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PARCHMENT PAPER AND PROCESS OF MAKING THE SAME

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The invention relates to the preparation of paper or similar substances which may be used in the manufacture of lamp shades or other devices wherein a high degree of translucency, or any other characteristic, is desirable.

The prime object of the invention is the production of a paper lamp shade which not only is capable of reflecting light in desired directions, but is sufficiently translucent to directly transmit light of such intensity that extraneous objects will be well illuminated, and that relatively opaque ornamental features of the shade will strongly contrast with brighter unornamented areas thereof.

Heretofore, parchment shades for lamps have been made from various kinds of paper impregnated with paraffin, or various combinations of sizing materials, or various mixtures of oils, to render the papers somewhat translucent. Such parchment shades have proven unsatisfactory for use on lamps where high temperatures are encountered, and especially on incandescent mantle lamps of the kerosene type. They either become brittle or discolored or distorted, or in large measure lose their translucency.

Endeavoring to overcome these inherent defects of parchment shades, applicant impregnated paper with various kinds of gums dissolved in suitable volatile solvents to render the gums sufficiently fluent, and after impregnation evaporated the solvents, leaving the gums within the paper. The work performed along this line disclosed the fact that no matter what gum was selected and no matter what solvent was selected, the papers so treated rapidly lost their translucency. The solvent was fugitive and, in proportion as the solvent evaporated, the translucency of the paper decreased. Apparently, this decrease in translucency was due to the substitution of air for the solvent.

Applicant then discovered that, in order to make a satisfactory parchment paper for use under the thermal conditions surrounding a kerosene burner of the mantle type, it would be necessary to completely fill the paper with a non-volatile, non-fugitive substance that is capable of rendering the paper highly and permanently translucent under all conditions of use.

Many natural resins were tried, none of which were sufficiently resistant to the influences of light and heat to give satisfactory results. Also, synthetic resins of various types were tried. These resins failed because of their having too much color which produced varying and disagreeable color effects in the paper, or because of their having such a low melting point that they would flow in the paper under the influence of heat, or because they were too viscous when melted to properly impregnate the paper.

After many trials, covering some forty-odd gums, applicant discovered that an alkyd type resin, such as that produced by the condensation of glycerol and phthalic anhydride with or without the presence of a third component such as benzoic acid, incompletely polymerized in the process of manufacture, could be melted, and, when combined with a suitable plasticizer such as tricresyl-phosphate, could be used to impregnate a suitable paper, and that the product thus produced was a highly-translucent and highly-heat-resistant parchment paper that maintained its translucency and was stable for a very extended length of time, even when heated to a temperature of approximately 80° C., and also when surrounding an incandescent kerosene mantle lamp where it was subjected to the action of both great heat and intense light.

The discovery of a suitable paper as an element of the new combination, in itself required considerable investigation. Ordinary rag papers and sulphite papers proved undesirable, because of discoloration which they suffered during the process of impregnating them with the high-melting-point gum above described. But a paper was finally discovered, which proved to be more resistant to changes than all others.

This paper is made from the type of pulp which carries the trade-name of "Super Alpha", and consists of a pulp made from spruce chips which have been digested with sulphurous acid at a definite temperature and for a definite length of time, and at the completion of the digestion, has been "blown". The word "blown" refers to a process in the manufacture of the pulp, whereby the pulp which has been cooked under steam pressure is forced out of the container against a target with such violence as to almost constitute an explosion, whereby the fibres are so thoroughly opened up that all of the inner-cellular material, consisting of lignin, mucine and the natural resins which have been dissolved by the sulphurous acid, are readily washed away, together with a considerable amount of hydrolyzed cellulose.

That portion of the cellulose in the wood fibre which constitutes the firm and resistant fibres, or, as the paper maker calls them after they have been physically altered by beating, "fibrilla", is composed of what is known to the paper chemist as "alpha cellulose". There exists in the wood

and in the most papers formed from wood pulp, two other forms of cellulose known to the paper chemist as "beta" and "gamma cellulose". These two forms of cellulose are readily hydrated and hydrolyzed to produce the slimy binding materials with which the paper maker succeeds in binding the fibres of alpha cellulose together into a sheet.

In ordinary papers the beta and gamma cellulose remain in large percent, but in the paper used by applicant, all but approximately 5% of mixed beta and gamma cellulose are removed, and only just sufficient of this binding material is allowed to remain to properly fabricate the paper, whereas in ordinary papers made from ordinary pulp the cooking process has not proceeded far enough in the making of the pulp to produce slimy materials from the alpha and beta cellulose present. Therefore it is necessary to add various kinds of size, consisting of glue-like substances or adhesives of the modified starch types, all known under the general heading of "sizing", to bind the fibres of the pulp together to make paper.

