ABSTRACT: Vapor permeable films for packaging having low, medium or high controlled breathing rates for gases and vapors are prepared by blending latex emulsions having minimum film formation temperatures no less than about 50°C with latex emulsions having minimum formation temperatures no greater than about 25°C in polymer component ratios selected for controlling the degree of breathing or porosity to within a predetermined range, and coating the mixture on a fibrous sheet material with subsequent drying at room temperature or accelerated drying at elevated temperatures.
PERMEABLE CLOSURE LINER

FIELD OF THE INVENTION

This invention relates to aqueous coating compositions adapted to produce in an improved manner liquid resistant liners for controlled vapor venting of closure caps.

DESCRIPTION OF THE ART

The need for improved, more economical coating compositions for closure liners adapted to release excess pressure or equalize pressure through controlled vapor venting or breathing in sealed containers is currently recognized for packaging applications. The problems associated with improper container venting or breathing are prevalent with synthetic resin or plastic-type containers wherein the liquids exhibit fluctuations in vapor pressure during packaging operations, transit and storage. However, glass and metal containers, which are less prone to structural deformation, cannot be excluded since the shattering of glass or rupturing of metal from excessive pressure constitutes a consumer hazard.

Nevertheless, plastic containers with insufficient breathing through essentially vapor barrier lines will flex considerably from the pressure, structurally distort and cause liquid to be forced upward and through the container rim. If the vapor barrier liner is also liquid-proof, the pressure buildup will be rapidly released when opened and thus presents a consumer hazard. In other instances, the container may develop negative pressure, such that the structure collapses inward, decreases capacity with the result that liquid is forced out of the container. If the liner is also a liquid barrier then the distorted container has poor aesthetic appeal or the consumer may think that the product is inferior. Excessive vapor venting or breathing fails to seal container contents from evaporation, spoilage, incoming moisture and escaping odors. Also these liners would be more prone to liquid penetration and flow out of the container because of the greater porosity associated with high breathing rate liners. Thus, containers must be adequately vented and liners are required to provide controlled breathing to satisfy a diversity of packaging applications which could range from household to commercial consumables.

Vapor permeable, vapor venting as well as vapor barrier compositions and materials are known in the art. The art describes a variety of natural and synthetic latex compositions, polymeric compositions, latex and or polymeric compositions as self-supported films or in combination with substrates, fibrous backing layers which swell to form compressible structures, and materials with substrates having apertures therein. These compositions or methods, however, are specific and provide a limited selection of materials which exhibit widely separated breathing ranges from barrier to high breathing. Other materials employ organic solvent systems requiring special drying precautions or use multistep methods of preparation, formulation and manufacture.

The present invention provides improved container closure liner materials which are vapor venting and nonleaking. These are useful for packing a wide variety of materials including in particular aqueous based liquids such as detergents and cosmetics and also organic substances such as motor oil.

The liner materials of this invention are formed of a porous base, such as cardboard or paste board, and a surface coating formed from a controlled organic-laqueous latex emulsion compounded to produce a porosity within the range of 0.5 to 25 cc./min. (Measured as cc./min. of nitrogen applied under a pressure of 20 p.s.i.g over a sample area of 4 sq. cm.).

Controlled breathing rates are obtained by blending preselected latex emulsions which have specific ranges and specific separate in minimum film formation temperature (MFT) characteristics. Hard polymer, nonfilm-forming emulsion particles having an MFT greater than about 50°C and soft polymer, film forming, emulsion particles having an MFT less than about 25°C can be prepared by conventional polymerization procedures. These latex emulsions are blended in ratios of high MFT to low MFT to produce the porosity required. The porosity is proportional to the quantity of high MFT polymer present and is also influenced by the MFT separation of the hard and soft polymer components. This latex blend is coated on smooth surface paper support which may include as an integral part, a kraft or oil resistant paper backing for liner backer control. Preferably however backer is prevented by applying a backcoat of the same or a similar latex coating to the back side of the liner. Subsequent drying at room temperature or accelerated heat drying yields a liner material.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of a cross section through a closure liner material of this invention;

FIG. 2 is a cross-sectional view of a closure illustrating the relationship of the liner to the container; and

