embodiment, the plasticizer is a novel triblend comprising from about 10 wt. % to about 90 wt.% DEGDB, from about 1 wt. % to about 50 wt.% DPGDB and from about 10 wt. % to about 90 wt. % PGDB, based upon the total weight of the blend.

[0031] The above-identified plasticizers/coalescents are compatible with each other and with various polymers used in paints and coatings, such as, for example, polyvinyl chloride and copolymers thereof, various polyurethanes and copolymers thereof; various polysulfides, various polyacrylates and copolymers thereof, various polysulfides and copolymers thereof, various epoxies and copolymers thereof, and vinyl acetate and copolymers thereof. In particular, the novel triblend of the invention is particularly compatible with latex and other polymeric emulsions used in the paint and coatings industry.

[0032] The inventive plasticizer/coalescent dibenzoate triblend has low volatility and compares favorably to the industry standard film forming aid, TXMB, and a current non-dibenzoate low VOC coalescent tri(ethylene glycol) bis-(2-ethylhexanoate) (TEGDO). In particular, the inventive dibenzoate triblend delivers equivalent and in some cases better performance benefits in gloss and scrub resistance as compared to some of the current standard and low VOC coalescent alternatives, including traditional dibenzoate blends. The inventive triblend particularly shows significant benefit in use in the more discerning acrylic copolymer gloss system, where it provides superior advantages to both scrub and block resistance. The inventive formulations provide an alternative to paint and coatings formulators to improve on the current landscape of low VOC coalescents, including traditional dibenzoate coalescents. They also provide options to use harder polymers (Tg > 10° C) in paints and coatings. The inventive triblend can also be used with softer polymers designed for low VOC coatings, as it will help the coating to form a better film.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] FIG. 1 is a chart reflecting volatility of both non-dibenzoate and dibenzoate plasticizers and coalescents.

[0034] FIG. 2 is a chart reflecting viscosity stability of acrylic flat paint after three freeze/thaw cycles for various low VOC coalescents.

used in combination with the novel triblend to prepare a low VOC content paint or coating in accordance with the present invention.

[0047] Useful polymers include but are not limited to various latex and vinyl polymers including vinyl acetate, vinylidene chloride, diethyl fumarate, diethyl maleate, or polyvinyl butyral; various polyurethanes and copolymers thereof; various polysulfides; cellulose nitrate; polyvinyl acetate, ethylene vinyl acetate, and copolymers thereof; and various polyacrylates and copolymers thereof.

[0048] The acrylates in particular constitute a large group of polymers of varying hardness for use with the triblend of the present invention and include without limitation various polyalkyl methacrylates, such as methyl methacrylate, ethyl methacrylate, butyl methacrylate, cyclohexyl methacrylate, or allyl methacrylate; various aromatic methacrylates, such as benzyl methacrylate; various alkyl acrylates, such as methyl acrylate, ethyl acrylate, butyl acrylate, or 2-ethylhexyl acrylate; various acrylic acids, such as methacrylic acid; vinyl acrylics; styrenated acrylics, and acrylic-epoxy hybrids.

[0049] Other polymers include without limitation epoxies, phenol-formaldehyde types; melamines; and the like.

[0050] The invention is not limited to any particular polymer. Other polymers useful in paint and coating applications will be known to one skilled in the art.

[0051] The present invention is described herein in terms of latex or other emulsions, such as acrylics, but has utility with a wide variety of polymers.

[0052] The preferred dibenzoates comprising the inventive plasticizer/coalescent triblend include DEGDB, DPGDB, and 1,2-propylene glycol dibenzoate (PGDB).

[0053] The amounts of the individual dibenzoates in the inventive triblend can vary broadly depending on the particular end use and properties desired. Thus, the amount of DEGDB can vary from about 10% to about 90% by weight based upon the total weight of the dibenzoate triblend composition, preferably greater than about 60% by weight. Higher amounts of DEGDB than either of the other two plasticizers are preferred due to cost considerations. DEGDB is far less expensive than PGDB and DEGDB. The amount of DPGDB can generally vary from about 1% to 50% by weight based upon the total weight of the triblend, preferably greater than about 15%. The amount of PGDB can vary broadly such as from 10% to about 90% by weight based

Table 4. Coalescent Abbreviations

Abbreviation	*Coalescent Name*	*Coalescent Manufacturer*
TXMB	2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate	Several
KF850S	K-FLEX® 850S – Blend of dipropylene glycol dibenzoate and diethylene glycol dibenzoate	Emerald Kalama Chemical
LA705	BENZOFLEX® LA-705 – Competitive blend of dipropylene glycol dibenzoate and diethylene glycol dibenzoate	Several commercial manufacturers
KF500	K-FLEX® 500 – 50:50 blend of dipropylene glycol dibenzoate and diethylene glycol dibenzoate	Emerald Kalama Chemical
X10	Inventive triblend of dibenzoates (Different ratio than X20)	Emerald Kalama Chemical
X20	Inventive triblend of dibenzoates (4:1 DEGDB/DPGDB 80%, PDGD 20%)	Emerald Kalama Chemical
TEGDO	Triethylene glycol di-2-ethylhexanoate	Several commercial manufacturers

[0070] TXMB, 2,2,4–trimethyl–1,3–pentanediol monoisobutyrate, is a very widely used product that is a standard in the industry, despite the fact that it is deemed 100% volatile by the EPA 24 ASTM D-2369 test method.

