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## WAX COMPOSITIONS PRODUCING HIGH GLOSS, SMOOTH COATINGS

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### ABSTRACT OF THE DISCLOSURE

Petroleum wax compositions suitable for producing high gloss, smooth coatings on paper products are obtained by combining a selected type of paraffinic wax, characterized by properties including a melting point of 148–158° F. and a viscosity SSU at 210° F. of 44–52, with a very small amount, from 0.005 to 0.1 percent based on the weight of the wax, of solid polyethylene, preferably having a softening point of at least about 215° F. and an average molecular weight of at least about 12,000. Such coatings can be achieved by slow cooling at essentially ambient temperatures. A high gloss, smooth wax coating is thus obtained without the necessity of shock-chilling.

This invention relates to petroleum wax compositions suitable for coating cellulosic material and to articles made therefrom. More particularly, the invention concerns coating compositions composed of a selected type of paraffinic wax and a very small amount of solid polyethylene which is used to impart smooth, glossy characteristics to coatings of the wax on paper and paperboard articles.

Large quantities of petroleum waxes are used for waterproofing and strengthening paper products made for various uses. One such use is in treating paper drinking containers employed in dispensing a variety of beverages such as, for example, soft drinks, beer, milk, iced tea, ice cream, etc. The wax treatment serves both to waterproof and strengthen the paper cup.

Wax-treated, paper products can be classified in one or two categories: dry waxed or surface waxed. In the case of the dry-waxed containers, the applied wax is caused to penetrate into the confines of the paper. Any excess is removed, so that no surface wax film remains. Such a container is adequate for some uses where low cost is important and only a moderate degree of liquid-proofness is required. For more critical usage where a high degree of liquid-proofness is desired, the container must be surface waxed so that, while a substantial part of the applied wax may penetrate into the paper, a continuous, unbroken wax film remains on both the inner and outer container surfaces. This surface wax film prevents water or other aqueous mixtures from penetrating the surface cellulosic fibers, wicking through the container, and causing loss of strength, stiffness and utility. It is this latter type of waxed container with which I am concerned in the present invention.

The technique normally used in waxing containers involves dipping the container in a bath of molten wax, removing, and allowing the excess wax to drain off. Instead of dipping, the molten wax can be applied to the container by spraying if desired or any other conventional method. The position of the container can be changed during the draining period in order to promote the most

favorable distribution of surface wax. It also is common practice to expedite cooling by circulating relatively cool air around the container during the drain cycle in order to accelerate the process and ensure that the film cools and hardens before the wax drains away or penetrates the paper completely, leaving "dry spots."

Waxes used for coating various containers should give smooth, continuous coatings free of serpentine or other imperfections. The melting point and blocking temperature of the coatings should be sufficiently high to prevent the waxed containers from sticking to each other when nested in storage—especially during summer temperatures. Moreover, the viscosity of the coatings at application temperatures should be low enough to provide good drain properties and low wax consumption, thus keeping costs to a minimum. Low viscosity also minimizes wax build-up on machine parts during coating operations, thereby eliminating or reducing stoppages for cleaning and resulting in more efficient operations.

Some manufacturers and consumers of waxed products desire wax coatings which exhibit a non-glossy, satin-like finish while others prefer glossy coatings. Those skilled in the art recognize that the glossiness of petroleum wax coatings, in general, depends on the processing methods and conditions employed in applying the coating. For example, it is known that non-glossy, satin-like wax coatings are normally produced by permitting the molten wax coating to cool rather slowly through its melting point. This promotes larger wax crystal formations in the coating which scatter light and result in a dull, satin-like appearance. On the other hand, a glossy coating can be produced by shock-chilling the wax film either with cold water or by intimate contact with a cold roll. The rapid chilling induces formation of very small wax crystals which are less capable of scattering light, so that the film reflects light in a more mirror-like manner.

While rapid quenching of a wax film, e.g., on a continuous web of paper, is not difficult and is commonly practiced, rapid quenching of an irregular, semi-enclosed object such as a paper container, for example, a paper cup, is not quite so simple. The article can not be cooled by passing over a cold roll. It can be cooled by immersing in cold water but this creates problems such as completely removing the water together with any debris that might accumulate in the water, and accomplishing the chilling step quickly enough so that the coated products can be nested, boxed and removed from the production area. Rapid cooling can also be achieved by using a stream of refrigerated air. However, this method does not normally provide a fast enough shock-chill to give good gloss properties, and increasing the air velocity to a high value to maximize shock-chilling can cause unsightly patterns in the wax film. Thus, there is need for an improved, simple and effective method for producing glossy, uniform wax films on paper containers, such as paper cups and other articles normally waxed by the ambient cooling technique.