FIG. 3 is a schematic representation in side elevation showing the manufacture of the liner of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

To accomplish the foregoing objects in accordance with the present invention, improved coating compositions adapted to produce controlled gas and vapor-venting, liquid resistant liner materials comprises blending from 30—80 percent of an aqueous dispersion of polymer or copolymer containing from about 30—65 percent by weight said polymer or copolymer which has an MFT value greater than 50°C and from about 70—20 percent of an aqueous dispersion of polymer or copolymer containing from about 30—65 percent by weight said polymer or copolymer which has an MFT value less than about 25°C; and coating the surface of a paper, pasteboard or like support base with the blended latex emulsion; and drying at room temperature or accelerated drying at elevated temperatures.

The preferred latex emulsion containing hard polymer particles and being nonfilm-forming, with an MFT greater than 50°C is an aqueous emulsion of polymethylmethacrylate having a solids content of 38 percent by weight, specifically Rohm & Haas Rhoplex B-85. Other satisfactory equivalent polymeric emulsions include Dow Latex 870 (believed to be polyvinyl chloride) Dow Latex 874 (believed to be a copolymer of vinylidene chloride and vinyl chloride) Dow Latex 860 (believed to be polystyrene) B. F. Goodrich Geo Latex 352 (believed to be vinyl chloride copolymer) and B. F. Goodrich Geo Latex 151 (believed to be a vinyl chloride homopolymer).

The preferred latex emulsion containing a soft polymer particle, the film forming constituent and having a MFT less than 25°C is an aqueous emulsion of a 35—65 copolymer of methyImethacrylate and ethylacrylate, specifically Rohm & Haas Rhoplex AC—34. Other satisfactory equivalent emulsions include Union Carbide Vcar WC-130 (believed to be a vinylacetate polymer), Grace Everflex E (believed to be a methyImethacrylate ethylacrylate copolymer) Rohm & Haas Rhoplex WN-80 (believed to be a polyvinyl acetate-acrylic ester copolymer) Rohm & Haas Rhoplex E-32 (believed to be an ethyl hexyl acrylate acrylamide copolymer).

EXAMPLE I

The preferred products made according to this invention, illustrated in FIG. 1, consists of a pasteboard support 10, 12 of the type commonly employed as shirt cardboards, and designated specifically as .022 inch thick 180° bending special white lined chip news back, (Diamond National Corporation) being a body of pasteboard 10 with a smooth paper facing layer 12. A kraft paper backing 14 may be adhered to the back side of the support and with it makes up the base 11, and the facing side carries the polymeric coating 16. Alternatively and preferably the backing 14 is a back coating of the polymer, in which case the backing 14 and coating 16 are the same.
The method of manufacture is illustrated in FIG. 3 and preferably consists in feeding the support 10, 12 through a reverse-roll coater 20, in the nip of which is a supply 22 of the latex emulsion mixture. The base is fed through the coater and then underneath an array of radiant heaters 24 which are adjusted to provide a surface temperature under steady conditions of from 70°F. to 700°F., progressively increasing as the liner material dries.

In the preferred embodiment the latex consists of 60 parts by weight of the polymethylmethacrylate copolymer emulsion having 38 percent solids and an MFT of over 90°C, and 40 parts by weight of the 35-65 methylmethacrylate-ethylacrylate copolymer emulsion having a solids content of 46 percent by weight and an MFT of about 12°C. This is applied to a coating weight of about 14.2 pounds of solids per 3 square feet, and at a linear rate of 42 feet/min.

In the preferred embodiment, after the coating 16 has been applied to the facing side, the support 10, 12 is turned over and again passed through the coater and dried to apply the backing coating 14.

After the latex emulsion has been dried, closure liners are cut out of the coated stock and may be placed in a container closure in the usual manner as illustrated in FIG. 2 wherein the closure liner 30 is shown covering the mouth of a jar 32 and held in place by a screw cap 34 of conventional design.

The foregoing example describes a material which has been found to be adequately suited for the packaging of motor oil, in that it permits breathing of the contents without leakage.

