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MOISTUREPROOFING PAPER

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The invention relates to the moistureproofing of paper by the application of coating compositions, and it is particularly concerned with a composite film coating for paper, of high moisture resistance, which includes both vinyl resins and waxes.

The coating of papers of different kinds with vinyl resin compositions has been heretofore proposed as a means for improving the imperviousness of the paper to water, grease and other materials, as a method for enabling the paper to be joined to itself or other surfaces by heat sealing, and as a means for increasing the flexibility and resistance to cracking of the paper when subjected to the creasing encountered in wrapping and packaging operations. To increase the moisture resistance of such coatings, waxes have been compounded with the vinyl resin. This has usually been done by dissolving the wax and the resin in a mutual solvent to produce homogeneous lacquer-like compositions. Difficulty has been encountered, however, in obtaining adhesion of sufficient strength and permanency of the films deposited from such solutions, particularly to papers which have a hard and substantially non-porous surface, such as glassine. This difficulty increases if more than about 2% of wax is sought to be incorporated in the resin coating because the lack of adequate compatibility of the resin with these amounts of wax usually results in blushing of the film with accompanying brittleness and loss of film strength. To incorporate even such small amounts of wax in film cast from a solution requires special selection and control of the solvent compositions, the inclusion of predominating proportions of aromatic hydrocarbons and esters which have good solvent powers for waxes, rather than the ketone compounds usually preferred as solvents for the vinyl resins used as coating bases.

It is an object of this invention to provide improved moistureproof coatings for paper which include both vinyl resins and waxes, and to provide such coatings in a manner which enables the essential advantages of each component to be utilized without interference with the intended and most satisfactory function of the other. A further object is to provide an improved process for applying composite moistureproofing films of vinyl resins and waxes on one or both surfaces of paper to produce a more strongly adherent and permanent coating than has heretofore been possible by ordinary means. Hard finished papers having a substantially non-porous surface, such as those of the glassine type, constitute a preferred class of paper for treatment.

Surprisingly enough, we have discovered by test that the above objects can be attained by applying the wax and the vinyl resin as a non-homogeneous deposit on the paper surface, rather than from a homogeneous solution containing the wax and the resin, and thereafter briefly exposing this composite coating to high temperatures. Two general forms of procedure are contemplated for accomplishing this: one in which the wax is applied directly to the paper surface prior to the vinyl resin coating, and another in which the wax portion of the composite coating is applied in the form of a dispersion of the solid wax in the vinyl resin coating solution. A very quick bake of the composite coating at high temperatures is then employed in either instance to obtain the required adhesion and continuity of the coating. In the case of papers having a smooth hard surface like that of glassine, the wax film is preferably applied before the vinyl resin coating. This may be done by melting the wax and forming it into a continuous thin film directly on the paper surface. Over this coating of wax a film of vinyl resin is then applied from a solution of the resin in solvents, which have little or no softening and solvent action on the wax, for instance, ketones, and the composite coating of wax and vinyl resin is immediately subjected to an intense baking operation for a period of a few seconds and at a temperature in the neighborhood of 400° F. The very rapid baking, and the fact that the solvents employed to disperse the vinyl resin have very little solvent action for wax, cooperate to prevent the wax from dissolving or diffusing into the resin film and causing it to blush. A clear vinyl resin film thus results, which has excellent adhesion to the waxed paper surface, and which covers and protects the wax film to insure substantially permanent moistureproofness of the coated material.

In another modification, particularly adapted for coating papers of more porous surface than glassine, the wax may be applied simultaneously with the vinyl resin coating, by suspending or dispersing the wax in fine solid form in the solution containing the resin. For example, a solution of the vinyl resin in suitable ketone solvents is prepared, and heated to a temperature close to the melting point of the wax to be incorporated. Molten wax is then poured into the hot solution with stirring. As the solution slowly cools, the wax separates out in a very finely dispersed state, forming a fluid lacquer or composi-

tion which can be readily applied by spraying, roller coating or other means. This composition is then applied to the paper surface, and subjected to an intense baking operation as mentioned above, producing an adherent, continuous protective film having the desirable properties of both a vinyl resin and a wax coating. In this embodiment, it is likely that the wax forms a separate coating underlying the vinyl resin film. In any event, the vinyl resin film is continuous and the dispersed particles of wax, if a separate wax layer is not formed, do not affect the strength of the vinyl resin film, and the maximum adherence and imperviousness in the composite coating is provided. This is to be distinguished from the application of the wax and vinyl resin from solution in a common solvent, wherein the vinyl resin does not form a continuous film and the resulting coating is brittle and weak.

When papers of medium or extreme porosity are to be coated, the above procedure sometimes causes the wax, if large amounts are present, to penetrate the paper, resulting in an unsightly spot. This may be prevented by initially coating the paper with a thin film of vinyl resin containing no wax and then applying the vinyl resin solution containing the dispersed wax as previously described.