In this paper used by applicant no such size, or sizing material, is used, since the cooking process has proceeded to the limit of possibility in hydrolyzing and hydrating the beta and gamma cellulose content and it is all eliminated with the exception of that which is required to effect the final binding of the fibres. This point is stressed because of the fact that experience has shown that all papers containing the usual sizing materials have failed to make suitable parchment paper, serious discolorations of the paper or of the sizing materials contained in the paper having been produced by the treatment. The pure alpha cellulose is capable of withstanding the temperatures necessary for impregnation with the type of gum mentioned, and if discoloration of the small percentage (5%) of gamma and beta cellulose does occur it is not noticeable.

The final result, therefore, has been the production of a highly translucent, highly light diffusive, highly-heat-resistant parchment paper, suitable for use in the heated locations around high temperature lamps, and which is practically permanent in the retention of these qualities as no other paper is.

Papers commonly employed in the manufacture of lamp shades and similar products usually vary in thickness from 0.010 inch to 0.015 inch. Measurements on papers of this order of thickness, impregnated in accordance with the present invention, have shown an increase in the actual transmission of light over that of the unimpregnated paper of from 6 to as high as 15 times, depending upon the nature of the paper used. On the other hand, measurements on similar papers, treated in accordance with heretofore-proposed methods which, because of the materials employed, might produce a useful light-stable and heat-resistant product, showed an increase in transmission, due to the treatment, in no case greater than 2.3 times.

The above measurements were made with the "integrating sphere-diffuse light" method. The apparatus consisted of an integrating sphere of high reflecting inner surface with a hole at the top. Over the hole was placed the sample to be measured and it was covered by a diffusing glass hemisphere, the sample being at the center of curvature of the hemisphere. The hemisphere was illuminated from the outside by seven 100-watt gas-filled tungsten lamps operated at rated voltage. The lamps were evenly spaced 120° apart, giving substantially uniform illumination over the entire hemisphere. The transmission of the sample is the ratio of the brightness of the sphere window with the sample in place to the brightness without the sample.

In performing the process of making this new parchment paper, Super Alpha paper, such as described above, is immersed in a bath of molten alkyd resin, that has been heated to a point short of complete polymerization and combined with a suitable plasticizer, for a sufficient length of time to allow the heat to expel as much as possible of the air held within the paper, and to impregnate the paper as far as it can be impregnated under those conditions. The paper is drawn from the bath, and the excess of gum is removed from the surface of the paper.

The paper is then introduced into a heated space, where it is heat treated to complete the polymerization of the gum and, thereby, remove the tackiness or stickiness which the partially polymerized gum, on or in the paper, possesses as it is removed from the bath. In practice it is desirable to heat the gum in the impregnating bath to a temperature of approximately 140° to 160° C., and that the paper should remain immersed in the bath for a period of one to three minutes, after which the excess gum is removed from the surface of the paper by passing the paper between two stationary heated doffers. The distance between the surface of the gum in the bath and the doffers, is carefully regulated, so that the spaces from which the air was expelled by heat in the impregnating bath, will be filled with the gum carried up on the surfaces of the paper before it reaches said doffers. Also there will be time for the cooling of the paper, upon which cooling absorption of the gum is largely dependent. After passing the doffers the paper is heated for a period approaching six hours, at a temperature of 130° C., to complete the polymerization of the gum. At this time the paper has lost all tackiness and is suitable for parchment shade manufacture.

The stability of this product is due to the fact that none of its constituent elements is volatile, or fusible, or subject to either physical or chemical alterations at temperatures below the temperature (140 degrees to 160 degrees centigrade) required for the polymerization of the initial polymerizable substances, and that stability is also due to the fact that none of said constituent elements is materially affected by light.

The partially-polymerized impregnating substance herein described initially and inherently is sticky and highly resistant to the discoloring influence of light and heat. However, after complete polymerization it is no longer sticky, although it retains its light and heat resisting characteristics.

The term "non-fugitive", as herein employed, means that the impregnating substance is of such character that, when solidified, it will remain fixed and not migrate.

By the term "non-spotting", as used in the claims, I mean the opposite of the property possessed generally by greases, oils, fats, waxes and similar materials, by which a part of the material will readily separate from the mass of the material and adhere to an object touching it, and stain, soil, or spot said object.

Having thus described my invention, what I claim is:

1. A paper having an alpha-cellulose content of approximately 95% of its total cellulose content and highly resistant to the destructive influence of light or heat, impregnated with a polymerized alkyd-type resin similarly resistant to the destructive influence of light or heat, said impregnated paper having a high light-transmissiveness.