[0071] Triethylene glycol di-2-ethylhexanoate (TEGDO) is a commercial low VOC coalescent (CLVOC), which is a newer, lower VOC non-dibenzoate coalescent used as the primary control.

[0072] Both K-FLEX 850S and BENZOFLEX LA-705 are newer, commercially available blends of two dibenzoates; K-FLEX 500 is an older, traditional blend of two dibenzoate esters.

[0073] The inventive formulations include X10 and X20, which are blends of three dibenzoate esters pursuant to the present invention, differing only in the ratios of esters used.

[0074] Methods:

[0075] Paint Preparation

[0076] Raw materials for the grind were mixed for 20 minutes in a high speed disperser. Resin was then added, and the master batch was divided into smaller batches. To each small batch was added coalescent, defoamer and additional water.

WHAT IS CLAIMED IS:

1. A low VOC coalescent triblend additive for use in a polymeric coating composition, comprising:
   a. diethylene glycol dibenzoate present in amounts ranging from about 10 to about 90 wt.%,
   b. dipropylene glycol dibenzoate present in amounts ranging from about 1 to about 50 wt.%, and
   c. 1, 2- dipropylene glycol dibenzoate present in amounts ranging from about 10 to about 90 wt.%,
   based upon the total weight of the triblend composition.
2. The triblend additive of claim 1,
   wherein the diethylene glycol dibenzoate is present in amounts of at least about 60 wt.%,
   wherein the dipropylene glycol dibenzoate is present in amounts of at least about 5 wt.%, and
   wherein the 1, 2-propylene glycol dibenzoate is present in amounts of at least about 20 wt.%.

3. The triblend additive of claim 1, wherein the blend comprises 80 wt.% of a mixture of diethylene glycol dibenzoate and dipropylene glycol dibenzoate, wherein the ratio of DEGDB to DPGDB is about 4:1, and 20 wt. % of 1,2-propylene glycol dibenzoate, based upon the total weight of the plasticizer triblend.

4. A low VOC coating composition, comprising:
   a. an aqueous polymeric emulsion; and
   b. a non-phthalate, low VOC coalescent comprising a triblend of diethylene glycol dibenzoate, dipropylene glycol dibenzoate, and 1,2-propylene glycol dibenzoate,

wherein the coalescent has low volatility and achieves equivalent or better wet edge/open time and gloss ratings, equivalent or better scrub resistance and block resistance over traditional low VOC coalescents, and
wherein the viscosity of the coating composition remains stable after three freeze/thaw cycles.

5. The low VOC coating composition of claim 4,
wherein the diethylene glycol dibenzoate is present in an amount ranging from about 10 wt. % to about 90 wt. %;
wherein the dipropylene glycol dibenzoate is present in an amount ranging from about 1 wt. % to about 50 wt. %; and
wherein the 1,2-propylene glycol dibenzoate is present in an amount ranging from about 10 wt. % to about 90 wt. %,
based upon the total weight of the triblend.

6. The low VOC coating composition of claim 5,
wherein the diethylene glycol dibenzoate is present in an amount greater than about 60 wt.%;
wherein the dipropylene glycol dibenzoate is present in an amount greater than about 15 wt.%; and
wherein the 1,2-propylene glycol dibenzoate is present in an amount greater than about 20 wt.%,
based upon the total weight of the triblend.

7. The low VOC coating composition of claim 4,
wherein the polymeric emulsion is a latex, vinyl acrylic, acrylic semigloss or an acrylic copolymer gloss emulsion.

8. The low VOC coating composition of claim 4,
wherein the aqueous polymeric emulsion comprises vinyl acetate, polyvinyl acetate, ethylene vinyl acetate, and copolymers thereof; vinylidene chloride;

diethyl fumarate; diethyl maleate; polyvinyl butyral; polyurethanes and copolymers thereof; polysulfides; cellulose nitrate; polyalkyl methacrylates, such as methyl methacrylate, ethyl methacrylate, butyl methacrylate, cyclohexyl methacrylate, or allyl methacrylate; various aromatic methacrylates, such as benzyl methacrylate; various alkyl acrylates, such as methyl acrylate, ethyl acrylate, butyl acrylate, or 2-ethylhexyl acrylate; various acrylic acids, such as methacrylic acid; vinyl acrylics; styrenated acrylics; acrylic-epoxy hybrids; epoxies, phenol formaldehyde polymers; melamines; or mixtures thereof.

