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WAX COMPOSITIONS

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This invention relates to a new wax composition especially suitable for coating fibrous containers for liquids, such as paper cups.

Paraffin waxes have heretofore been employed for coating paper containers designed to hold liquids, but such waxes suffer many shortcomings. In order to overcome some of the difficulties, microcrystalline waxes and polymers, such as polyethylene, have been incorporated therewith. Such compositions, however, have also been unsatisfactory in one or more of the following: in presenting an unsightly appearance, in obtaining poor coverage with subsequent softening when filled with liquids, in blocking at relatively low temperatures, and in requiring conditions during application to paper containers which cannot be met with existing equipment.

An object of the present invention is to provide wax compositions especially suitable for coating fibrous containers for fluids. A particular object is to provide a wax composition effective for coating paper containers for liquids, which imparts a pleasing appearance to the resulting article of manufacture, while obtaining good coverage and good blocking characteristics, and which can be readily applied with existing equipment. A further object is to provide a process for the preparation of such wax composition.

It has now been found that by blending four components in certain amounts, a wax composition which achieves the above and other objects is obtained. The four components comprise two paraffin waxes, a microcrystalline wax and polyethylene, each of which must have specific properties and must be used in certain amounts as hereinafter described.

As used herein, melting points for paraffin waxes are determined by ASTM D87–42 and for microcrystalline waxes are determined by ASTM D127–49, penetrations by ASTM D5–52 and viscosities (SUS—Saybolt Universal seconds) by ASTM D446–53, unless otherwise stated.

The first paraffin wax must have a melting point of from 149° F. to 155° F., a penetration (at 77° F.) of from about 9 to 15 and a viscosity (at 210° F.) of from 42 to 46 SUS. On distillation, 5% of the wax should distill at about 820° F. and 95% should be distilled at about 950° F. This wax is prepared from petroleum by distilling slack wax which may be from the dewaxing of lubricating oil, or from a topped, high wax content crude petroleum, and collecting the fraction distilled between about 450° F. to 565° F. at 2 mm. of mercury pressure. This distillate fraction is then dissolved in a solvent such as a mixture of methyl ethyl ketone and benzene at an elevated temperature. The resulting solution is then cooled to a temperature of from about 77° F. to 83° F. and the wax which precipitates at this temperature is separated such as by filtration. Advantageously the wax is washed with the same material as used for the solvent at the temperature of precipitation, and the wax is then separated from the solvent. The resulting wax forms the first paraffin wax of the present composition.

The second paraffin wax used in the present compositions must have a melting point of from about 130° F. to 136° F., a penetration (at 77° F.) of from about 10 to 16 and a viscosity (at 210° F.) of from about 36 to 40 SUS. On distillation, 5% of the wax should distill at about 750° F. and 95% should be distilled at about 820° F. This wax is prepared from petroleum by distilling slack wax from the dewaxing of lubricating oil, or from a topped, high wax content crude petroleum, and collecting the fraction distilled between about 390° F. and 475° F. at 2 mm. of mercury pressure. This distillate fraction is dissolved in a solvent such as a mixture of methyl ethyl ketone and benzene at an elevated temperature and the resulting solution cooled to from 32° F. to 37° F. The wax precipitated at this temperature is separated as by filtration. Advantageously the wax is washed with the same material as used for the solvent, and after removal of the wash liquid, the recovered wax forms the second paraffin wax of the present composition.

The microcrystalline wax of the present composition must have a melting point of from about 169° F. to 179° F., a penetration (at 77° F.) of from about 10 to 20 and a viscosity (at 210° F.) of from about 70 to 85 SUS. This wax is prepared from petroleum by distilling slack wax from the dewaxing of lubricating oil to remove all material boiling above about 550° F. at 2 mm. of mercury pressure. On distillation, about 5% of the residual material should distill at about 560° F. at 2 mm. of mercury pressure, and about 40% should be distilled at about 640° F. at 2 mm. of mercury pressure. The residual material is dissolved in a solvent, such as a mixture of methyl ethyl ketone and benzene, at an elevated temperature and the resulting solution cooled to a temperature of from about 50° F. to 60° F. The wax precipitated by cooling to this temperature is separated as by filtration. The resulting wax, after washing preferably with the same material as used for the solvent at the temperature of the precipitation, and removal of the solvent, is the microcrystalline wax used in the present composition.