2. A paper having an alpha-cellulose content of approximately 95% of its total cellulose content and highly resistant to the destructive influence of light or heat, impregnated with an alkyd-type resin produced by the condensation of glycerol and phthalic anhydride and similarly resistant to the destructive influence of light or heat said impregnated paper having a high light-transmissiveness.

3. A paper having an alpha-cellulose content of approximately 95% of its total cellulose content and highly resistant to the destructive influence of light or heat, impregnated with an alkyd-type resin produced by the condensation of glycerol and phthalic anhydride in the presence of a third component such as benzoic acid, said alkyd-type resin being similarly resistant to the destructive influence of light or heat, said impregnated paper having a high light-transmissiveness.

4. A paper having an alpha-cellulose content of approximately 95% of its total cellulose content and highly resistant to the destructive influence of light or heat, impregnated with an alkyd-type resin produced by the condensation of glycerol and phthalic anhydride in the presence of benzoic acid, said alkyd-type resin being similarly resistant to the destructive influence of light or heat, said impregnated paper having a high light-transmissiveness.

5. The method of treating paper to render it highly light-transmissive, which includes impregnating said paper with a molten polymer of an alkyd-type resin having a sufficiently low viscosity when melted at between 140° C.–160° C. to thoroughly permeate the paper.

6. Wood-fiber paper having a high alpha-cellulose content and impregnated with an alkyd-type resin which substantially fills the voids of said paper and imparts to said paper a high degree of light translucency.

7. The process which includes treating paper with a molten alkyd-type resin and polymerizing said resin.

8. The process which includes impregnating paper with a partially-polymerized molten alkyd-type resin of sufficiently low viscosity to enable it to thoroughly penetrate the paper, and polymerizing said resin in situ.

9. The process which includes treating paper with a molten alkyd-type resin, and polymerizing said resin by subjecting the treated paper to heat at substantially 130 degrees centigrade.

10. The process which includes treating paper with a molten alkyd-type resin produced by the condensation of glycerol and phthalic anhydride, and polymerizing said resin.

11. The process which includes treating paper with a molten alkyd-type resin produced by the condensation of glycerol and phthalic anhydride in the presence of benzoic acid, and polymerizing said resin.

12. The process which includes applying to paper a transparent fluent resin of the alkyd-type at a temperature of from 140 to 160 degrees centigrade, and polymerizing said resin by subjecting the treated paper to heat at substantially 130 degrees centigrade.

13. The process of producing a highly-translucent and light-diffusive parchment which will not discolor or otherwise deteriorate when subjected for long periods to a temperature of 80 degrees centigrade, which consists in impregnating a paper substantially composed of alpha-cellulose with a molten alkyd-type resin, by coating said paper with said resin and heating it, then allowing said coated paper to cool and absorb into its voids a portion of said coating, removing the unabsorbed resin from the surfaces of said paper and again heating said impregnated paper to complete the polymerization of said absorbed resin and to render said parchment stable.

14. The process of producing a highly-translucent and light-diffusive sheet material which is highly resistant to the discoloring influence of light and heat, which consists in immersing a paper having a subnormal beta and gamma cellulose content in a molten bath of an alkyd-type resin, to coat said paper with said resin, heating said paper to expel the air and moisture normally held in the voids of said paper, cooling said coated paper to cause it to absorb into its voids a portion of said coating, removing the unabsorbed resin from the surfaces of said paper and again heating said paper and said absorbed resin to complete the polymerization of said resin and to render said sheet material stable.

15. The process of producing a lamp shade material, which consists in treating a paper composed of alpha-cellulose and a subnormal quantity of beta and gamma cellulose in a molten bath of an alkyd-type resin, to coat said paper with said resin and to heat it, then cooling said coated paper to substitute said resin for the air normally held in the voids of said paper, removing the unabsorbed resin from both surfaces of said paper, and again heating said treated paper to complete the polymerization of said resin.

16. The process of producing a parchment, which consists in immersing a paper having a high alpha-cellulose content in a molten bath of an alkyd-type resin, to coat said paper with said resin and to heat it, then allowing said coated paper to cool to thereby saturate it with said resin, removing the unabsorbed resin from the surfaces of said paper, and again heating the resin which has been absorbed into said paper to complete its polymerization and to render said parchment stable.

17. The method of treating paper to render it translucent without substantial discoloration, which consists in immersing sheet paper having a high alpha-cellulose content and low translucency in a bath of molten alkyd-type resin for a time period of from 1 to 3 minutes, cooling said paper to permit the atmospheric air to force the films of fluent resin on the surfaces thereof into the pores of said paper, removing the surplus resin from said surfaces, and heating said paper and resin to polymerize said resin, thereby imparting a high degree of translucency and resistance to discoloration of the product.