The vinyl resins preferred for use in the invention are those which result from the conjoint polymerization of a vinyl halide and a vinyl ester of an aliphatic acid, and which contain from about 70% to about 95% vinyl halide. Particularly desirable are the conjoint polymers of vinyl chloride and vinyl acetate which contain about 80% to 95% vinyl chloride, and which possess an average molecular weight of from about 9,000 to about 12,000, as determined according to Staudinger's method from the specific viscosity of dilute solutions. Less desirably, other vinyl resins may be employed, such as polyvinyl organic and inorganic esters or polyvinyl acetals.

Suitable waxes for use in the invention include the conventional waxes which have been used heretofore in moistureproofing, such as paraffin wax, ceresin wax, Japan wax, spermaceti wax, or the wax-like derivatives of chlorinated naphthalene. Particularly desirable are those waxes which are highly incompatible with the vinyl resin, such as highly refined paraffin wax melting at 165° to 170° F. The amount of wax used, in the second one of the above process embodiments can be varied according to the degree of imperviousness to moisture desired. Even when the wax is incorporated in amounts of 10% or higher by weight of the vinyl resin, the coating has an excellent appearance and adhesion and the heat sealing characteristics of the coated paper are not impaired. Usually about 2% to 10% of wax is sufficient to provide the required moisture resistance. Where the wax film is applied prior to the resin coating, it should be very thin, and preferably of a thickness not greater than about 0.00015 inch, so that the finished coating may have an overall thickness of not greater than about 0.0003 inch. Within this range, the resistance of the coated paper to moisture will depend primarily on the actual thickness of the wax film and secondarily on that of the vinyl resin film.

In either modification of the process, an intense baking operation is essential to insure firm adhesion of the composite, non-homogeneous coating of wax and vinyl resin. The baking time should preferably be only a few seconds, varying from about 5 to 120 seconds inversely with the temperature employed. The preferred operating range of temperatures is from 375° to 400° F. At 400° F. a baking period of no longer than 20 seconds is usually sufficient to obtain suitable adhesion and brilliance of the film, but in any event the baking time should be correlated with the temperature so as to avoid thermal deterioration of the resin. It is also important that resin solvents be selected which will not dissolve the wax to any appreciable extent, and the commonly known ketone lacquer solvents, such as methyl ethyl ketone, methyl isobutyl ketone, diisopropyl ketone, and isophorone, not only serve this purpose, but are recognized as excellent thinner components for vinyl resin lacquers. The resin coating compositions may further incorporate, if desired, plasticizers, pigments, fillers, and agents to stabilize the resin against heat or light.

The following examples will serve to illustrate the practice of this invention:

Example 1.—A sheet of heavy calendered Manila paper was lightly coated over one half its surface with a thick suspension of ceresin wax in toluene. After evaporation of the toluene, the entire paper was then coated with a thin film of a conjoint polymer of vinyl chloride with vinyl acetate, which was deposited by spraying the paper with a dilute solution of the resin in a mixture of aliphatic ketones. The vinyl resin coating was dried and the coated paper then subjected to a flash baking operation at 400° F. It was found that the vinyl resin film adhered tenaciously both to the wax-coated paper and to the uncoated paper and the coated product was of excellent appearance and high gloss. However, the wax coated portion of the paper had much superior resistance to moisture. This was shown by tests conducted at 35° C. on discs of the coated paper having saturated water vapor on one side and an absolutely dry atmosphere on the other. The portion of the coated paper which had not received the wax treatment transmitted moisture at the rate of 6.6 milligrams per hour per square centimeter, whereas the waxed portion transmitted moisture at the much reduced rate of 0.53 milligram per hour per square centimeter.

Example 2.—Glassine paper was coated with a thin film of a high melting paraffin wax by applying the wax from a dispersion in toluene and briefly heating the coated paper to drive off the solvent and to flow out the wax. A very thin film of a conjoint polymer of vinyl chloride with vinyl acetate was then applied by spraying over the wax coated paper a dilute solution of the resin in volatile ketones; these solvents being selected because they do not dissolve the wax. The total thickness of the resin film and the wax film was about 0.0003 inch. The coated paper was then intensely baked for a few seconds at 400° F. resulting in a firmly adherent coating of high gloss. It transmitted moisture at the very low rate of 0.013 milligram per hour per square centimeter when subjected to the test previously described. Because of its high resistance to moisture and because of its ability to be joined by heat sealing, this coated paper makes an excellent wrapper or container for foodstuffs.

Numerous modifications in the invention as described will be evident to those skilled in the art, and are intended to be included within the scope of the appended claims.

This application contains subject matter in common with that of Arthur K. Doolittle, Serial No. 349,235, filed August 1, 1940.