It has now been found unexpectedly that smooth, glossy wax coatings for paper products can be obtained using essentially ambient cooling temperatures rather than the shock-chilling technique if the coating contains a selected type of paraffinic wax blended with a very small amount of a solid polyethylene. The use of polyethylene as a gloss improver for petroleum wax films has long been known in the art. It is common practice for example to add about 0.5–5% polyethylene to a paraffinic wax or to a blend of paraffinic and microcrystalline waxes in order

to improve or alter several properties, including gloss and gloss stability. Actually, commercial polyethylenes in such cases usually have little or no beneficial effect on initial gloss, and may have a slight detrimental effect, but such addition often has a very pronounced and beneficial effect on gloss stability. However, this use of polyethylene applies only to films which are cooled by shock-chilling from the molten state. In fact, it is well known to the art that solid, commercially available polyethylenes, when added to petroleum wax normally cause a loss of gloss, i.e., a very flat or semi-flat finish, when the molten film is cooled without shock-chilling. Therefore, to be able to achieve high gloss in a slow, essentially ambient temperature cooled wax film is a very unexpected and surprising discovery.

One of the essential features in producing smooth, glossy, ambient temperature-cooled coatings of the present invention is the selection of the particular type of paraffinic wax which is blended with the polyethylene. The petroleum wax found to be effective is a relatively high melting wax with the properties shown below. It can be obtained by the conventional dewaxing of a very high boiling lube distillate made by vacuum distillation of Mid-Continent type crude oil. The slack wax so obtained can be solvent deoiled and further refined by hydrogenation or clay treating. The wax is characterized by these properties:

|                                           |               |
|-------------------------------------------|---------------|
| Melting point, ° F. (ASTM D87)-----       | 148-158       |
| Refractive index at 80° C. -----          | 1.4344-1.4384 |
| Viscosity, SSU/210° F. -----              | 44-52         |
| 10% distillation point, ° F. (atm.)-----  | 775-850       |
| 90% distillation point, ° F. (atm.) ----- | 975-1050      |

A further essential element of the present invention is the very small amount of polyethylene which is blended with the paraffin wax. The concentration of polyethylene can be varied from 0.005-0.055 or even 0.1% with lower molecular weight polyethylenes, based on the weight of the wax, preferably 0.02-0.05%. If the upper concentration limit of polyethylene is exceeded, there is a gloss reduction in the final product. By sizably exceeding this upper limit, coatings, although very smooth, become very dull. Thus by combining the features of blending a particular type of petroleum wax with a very small amount of polyethylene, a high gloss, smooth coating can be achieved by slow cooling at essentially ambient temperatures rather than the shock-chilling techniques heretofore discussed.

Additional advantages accrue using the compositions of the present invention as a coating for containers. For example, the viscosity of the melted mixture is not unduly high so there is no problem from slow drainage. Also, since the prescribed wax is relatively high-melting and hard, containers coated with this product are not prone to "block" or stick together, even in summer storage.

Although most conventional commercial grade, normally solid polyethylenes can be used in the present invention, the higher molecular weight solid polyethylenes with a softening point of about 215° F. or higher and an average molecular weight of about 12,000 or higher are especially useful. Polyethylenes of low softening point or low molecular weight are generally not as suitable, apparently because they do not have the degree of insolubility at draining temperatures and/or the proper crystal shape to nucleate the wax most effectively.

According to the process of the present invention, coated containers are prepared by contacting the containers with the molten petroleum wax and polyethylene as defined above, generally maintained at a temperature of about 165-200° F. and allowing the coated product to cool at ambient temperatures. Suitable coatings are formed when using wax-polyethylene mixtures at temperatures of about 180° F., for instance, by a 5 second dip or by spraying and then draining in an oven, e.g., at about 180° F. for about 30 seconds. Table I below illustrates results obtained using the prescribed type paraffin wax with vari-

ous concentrations of several grades of polyethylene additives. From this table it can be seen that the low molecular weight polyethylene provides a definite but rather limited over-all improvement in gloss and smoothness. Higher molecular weight polyethylene is much more effective in producing these desired properties.