The polyethylene employed in the invention should have a relatively low molecular weight, i.e., from about 1,000 to 10,000, and preferably has an average molecular weight of about 2,000. The specific gravity of the polyethylene should be about 0.92 and the melting point from about 206° F. to 216° F. This polyethylene can be prepared by any means heretofore described, such as by subjecting ethylene to elevated pressures preferably with free radical producing catalyst such as benzoyl peroxide.

As above stated, it is essential that the above-described components of the composition be used in specific amounts. The two paraffin waxes must be used in substantially identical quantities, and the individual quantities may vary from about 41% to 50% by weight of the final composition. The amount of the microcrylstalline wax can be varied only from about 5% to 10% by weight and the polyethylene can be varied only from about 0.1% to 1.0% by weight. If the quantity of the lower melting paraffin wax is below the stated range, poor coverage of the paper containers results so that leakage of the container may occur, whereas if a quantity thereof above the stated range is used, blocking of the coated articles is observed even at relatively low temperatures. If the quantity of the higher melting paraffin wax is below the stated range, the coated containers exhibit poor blocking characteristics in that blocking is observed even at relatively low temperatures whereas if the quantity thereof is above the stated range, the coated articles present an unsightly appearance in that the surface exihibit serpentine lines, and poor gloss. If the quantity of microcrystalline wax is below the stated range, poor coverage and protection are obtained so that leakage is frequently observed, whereas if the quantity thereof is above the stated range, the composition cannot be worked on existing equipment since the temperature required for coating is too high. Polyethylene is an essential component in the amounts stated. If the amount used is below the stated range, poor coverage is obtained, and the surface wax tends to be brittle, whereas if a quantity above the stated range is used, the wax composition cannot be used in existing equipment since the temperature required for coating the articles is too high.

In addition to requiring critical amounts of each component, it appears that waxes having properties outside of the stated ranges for each wax component cannot be used. For example, substituting a wax having a melting point of 127° F. for the lower melting paraffin wax defeats the purposes of the invention in that the resulting composition exhibits poor blocking characteristics, and hence is unsuitable for coating paper articles. Likewise, substituting a higher melting paraffin having properties outside the ranges of those described for the higher melting paraffin of the present invention, or substituting a different microcrystalline wax for the one herein described, results in a composition exhibiting one or more of the above-described difficulties.

In order to illustrate a specific embodiment of the present invention, a paraffin wax having a melting point of 151° F., a viscosity (at 210° F.) of 43.6 SUS and a penetration (at 77° F.) of 10 was prepared as above described. On distillation, 5% of the wax distilled at 820° F. and 95% distilled at 950° F. Specifically, this wax was prepared by topping a high wax content crude petroleum to about 38% bottoms. The bottoms were charged to a vacuum distillation operation, operating at 2 mm. of mercury pressure and the fraction distilling between 450° F. and 565° F. was collected. This distillate fraction was dissolved in a solvent consisting of a mixture of about 60% methyl ethyl ketone and 40% benzene at a temperature of about 180° F., about two parts by volume of solvent per part of wax being used. The resulting solution was slowly cooled to 80° F. and the wax precipitated at this temperature was separated by filtering. The wax cake was washed with an additional quantity of the solvent at a temperature of 80° F. and the wax recovered from the solvent.