We claim:

1. A process of moistureproofing paper which comprises forming on the surface of the paper a non-homogeneous deposit of a resinous vinyl polymer formed predominantly from vinyl chloride, and a wax incompatible therewith, the vinyl polymer being applied from solution in an organic solvent which is a non-solvent for the wax, and the amount of wax being very small relative to the weight of the paper and being between 2% and 10% by weight of the vinyl polymer, and effecting a strong adhesion of the composite coating while maintaining its non-homogeneous nature by baking the coated paper at temperatures of about 375° to 400° F. for a period not exceeding about 120 seconds, whereby a clear and non-tacky composite film of wax and vinyl polymer is formed on the paper.

2. A process of moistureproofing paper which comprises forming on the surface of the paper a non-homogeneous deposit of a vinyl resin, substantially identical with that resulting from the conjoint polymerization of vinyl chloride with vinyl acetate and containing from about 80% to 95% combined vinyl chloride, and a wax incompatible therewith, the vinyl resin being applied from solution in an organic solvent which is a non-solvent for the wax and the amount of wax being very small relative to the weight of the paper and being between 2% and 10% by weight of the vinyl resin, and effecting a strong adhesion of the composite coating while maintaining its non-homogeneous nature by baking the coated paper at temperatures of about 375° to 400° F. for a period not exceeding about 20 seconds, whereby a clear and non-tacky composite film of wax and vinyl resin is formed on the paper.

3. A process of moistureproofing paper which comprises forming on the paper surface a film of wax having a thickness not greater than about 0.00015 inch, covering the wax film with a film of a resinous vinyl polymer formed predominantly from vinyl chloride, the vinyl polymer being incompatible with the wax and being applied from solution in a liquid which is a non-solvent for the wax to form a composite coating not greater than about 0.0003 inch in total thickness, baking the composite coating at a temperature of about 375° to 400° F. for a period not exceeding about 120 seconds, whereby a strongly adherent, clear, non-tacky and non-homogeneous composite film of the wax and vinyl polymer is formed on the paper.

4. A process of moistureproofing paper of the glassine type which comprises applying a thin film of paraffin wax having a thickness less than about 0.00015 inch on the paper surface, covering the wax film with a thin film of a vinyl resin deposited from solution in a ketone solvent to form a composite coating having a total thickness not greater than about 0.0003 inch, said resin being substantially identical with the product resulting from the conjoint polymerization of vinyl chloride with vinyl acetate and containing from about 80% to 95% combined vinyl chloride, and subjecting the composite coating to a brief baking operation at a temperature of about 375° to 400° F. for a period not exceeding about 20 seconds, whereby a strongly adherent, clear, non-tacky and non-homogeneous composite film of wax and vinyl resin is formed on the paper.

5. A process of moistureproofing paper which comprises uniformly dispersing a wax in finely divided solid form in a solution of a resinous vinyl polymer formed predominantly from vinyl chloride in a solvent which does not dissolve the wax, applying a thin film of the mixture so formed on the surface of the paper, subjecting the coated paper to a brief baking operation at a temperature of about 375° to 400° F. for a period not exceeding about 120 seconds, and forming an adherent, clear, non-tacky and non-homogeneous composite film of wax and said vinyl resin on the surface of the paper.

6. A process of moistureproofing paper which comprises uniformly dispersing a wax in finely divided solid form in a solution of a conjoint polymer of vinyl chloride with vinyl acetate in a solvent which does not dissolve the wax, applying a thin film of the mixture so formed on the surface of the paper, subjecting the coated paper to a brief baking operation at a temperature of about 375° to 400° F. for a period not exceeding about 120 seconds, and forming an adherent, clear, non-tacky and non-homogeneous composite film of wax and said vinyl resin on the surface of the paper.

7. A process of moistureproofing paper which comprises uniformly dispersing a wax in finely divided solid form in a solution of a vinyl resin in a ketone solvent, said resin being substantially identical with the product resulting from the conjoint polymerization of vinyl chloride and vinyl acetate, applying a thin film of the mixture so formed on the paper surface, subjecting the coated paper to a brief baking operation at a temperature of about 375° to 400° F. for a period not exceeding about 20 seconds, and forming an adherent, clear, non-tacky and non-homogeneous composite film of wax and said vinyl resin on the paper surface.

8. A process of moistureproofing a porous paper which comprises forming a thin film of a vinyl resin on the porous surface thereof, applying to the resin coated surface a uniform dispersion of a wax in finely divided solid form in a solution of a vinyl resin in a solvent which does not dissolve the wax, subjecting the coated paper to a brief baking operation at a temperature of about 375° to 400° F. for a period not exceeding about 20 seconds, and forming an adherent, clear non-tacky and non-homogeneous composite coating of wax and vinyl resin on the paper surface, said vinyl resin being substantially identical with that resulting from the conjoint polymerization of vinyl chloride with vinyl acetate.

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