TABLE I.—BLENDS OF PETROLEUM WAX (154° F. MELT ING POINT) WITH VARIOUS TYPES OF POLYETHYLENE

| Polyethylene Type | Mol. Wt. | Wt. Percent Conc. | Gloss † | Smoothness † |
|-------------------|----------|-------------------|---------|--------------|
| None              |          |                   | 4       | 3            |
| Low Density ‡     | 2,000    | 0.03              | 4       | 5            |
| Do                | 2,000    | 0.05              | 4       | 7            |
| Do                | 2,000    | 0.1               | 5       | 6            |
| Do                | 2,000    | 0.2               | 1       | 7            |
| Do                | 12,000   | 0.1               | 7       | 6            |
| Do                | 18,000   | 0.05              | 7       | 6            |
| Do                | 18,000   | 0.1               | 4       | 7            |
| Do                | 18,000   | 0.2               | 2       | 7            |
| Do                | 21,000   | 0.03              | 7       | 7            |
| Do                | 23,000   | 0.05              | 7       | 7            |
| Do                | 23,000   | 0.1               | 3       | 6            |
| Do                | 23,000   | 0.2               | 2       | 7            |
| High Density §    | 100,000+ | 0.01              | 8       | 7            |
| Do                | 100,000+ | 0.05              | 8       | 7            |

† Visual ratings of film gloss and smoothness on 0-8 scale with 8 = maximum gloss and smoothness.

‡ Polyethylene with a density of about 0.91 to 0.93.

§ Polyethylene with a density of about 0.94 to 0.97.

Table II illustrates the use of three waxes other than the type prescribed for this invention. Although the additive concentrations are in or near the preferred range, both good gloss and film smoothness cannot be obtained. When one of these properties is obtained the other is not.

TABLE II.—BLENDS OF POLYETHYLENE WITH PETROLEUM WAXES B, C AND D †

| Wax | Polyethylene Type | Mol. Wt. | Wt. Percent | Gloss | Smoothness |
|-----|-------------------|----------|-------------|-------|------------|
| B   | None              |          |             | 5     | 5          |
| B   | Low Density       | 23,000   | 0.01        | 8     | 2          |
| B   | do                | 23,000   | 0.05        | 8     | 3          |
| B   | High Density      | 100,000+ | 0.05        | 8     | 2          |
| C   | None              |          |             | 2     | 4          |
| C   | High Density      | 100,000+ | 0.01        | 0     | 7          |
| C   | do                | 100,000+ | 0.05        | 0     | 7          |
| D   | None              |          |             | 3     | 3          |
| D   | Low Density       | 2,000    | 0.03        | 4     | 3          |
| D   | do                | 21,000   | 0.03        | 5     | 3          |

† Wax B is a 141° M.P. sweated paraffin wax; Wax C is a 142° M.P. broad-range paraffin wax; Wax D is a 143° M.P. solvent deoiled paraffin wax.

It is claimed:

1. A wax coating composition of high gloss and smoothness consisting essentially of a blend of petroleum paraffinic wax having a melting point of 148-158° F., a viscosity SSU at 210° F. of 44-52, a refractive index at 80° C. of 1.4344-1.4384, a 10% distillation point of about 775-850° F., and a 90% distillation point of about 975-1050° F., and 0.005-0.1% based on the weight of the wax, of a normally solid polyethylene.

2. The composition of claim 1 wherein the normally solid polyethylene has a softening point of at least about 215° F. and an average molecular weight of at least about 12,000.

3. The composition of claim 2 wherein the normally solid polyethylene is present in an amount of 0.02-0.05% based on the weight of the wax.

4. A cellulosic article coated with the wax composition of claim 1.

5. A cellulosic article coated with the wax composition of claim 2.

6. A wax coating composition of high gloss and smoothness consisting essentially of a blend of petroleum paraffinic wax having a melting point of 148-158° F., a viscosity SSU at 210° F. of 44-52, a refractive index at 80° C. of 1.4344-1.4384, a 10% distillation point of about 775-850° F., and a 90% distillation point of about 975-1050° F., and 0.005 to 0.055% based on the weight of the wax, of a normally solid polyethylene having a softening point of at least about 215° F. and an average molecular weight of at least about 12,000.

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7. A cellulosic article coated with the wax composition of claim 6.

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