18. The process which includes impregnating paper having a high alpha-cellulose content throughout with a partially polymerized transparent alkyd-type resin, and polymerizing said resin in situ.

19. The process which includes impregnating paper having a high alpha-cellulose content with

a partially polymerized molten alkyd-type resin of sufficiently low viscosity to enable it to thoroughly penetrate the paper, and polymerizing said resin in situ.

20. The process which includes treating paper having a high alpha-cellulose content with a molten alkyd-type resin, and stabilizing said resin.

21. A paper having an alpha-cellulose content approximating 95% of its total cellulose content impregnated with a polymerized alkyd-type resin.

22. Paper having a high alpha-cellulose content impregnated with an alkyd-type resin produced by the condensation of glycerol and phthalic anhydride, which resin substantially fills the voids of said paper.

23. Absorptive paper having a high alpha-cellulose content and impregnated with a synthetic resin produced by the condensation of glycerol and phthalic anhydride in the presence of a third component such as benzoic acid, said resin substantially filling the voids of said paper and imparting to said paper a high degree of light-translucency.

24. Highly-translucent sheet material for light-diffusing purposes, including in combination absorptive material which is of high alpha-cellulose content having initially-low translucency, and a transparent light-stable synthetic resin of the kind produced from glycerol and phthalic anhydride, with a suitable plasticizer, completely filling the pores of and imparting to said absorptive material a high degree of translucency, said resin being non-fusible and non-fugitive at temperatures below 80° C.

25. The process of impregnating paper with a transparent synthetic polymerizable resin which includes substituting said resin in a molten state and free from solvent, for the air normally present in the pores of the paper and polymerizing said resin in situ.

26. The process of producing a highly-translucent and light-diffusive sheet material, which includes immersing an absorptive paper in a molten bath of light-resistant, low-viscosity, alkyd-type resin, removing said paper from said bath and subsequently removing any surplus of said resin from the surfaces of said paper.

27. The process of producing a highly-translucent and light-diffusive sheet material, suitable for lamp shades, which includes immersing an absorptive paper in a molten bath of low-viscosity, alkyd-type resin, to drive out the air and moisture from said paper, and to impregnate the paper as much as possible under those conditions, withdrawing said paper from said molten bath with coatings of molten resin thereon, and causing portions of said molten coatings to permeate said paper, and removing the surplus resin from the surfaces of said paper.

28. The process of treating paper of low translucency to make it highly transmissive of light and to render it resistant to the destructive influence of light or heat radiated by lamps, which includes impregnating said paper with a molten transparent resinous material of sufficiently low viscosity to permeate said paper, and solidifying said resinous material in said paper, said resinous material, after solidification in the paper, being substantially light-stable, non-fugitive, non-spotting, and stable at temperatures up to approximately 80° C.

29. Highly-translucent sheet material for light-diffusing purposes, comprising paper the voids of which are substantially filled throughout with a resinous material, said resinous material being highly-light-transmissive, substantially light-stable, non-fugitive, and non-spotting, and, when solidified, stable at temperatures up to approximately 80° C.

30. A translucent light-diffusing lamp shade material, comprising paper the pores of which are substantially filled with a resinous substance, said impregnated paper being substantially identical with the product produced by the process of claim 8.

31. A lamp-shade material, including paper impregnated throughout with an alkyd-type resin, said lamp-shade material having optical properties such that its total transmission of completely diffuse light is at least six times that of said paper.

32. A lamp-shade material, including paper having a high-alpha-cellulose content impregnated throughout with an alkyd-type resin, said lamp-shade material having optical properties such that the total transmission of completely diffuse light is at least six times that of said paper.

33. The process of impregnation, which includes immersing a sheet of absorptive cellulose material in a bath of molten transparent polymerizable resin of low viscosity for a sufficient length of time to allow the heat to expel as much as possible of the air held within the sheet, removing the resin-coated sheet from the bath and cooling the coated sheet for a sufficient time to permit the desired quantity of molten resin to be absorbed by the sheet, removing the surplus resin from the sheet and finishing the sheet to produce a material suitable for parchment shade manufacture.

34. The process of impregnation, which includes immersing a sheet of absorptive cellulose material in a bath of a transparent molten polymerizable resin of low viscosity for a sufficient length of time to allow the heat to expel as much as possible of the air held within the sheet, removing the resin-coated sheet from the bath and cooling the coated sheet for a sufficient time to permit the desired quantity of molten resin to be absorbed by the sheet, removing the surplus resin from the sheet and polymerizing the resin in situ.

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