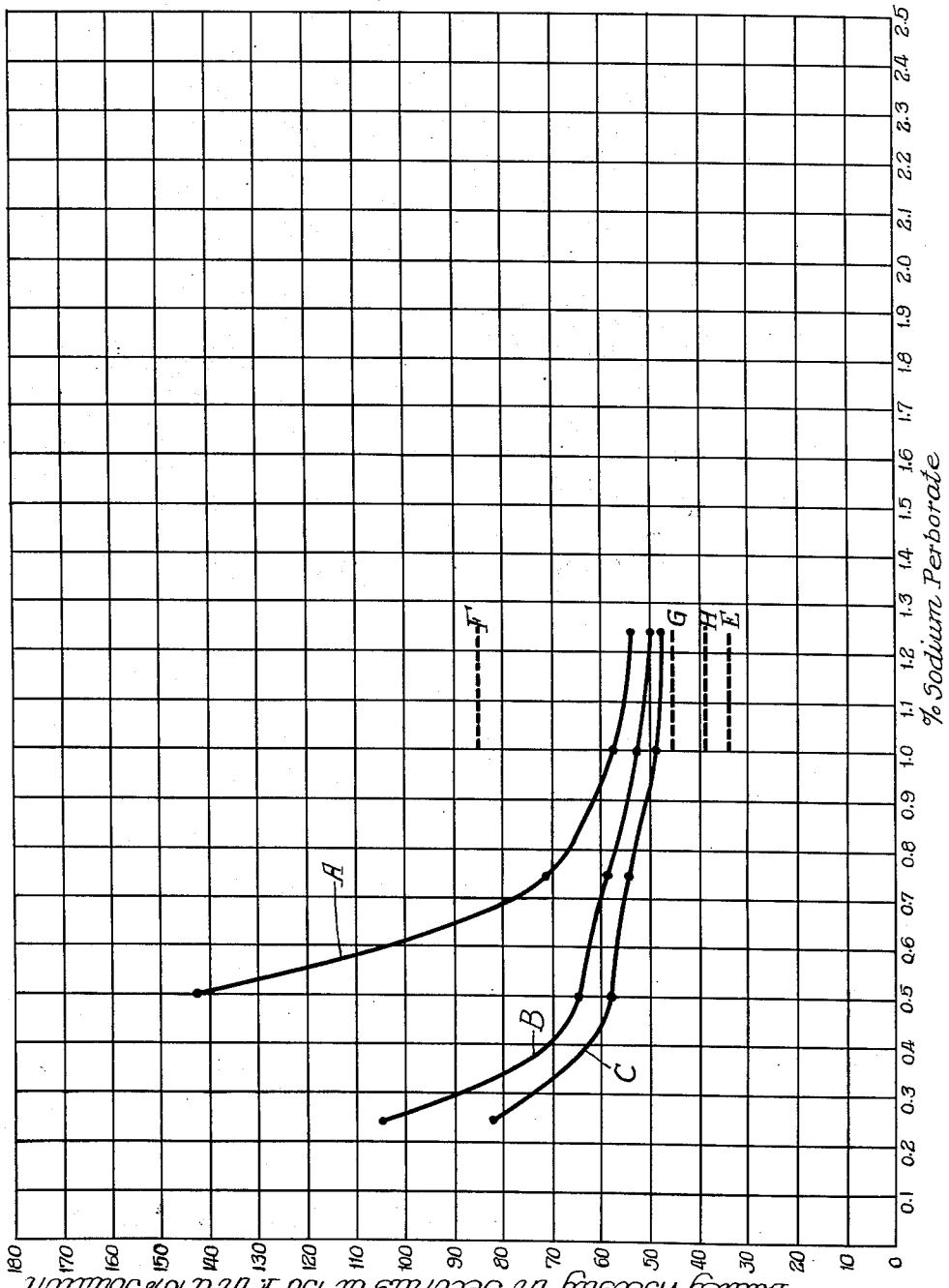
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TUB SIZE FOR PAPER

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TUB SIZE FOR PAPER

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This invention relates to a tub size for paper, more particularly a grain starch tub size and to a new and improved method for the production thereof.