A second paraffin wax having a melting point of 134° F., a penetration (at 77° F.) of 12 and a viscosity (at 210° F.) of 38.1 was prepared as above described. On distillation, 5% of the wax distilled at 750° F., and 95% distilled at 820° F. Specifically, this wax was prepared by topping a high wax content crude petroleum to about 38% bottoms. The bottoms were charged to a vacuum distillation operation which operated at 2 mm. of mercury pressure and the fraction distilling between 390° F. and 475° F. was collected. This distillate fraction was dissolved in a solvent consisting of a mixture of about 60% methyl ethyl ketone and 40% benzene at a temperature of about 180° F., about 4 parts by volume of solvent per part of wax being used. The resulting solution was slowly cooled to 35° F. and the wax precipitated at this temperature was separated by filtering. The wax cake was washed with an additional quantity of the solvent at a temperature of 35° F., and the wax was then recovered from the solvent.

A microcrystalline wax was prepared as above described. The microcrystalline wax had a melting point of 172° F., a penetration (at 77° F.) of 17 and a viscosity (at 210° F.) of 78 SUS. On distillation, 5% of the wax was distilled at 910° F. and 41% was distilled at 1,020° F. Specifically, this wax was prepared by vacuum distilling slack wax from the dewaxing of lubricating oil at 2 mm. of mercury pressure to remove materials boiling above about 550° F., and collecting a residual fraction 5% of which distilled at 560° F. (2 mm. of mercury pressure) and 40% of which distilled at 640° F. (2 mm. of mercury pressure). This residual fraction was dissolved in a solvent consisting of a mixture of about 60% methyl ethyl ketone and 40% benzene at a temperature of about 190° F., about 4.5 parts by volume of solvent per part of wax being used. The resulting solution was slowly cooled to 55° F. and the wax precipitated at this temperature was separated by filtering. The wax cake was washed with an additional quantity of the solvent at a temperature of 55° F., and the wax was then recovered from the solvent.

The two paraffin waxes were blended together with the microcrystalline wax by heating a mixture thereof to a temperature of about 200° F. with stirring. Polyethylene having a molecular weight of 2,000 and a specific gravity of 0.92 was added to the molten mixture with stirring and the stirring was continued until a homogeneous blend was obtained. The quantities of components employed were such that the resulting composition contained 46.1% of the lower melting paraffin wax, 46.1% of the higher melting paraffin wax, 7.55% of the microcrystalline wax and 0.25% of the polyethylene, the amounts being expressed as percent by weight. The resulting composition was employed in a commercial process for coating paper cups designed for use in holding liquids such as water. Application to the cups was made in existing equipment without observing any difficulties. Good coverage was obtained, and the resulting coated article presented a pleasing appearance, exhibited a high gloss, did not block even at temperatures of 100° F. and showed good working characteristics.

In preparing the wax constituents of the subject paraffin wax composition, the described operating variables must be observed in order to secure the advantages of the invention. However, the solvent used for dissolution of the wax fractions can be varied somewhat and good results obtained. The described solvent, consisting of about equal parts by volume of methyl ethyl ketone and benzene gives good results, but more or less of the two constituents, say from 30% to 70% by volume of benzene can be used. Also, other solvents can replace methyl ethyl ketone or benzene. For example, toluene can be substituted for a portion of the benzene and good results obtained.

The invention claimed is:

1. A wax composition consisting essentially of (A) from 41% to 50% of a paraffin wax having a melting point of from 149° F. to 155° F., a penetration at 77° F. of from 9 to 15 and a viscosity at 210° F. of from 42 to 46 SUS; (B) from 41% to 50% of a paraffin wax having a melting point of from 130° F. to 136° F., a penetration at 77° F. of from 10 to 16 and a viscosity at 210° F. of from 36 to 40 SUS; (C) from 5% to 10% of a microcrystalline wax having a melting point of from 169° F. to 179° F., a penetration at 77° F. of from 10 to 20 and a viscosity at 210° F. of from 70 to 85 SUS; and (D) from 0.1% to 1% of polyethylene having a molecular weight of from 1,000 to 10,000.

2. A wax composition according to claim 1 in which the paraffin wax of (A) and the paraffin wax of (B) are present in substantially the same quantities.

3. A container for holding liquids formed from a paper sheet material and provided with an adherent moisture and liquid resistant coating, said coating being formed from the wax composition of claim 1.

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