9. A low VOC coating composition, comprising:

a. a polymeric emulsion comprising latex, a vinyl acrylic or an acrylic copolymer; and
b. a non-phthalate coalescent triblend comprising:
   i. 80 wt.% of a mixture of diethylene glycol dibenzoate and dipropylene glycol dibenzoate, wherein the ratio of DEGDB to DPGDB is about 4:1; and
   ii. 20 wt. % of 1,2-propylene glycol dibenzoate,

based upon the total weight of the triblend.

embodiment, the plasticizer is a novel triblend comprising from about 10 wt. % to about 90 wt.% DEGDB, from about 1 wt. % to about 50 wt.% DPGDB and from about 10 wt. % to about 90 wt. % PGDB, based upon the total weight of the blend.

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[0033] FIG. 1 is a chart reflecting volatility of both non-dibenzoate and dibenzoate plasticizers and coalescents.

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[0053] The amounts of the individual dibenzoates in the inventive triblend can vary broadly depending on the particular end use and properties desired. Thus, the amount of DEGDB can vary from about 10% to about 90% by weight based upon the total weight of the dibenzoate triblend composition, preferably greater than about 60% by weight. Higher amounts of DEGDB than either of the other two plasticizers are preferred due to cost considerations. DEGDB is far less expensive than PGDB and DPGDB. The amount of DPGDB can generally vary from about 1% to 50% by weight based upon the total weight of the triblend, preferably greater than about 15%. The amount of PGDB can vary broadly such as from 10% to about 90% by weight based

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[0073] The inventive formulations include X10 and X20, which are blends of three dibenzoate esters pursuant to the present invention, differing only in the ratios of esters used.

[0074] Methods:

[0075] Paint Preparation

[0076] Raw materials for the grind were mixed for 20 minutes in a high speed disperser. Resin was then added, and the master batch was divided into smaller batches. To each small batch was added coalescent, defoamer and additional water.

Claims

1. A low VOC coalescent triblend additive for use in a polymeric coating composition, comprising:
   a. diethylene glycol dibenzoate present in amounts of at least about 60 wt.%,
   b. dipropylene glycol dibenzoate present in amounts of at least about 15 wt.%, and
   c. 1, 2- propylene glycol dibenzoate present in amounts of at least about 20 wt.%

   based upon the total weight of the triblend composition.

2. The triblend addictive of claim 1, wherein the triblend comprises 80 wt. % of a mixture of diethylene glycol dibenzoate and dipropylene glycol dibenzoate, wherein the ratio of DEGDB to DPGDB is about 4:1, and 20 wt. % of 1,2-propylene glycol dibenzoate, based upon the total weight of the plasticizer triblend.

3. A low VOC coating composition, comprising:

a. an aqueous polymeric emulsion; and

b. a non-phthalate, low VOC coalescent comprising a triblend of diethylene glycol dibenzoate present in amounts of at least 60wt.%, dipropylene glycol dibenzoate present in amounts of at least 15 wt. %, and 1,2-propylene glycol dibenzoate present in amounts of at least 20 wt.%,
   wherein the coalescent has low volatility and achieves equivalent or better wet edge/open time and gloss ratings, equivalent or better scrub resistance and block resistance over traditional low VOC coalescents, and
   wherein the viscosity of the coating composition remains stable after three freeze/thaw cycles.

4. The low VOC coating composition of claim 3,
   wherein the polymeric emulsion is a latex, vinyl acrylic, acrylic semigloss or an acrylic copolymer gloss emulsion.

5. The low VOC coating composition of claim 3,
   wherein the aqueous polymeric emulsion comprises vinyl acetate, polyvinyl acetate, ethylene vinyl acetate, and copolymers thereof; vinylidene chloride; diethyl fumarate; diethyl maleate; polyvinyl butyral; polyurethanes and copolymers thereof; polysulfides; cellulose nitrate; polyalkyl methacrylates, such as methyl methacrylate, ethyl methacrylate , butyl methacrylate, cyclohexyl methacrylate, or allyl methacrylate; various aromatic methacrylates, such as benzyl methacrylate; various alkyl acrylates, such as methyl acrylate, ethyl acrylate, butyl acrylate, or 2-ethylhexyl acrylate; various acrylic acids, such as methacrylic aid; vinyl acrylics; stryrenated acrylics; acrylic-epoxy hybrids; epoxies, phenol-formaldehyde polymers; melamines; or mixtures thereof.

6. A low VOC coating composition, comprising:
   a. a polymeric emulsion comprising latex, a vinyl acrylic or an acrylic copolymer; and
   b. a non-phthalate coalescent triblend comprising;
      i. 80 wt.% of a mixture of diethylene glycol dibenzoate and dipropylene glycol dibenzoate, wherein of the ratio of DEGDB to DPGDB is about 4;1; and
      ii. 20 wt. % of 1,2-propylene glycol dibenzoate,
      based upon the total weight of the triblend.