introduced at this point, and the size is preferably precipitated on the paper fibers before the filler is added. Such sizes may contain emulsified wax and/or emulsified normally fluid hydrocarbon oil. In general, any suitable size may be employed, as for example, the alkali salt of a normally solid and water insoluble organic acid. I may, if desired, employ as size the alkali metal salt of a fatty acid, although, for reasons of cheapness, rosin size is ordinarily employed.

In the preferred practice, as stated, the wax or oil is emulsified in the size, but may be separately emulsified by the use of any suitable emulsifying agent.

The amount of wax or oil may, for example, range from 0.2% to 3% by weight of the fibers present, and the amount of size may, for example, range from 1% to 6% by weight of the fibers present.

In addition to the filler of neutral to mildly acidic character, I preferably incorporate an alkaline earth metal carbonate which may, for example, be added to the extent of from 10% to 20% by weight of the paper fibers. The inorganic filler content of the finished sheet will, generally speaking, range from 10% to 30%. Where no size is employed, or where the size is of a neutral to basic character, the carbonate filler may be introduced to the paper stock in the beater. Where rosin size precipitated by alum is employed, the filler may likewise be introduced in the beater in accordance with the method more specifically disclosed in my copending application of even filing date, Serial No. 664,346.

In the preferred practice, the carbonate filler is introduced as a continuous stream to the continuously flowing paper stock subsequent to the beater chest and prior to dilution. After leaving the Jordan engine, the stock passes through the machine chest, mixing box, and thence through the screening equipment in the usual manner to the paper machine, which may, for example, be of the Fourdrinier type. The separated water from the paper machine is recirculated in conformity with the demands of the type of machine, and may, for example, be returned to the paper stock at the mixing box or subsequent thereto.

From the paper machine, the web formed on the wire passes through the driers in the usual way. It should be dried to a moisture content preferably of not exceeding about 6% and is then ready for the succeeding step of the process. At this stage there is applied to the sheet an aqueous suspension containing starch. The starch may be present, for example, to the extent of from 0.2% to 10%, and is preferably present to the extent of about 5%. I preferably employ a starch which has been subjected to a mild oxidation action obtained, for example, by the application of sodium peroxide, chlorine, etc. In one specific example, the starch in suspension in about five parts of water, was heated to 115° F. before use, while in contact with 0.375% of sodium peroxide. Best results are obtained by the use of an elastic starch, such as a root or tuber starch. Such starches include cassava, arrowroot, tapioca flour and starch made from potatoes. The starch suspension may be applied to one or both sides of the sheet in any suitable manner, as for example, by passing the paper through the vat containing the same, and the excess is thereafter preferably removed by the operation of squeeze rollers. After leaving the squeeze rollers, the paper is pref-

erably passed directly to the driers and therefrom to the calenders. The driers may be of the usual cylinder type or a specially constructed air drier or a combination of both. The starch suspension appears to provide a plasticity not otherwise present in papers of this character, and to permit calendering to a very high gloss finish, with relatively few passes through calender rolls, and with relatively little pressure applied to the calender rolls. In this way, a relatively high gloss finish, say in excess of 75%, may be obtained with relatively little calendering, while retaining to the maximum possible extent the cushioning effect of the sheet which is considered highly desirable for good printability. This procedure also reduces the amount of power otherwise consumed in calendering.

Size such as rosin size or its equivalent may, if desired, be omitted or reduced prior to the formation of the sheet, and similarly incorporated in whole or in part at this point. In this case rosin size, for example, and aluminum sulphate may be added to the starch suspension. After precipitation of the size, the suspension is preferably passed through a homogenizer or colloid mill for the purpose of thoroughly disseminating the precipitated size throughout the starch suspension. Emulsions of wax and/or hydrocarbon oil may also be incorporated in the starch suspension.

In lieu of starch, I may, generally speaking, employ substantially neutral organic colloidal substances such as glue carbohydrates such as gums, including gum arabic, dextrin, British gum and gum tragacanth.

In the preferred practice, there is added to the starch suspension a filler of high refractive index. The following are enumerated as examples of such fillers, but without limitation as to other fillers which may fall within the class comprehended herein:

Titanium dioxide
Titanium dioxide precipitated on barium sulphate
Titanium dioxide precipitated on calcium sulphate
Titanium dioxide compounds associated with phosphates of the alkaline earth metals
Zinc carbonate
Lithopone
Zinc oxide
Zinc sulphide
So-called high strength lithopone which contains 50% or more of zinc sulphide
Zirconium dioxide

The fillers enumerated are characterized by the fact that the mean refractive index of the same is not less than approximately 1.9. With some of the fillers enumerated, as for example, titanium dioxide, this refractive index may be in excess of 2.50. This may be contrasted with the materials normally employed in paper,—the paper fibers for example, have a refractive index of about 1.53; starch has a refractive index of about 1.53 and of the fillers generally employed, clay for example has a refractive index of about 1.55, and calcium carbonate a refractive index of about 1.56. The amount of such fillers may, for example, range from a few percent up to one hundred percent of the amount of starch in the suspension. Where the filler of high refractive index is omitted, the plasticity of the sheet up to this point may be so great that the decrease in opacity results on calendering. This may be explained by the assumption that the starch suspension fills much of the air space in the sheet with a material of the same refractive index as the paper fibers. The presence of the high refractive index filler, however, more than offsets any such effect and results in the preparation of a paper of superior whiteness and opacity.

Within the broader aspects of the invention, such starch suspension containing high refractive index filler may be applied to any type of paper filled or unfilled.

The foregoing description is for purposes of illustration and not of limitation, and it is therefore my intention that the invention be limited only by the appended claims or their equivalents, in which I have endeavored to claim broadly all inherent novelty.

I claim:

1. The improvement in the art of paper manufacture which comprises applying to the surface of paper an aqueous suspension of starch and finely divided water-insoluble, inorganic material, said suspension containing starch to the extent of not exceeding 5% of the starch and water present, said water-insoluble, inorganic material being present in amount not exceeding the amount of starch present, thereafter drying and thereafter calendering the said sheet.

2. Process according to claim 1 in which the starch is an oxidized starch.

3. Process according to claim 1 in which the water-insoluble, inorganic material has a refractive index of not less than 1.9.

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