It is a criterion of the liner material of this invention that it possesses a permeability of between 0.5 and 25 cubic centimeters per minute, as measured above. This condition is attained by blending the high MFT and low MFT polymeric emulsion latices following the principles that the permeability will be increased as the proportion of high MFT latex is increased. The drying temperature may also be varied to alter the permeability within certain amounts on the basis that the higher the drying temperature the lower the permeability. The manner in which varying the proportion of high to low MFT emulsions will cause the permeability to vary is shown by the following examples.

**EXAMPLE II**

Blended latices were prepared as described in Example I. The concentration ratios of the high MFT and low MFT respectively were varied in order to show the wide controlled breathing ranges according to this invention, and these were applied to a pasteboard backing at a coating weight of about 28 lbs./300 sq. ft. The properties of these liner materials are set forth in the following table:

<table>
<thead>
<tr>
<th>Latex Blend (high/low MFT):</th>
<th>Breathing rate range</th>
</tr>
</thead>
<tbody>
<tr>
<td>62/38</td>
<td>0.00-4.10</td>
</tr>
<tr>
<td>63/37</td>
<td>0.50-9.8</td>
</tr>
<tr>
<td>60/40</td>
<td>11.0-140.0</td>
</tr>
<tr>
<td>65/35</td>
<td>150.0-300.0</td>
</tr>
</tbody>
</table>

**TABLE I**

The manner in which varying the drying temperature will cause the breathing rate or permeability to vary is shown by the following Example.

**EXAMPLE IV**

Blended latex coatings were prepared according to the procedure described in Example I. The drying temperature was varied from 25°C. to 80°C in order to show the effects of accelerated drying at elevated temperatures upon the breathing rate of liner materials. These data are given in the following table:

| Breathing rate (cc/min. at 20 p.s.i.) at indicated drying temperatures |
|-----------------------------|----------------------|
| Chip Center                 | 25°C. | 40°C. | 65°C. | 80°C. |
| Rate                        | Rate | Rate | Rate | Rate |
| 0.0-8.0                     | 0.00-2.0 | 0.00-1.0 | 0.0-0.1 |

The minimum film-formation temperatures (MFT) of various polymeric latices are generally given by the supplier in general they may be taken as that characteristic which establishes the minimum drying temperature at which the polymeric material forms an integral film.

MFT values between 60°C. to 160°C. can be determined by visual observation through a microscope focused on a polymer coating deposited upon the surface of a variable temperature stage of the microscope. Another method consists of using a 15-inch long Parr bar constructed of brass having a heating means at one end and a cooling means at the other. The latex is cast upon the bar and the temperature at the various parts along the bar is continuously determined by means of thermocouples. For more details regarding MFT testing see "Journal of Applied Polymer Science," Vol. 4, pp. 81-85.

Although this invention has been described with specific reference to a particular paste board numerous other comparable porous support materials may be employed such as pulpboard, book paper, kraft, bond, wrapping paper, paperboard, cardboard, chipboard and the like. It is preferable that the surface be smooth in order that the ultimate film deposited from the mixture of latices be of relatively uniform thickness.

Coating techniques useful in the present invention include brushing, spraying, dipping, roller-coating, air-doctoring, reverse-roll and the like. Reverse-roll is the preferred method because of the simplicity of achieving uniform film thickness with minimal viscosity adjustments, changes and replenishers. Speed of this method for this invention lends well to economical operation.
The foregoing description, examples and preferred embodiments set forth representative methods for practicing this invention. It is contemplated, however, that modifications and equivalents will readily occur to those skilled in the art and familiar with this disclosure, and that such may be made or substituted without departing from the scope of this invention.

Having thus disclosed my invention and described in detail preferred embodiments thereof I claim and desire to secure by Letters Patent:

I claim:

1. A vapor-venting liquid-retaining container liner comprising a porous pasteboard backing having a surface coating of a dried polymeric emulsion latex comprising a blend of polymethylmethacrylate latex and a latex of a copolymer of 35 parts by weight of methylmethacrylate and 65 parts by weight of ethylacrylate, said latices being proportioned to provide a breathing rate of between 0.5 and 25 cc./min. as measured by nitrogen under a pressure of 20 p.s.i. over an area of 4 sq. cm.

2. The container closure liner as defined by claim 1 in combination with a closure cap, wherein the closure liner is positioned in the cap to cover the mouth of a container.