The problem of sizing paper with tub size made from grain starches, as, for example, corn starch, presents some difficulties which have never been satisfactorily overcome. Tub sizes for paper are normally relatively dilute and if a grain starch is used, this dilute condition causes alpha amylose to settle out and collect in the sizing box until it becomes heavy enough to interfere with the sizing operation. It therefore becomes necessary at intervals to clean the box or other means by which the size is applied. Otherwise, the paper may be blotched or non-uniform due to the deposit of sediment. It will be appreciated that in a continuous process such as paper making this is very undesirable.

Certain starches such as the root starches, particularly tapioca, do not suffer from this disadvantage since these starches do not contain as large a proportion of alpha amylose and the sediment does not form in troublesome amounts, nor does the formation of sediment occur with certain types of starches such as chlorinated grain starches. The starches which are satisfactory from the standpoint of sediment, however, are relatively more expensive.

One of the objects of the present invention is to provide a new and improved method of treating the less expensive and more readily available grades of grain starches to make them suitable for use as a tub size.

Another object of the invention is to provide a new and improved method of treatment for starches of the character described which reduces the amount of sediment.

Still another object of the invention is to provide a new and improved type of tub size made from readily available and inexpensive raw materials which have not heretofore been satisfactory for this purpose. Other objects will appear hereinafter.

In accordance with this invention it has been found that grain starches which have heretofore not been suitable for use as a tub size in paper making may be treated to make them suitable for this purpose by reacting them with an oxidizing agent under alkaline conditions and more particularly by reacting them with an alkali metal perborate in the presence of borax. In carrying out this reaction it has been found that improved results are obtained by using substantially higher temperatures than are normally necessary to gelatinize the starch and by holding the reaction mixture at said higher temperatures, preferably around 200° F., for a substantial period of time, say, for example, 10 to 20 minutes, or until there appears to be no further change in the viscosity of the reaction mixture.

A tub size produced in the manner described preferably contains about 1% to about 10% starch dispersed in an aqueous medium. The amounts of oxidizing agent and alkaline substance employed in producing the tub size may vary, but the preferred type of tub size prepared by treatment of the starchy substance with sodium perborate and borax (sodium tetraborate) preferably is made from about 1% to 3% borax and from about 0.25% to about 2% sodium perborate. If desired, somewhat larger proportions of the borax and sodium perborate may be used, as, for example, from about 0.5% to about 10% borax and from about 0.1% to about 5% sodium perborate. The preferred type of tub size produced in accordance with the invention has a tolerable sediment less than about 1% and a viscosity as determined on a Dudley viscosimeter within the range from about 40 to about 60 at 130° F. when the proportion of starch to water is at 1:9.

The tub sizes prepared in accordance with the present invention also have good film forming properties. It will be appreciated that such properties are very desirable because if the film tends to crack or break the ink will strike through the cracks and feather out into the paper. Film forming properties are usually tested more or less empirically by spreading the size on a synthetic resin plate and then drying. If the film peels off it is satisfactory. If it breaks up it is not satisfactory. Ordinary cooked corn starch has good film forming properties but it is too heavy to be used as a tub size. Many chemical treatments tend to destroy film forming properties, and hence, it is one of the advantages of the present invention that a sufficient amount of the film forming properties is retained while imparting to the starch being treated other properties that make the resultant product useful as a tub size.

It may be mentioned that certain starch conversion products such as dextrines, for example, white corn dextrine or yellow corn dextrine, are unsuitable for the purpose of the present invention. These products do not have the desired film forming properties when treated in accordance with the present process.

In carrying out this process it may also be mentioned that the combined use of borax and sodium perborate gives results that in general are

more desirable than the results obtained by the use of other substances. For instance, when sodium persulphate is substituted for sodium perborate it tends to give the product a yellow color. Sodium perpyrophosphate when substituted for sodium perborate likewise imparts a light yellow color to the product. Barium peroxide can be used but is more difficult to distribute throughout the product. In some cases of course color will not be a factor.

Other features and advantages of the invention will be apparent by reference to the following description and examples in conjunction with the accompanying drawing, in which the single figure represents graphically viscosity characteristics of various products obtained in accordance with this invention with varying amounts of sodium perborate and a constant amount of borax.

The graph shown in the drawing will be better understood by reference to the following example:

Example I

In order to evaluate, illustrate and compare the properties of various products made in accordance with the present invention, a series of such products was prepared as follows:

A. Raw or undegenerated corn starch was mixed with water in proportions of 1 part of corn starch to 7½ parts of water, this amount of starch corresponding to about 11.8% of the mixture. To this mixture was added 1% of borax based upon the weight of the starch. The mixture was then divided into aliquot portions and to each portion was added a different percentage of sodium perborate, four different mixtures being made in this manner containing 0.5%, 0.75%, 1.0% and 1.25% sodium perborate, respectively, said percentages each being based on the weight of the starch.

Each mixture was then heated to a temperature of 200° F. and held at said temperature for 15 minutes. Thereafter the resultant gelatinous product was diluted to a 10% solution (or 1 part of starch to 9 parts of water). The viscosity characteristic of each product is shown by the graph A in the drawing.

B. A No. 40 thin boiling starch was mixed with water in the proportion of 1 part of starch to 6 parts of water (14.5%) and 1% of borax based upon the weight of the starch was added to the mixture. This mixture was then divided into a number of aliquot portions and different percentages of sodium perborate were added to each portion, the percentages being 0.25%, 0.5%, 0.75%, 1.0% and 1.25%, respectively. Each portion was heated slowly to a temperature of 200° F. and then maintained at this temperature for 15 minutes. Thereafter each of the resultant products was diluted to a 10% dispersion (1 part of starch to 9 parts of water). The viscosity characteristic of each product was determined and is shown by the graph B of the drawing.

C. A series of products similar to the series of products described under B was prepared using a No. 60 thin boiling corn starch instead of a No. 40 thin boiling corn starch, the viscosity characteristic being shown in the drawing by graph C.

The viscosity of water in seconds as determined in a Dudley viscosimeter is shown by the dotted line E in the drawing. For comparison the viscosity characteristics of several standard products are shown by the dotted lines F, G and H, these products being standard chlorinated starches sold to the trade under the trade names of Superfilm No. 5(F), Superfilm No. 4(G) and Superfilm No. 6(H). It will be observed that the viscosity characteristic of products prepared in the manner herein described falls well within the range of viscosity characteristics of the more expensive chlorinated starches. While the preferred range of viscosity characteristics for products of the present invention is from about 40 to about 60, as measured by a Dudley viscosimeter test, it is possible by varying the amount of sodium perborate, as illustrated, to make much heavier tub sizes. Thus, the present invention permits the manufacture of a wide variety of products to meet any particular demand or purpose. The preferred compositions for most purposes were made with about 1% borax and about 1% sodium perborate.

It was also found that the products made as described above deposited less than 1% of sediment when tested in 3% solutions. Likewise, they exhibited satisfactory film forming properties.

Paper was sized with these products and gave results comparable to those obtained heretofore only by the use of more expensive products. The preferred concentrations for the tub sizes were about 1% to about 6% starch. These tub sizes may be applied at temperatures from room temperature to, say, 180° F., preferably at 110° F. to 130° F.

Example II

In this example 298 parts of corn starch, 6.2 parts barium peroxide, 6.2 parts sodium aluminate and 1860 parts of water were mixed together (representing a dilution of about 1:6). This mixture was heated to 200° F. and held at that temperature for about 15 minutes. It was then diluted to a ratio of starch to water of about 1:9 and gave a Dudley viscosity at 1:9 at 130° F. of 53.7 seconds. The amount of sediment on standing was about ½% to 1%. The color of the product, however, was yellow. The pH of the reaction mixture was around 10.6. This example is given to illustrate the action of other alkalies besides borax. Sodium aluminate was chosen because in many respects it behaves like borax when used in treating starches. For example, both borax and sodium aluminate are known to act as viscosity increasing agents for starch dispersions. Sodium aluminate, however, is a stronger alkali. In general the preferred results are obtained by maintaining the pH during the reaction below about pH 10.

Example III

In this example 290 parts of regular corn starch were mixed with 2.7 parts sodium perborate, 217 parts of hydrated lime and 2030 parts of water. This mixture was heated to a temperature of 200° F. in 10 minutes and then held at that temperature for 20 minutes. Thereafter it was diluted with water to a consistency of 1 part of starch to 15 parts of water. The Dudley viscosity at 130° F. was 50 seconds. However, this product exhibited more than the desired amount of sediment, the amount of sediment in a 3% starch dispersion being about 15%. Apparently this large amount of sediment was due to some reaction occurring between the lime and the sodium perborate to form an insoluble calcium salt.

Tub sizes may be prepared in accordance with the invention from other types of grain starches

such as those derived from rice, wheat, oats, rye and barley. Tub sizes of the type prepared in accordance with the invention may be applied to the paper in a conventional manner either between the drying rolls or at the calender rolls of the paper making machine.

As will be apparent by reference to the examples, certain of the oxidizing agents and alkaline reacting substances are preferred for the purpose of the invention. Borax seems to have a definite effect when employed in combination with oxidizing agents such as barium peroxide or sodium perborate of inhibiting the formation of sediment in the resultant product. The alkali chosen should be one which is soluble in water, preferably a mild alkali, and one which does not react with the oxidizing agent to form insoluble salts.

The temperature and time of reaction may vary rather widely but it is preferable to heat the reaction mixture rather slowly from the gelatinization temperature of the starch to about 200° F. and then to maintain this relatively high temperature for a substantial period of time until there is no further effect on the viscosity of the product. The time for raising the temperature will ordinarily vary from about 5 to 15 minutes and the time for heating at the raised or elevated temperature will ordinarily vary from about 10 to 20 minutes. The final viscosity, as previously indicated, is preferably from about 40 to 60 seconds, as measured on a Dudley viscosimeter, although it may vary from about 143 seconds to about 47 seconds. Thus, product A had a viscosity range from about 143 seconds to about 55 seconds, as shown by the graph of the accompanying drawing. In a like manner product B, as shown by the drawing, had a viscosity range from 105 to 50, and product C had a viscosity range from 83 to 47. The Dudley viscosimeter is a standard instrument used in the oil industry.

Having thus described the invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. The method of producing a tub size from a corn starch containing substantial amounts of alpha amylose which comprises heating said starch in an aqueous medium with sodium perborate and borax to a temperature of about 200° F. and maintaining said temperature until no further substantial change in viscosity occurs, the amount of borax corresponding to about 1% to about 3% based on the weight of the starch and the amount of sodium perborate corresponding to about 0.25% to about 2% based upon the weight of the starch.

2. The method of producing a tub size for paper from corn starch containing a substantial quantity of alpha amylose which comprises heating said starch with about 0.1% to about 5% of an alkali metal perborate in the presence of a mildly alkaline reacting aqueous medium comprising about 0.5% to about 10% borax with a pH less than about 10 to a temperature of about 200° F. and maintaining said temperature until no further substantial change in viscosity occurs and said starch is substantially free of any tendency to deposit sediment from dilute dispersions.

3. A tub size for paper comprising an intimate aqueous dispersion of about 1% to about 10% by weight of the coaction product of corn starch, about 0.25% to about 2% sodium perborate and about 1% to about 3% borax coacted in water at a temperature substantially above the gelatinization temperature of the starch, the viscosity of said dispersion being within the range from about 55 seconds to about 143 seconds, as determined in the manner herein described, and the amount of sediment being less than 1% by weight.

4. A tub size for paper comprising the coaction product of corn starch, borax and sodium perborate coacted in water at a temperature substantially above the gelatinization temperature of the starch, the amount of starch being within the range of about 1% to about 6% of the total weight of starch and water, the amount of borax and sodium perborate being approximately 1% each, based on the weight of the starch, the viscosity being substantially constant at a temperature of about 200° F. and the amount of sediment being less than about 1%.

5. The method of producing a starchy sizing composition which comprises coacting a grain starch containing substantial quantities of alpha amylose with about 0.1% to about 5% sodium perborate and about 0.5% to about 10% borax in the presence of water at a temperature above the gelatinization temperature of the starch up to about 200° F., and maintaining a temperature around 200° F. until no further substantial change in viscosity occurs.

6. The method of producing a starchy sizing composition which comprises coacting a grain starch containing substantial quantities of alpha amylose with about 0.1% to about 5% of an alkali metal perborate and about 0.5% to about 10% borax in the presence of water at a temperature above the gelatinization temperature of starch up to about 200° F., and maintaining a temperature around 200° F. until no further substantial change in viscosity occurs.

7. A starchy sizing composition comprising the coaction product of a grain starch containing substantial quantities of an alpha amylose with about 0.1% to about 5% of an alkali metal perborate and about 0.5% to about 10% borax coacted in water at a temperature substantially above the gelatinization temperature of the starch, the viscosity being substantially constant at a temperature of about 200° F. and the amount of sediment being less than about 1%.

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