CLAIMS

1. A low VOC multifunctional additive blend for use in a polymer film-forming composition, comprising:

a. at least one low volatile component ~~comprising~~ selected from a dibenzoate, a dibenzoate blend, a monobenzoate ester, a phthalate, a terephthalate, a 1,2-cyclohexane dicarboxylate ester, a citrate, an adipate, triethylene glycol dioctanoate, triethylene glycol bis(ethylhexanoate-2), or a mixture of refined diisobutyl esters of adipic acid, glutaric acid, and succinic acid, blended with;

b. at least one high volatile component ~~comprising~~ selected from diethylene glycol monomethyl ether, ethylene glycol monobutyl ether, diethylene glycol monobutyl ether, ~~2,2,4-trimethyl-1,3-pentanediol monoisobutyrate,~~ benzylamine, phenoxyethanol, phenyl ethanol, benzyl alcohol, ~~benzyl benzoate, butyl benzoate,~~ 3-phenyl propanol, 2-methyl-3-phenyl propanol, β-methylcinnamyl alcohol, or vanillin,

wherein the multifunctional additive blend does not include a blend of 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate ~~with triethylene glycol bis(ethylhexanoate-2) or a blend of 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate with triethylene glycol dioctanoate~~,

wherein the at least one low volatile component is blended with the at least one high volatile component prior to use in the polymer film forming composition.

2. The multifunctional additive blend according to claim 1, wherein the dibenzoate ~~comprises~~ is selected from diethylene glycol dibenzoate, dipropylene glycol dibenzoate, 1,2-propylene glycol dibenzoate, triethylene glycol dibenzoate, tripropylene glycol dibenzoate or mixtures thereof, wherein the monobenzoate ~~comprises~~ is selected from 2-ethylhexyl benzoate, isodecyl benzoate, isononyl benzoate, 3-phenyl propyl benzoate, 2-methyl-3-phenyl propyl benzoate, or mixtures thereof, wherein the terephthalate ~~comprises~~ is selected from di-2-ethylhexyl terephthalate, dibutyl terephthalate or

diisopentyl terephthalate, or mixtures thereof, wherein the 1,2-cyclohexane dicarboxylate ester is diisononyl-1, 2 cyclohexane dicarboxylate, wherein the phthalate ~~comprises~~ is selected from di-n-butyl phthalate, diisobutyl phthalate, or butyl benzyl phthalate, or mixtures thereof, and wherein the citrate comprises acetyl tributyl citrate or tri-n-butyl citrate, or mixtures thereof.

~~3. The multifunctional additive blend according to claim 1, wherein the low volatile component is a dibenzoate and the high volatile component is 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate.~~

~~4~~3. The multifunctional additive blend according to claim 1, wherein the low volatile component is a dibenzoate or a dibenzoate blend and the high volatile component is benzyl alcohol.

~~5~~4. The multifunctional additive ~~-~~blend according to claim 1, wherein the low volatile component is triethylene glycol dioctanoate or triethylene glycol bis(ethylhexanoate-2) and the high volatile component is benzyl alcohol.

~~6~~5. The multifunctional additive blend according to claim 1, wherein the low volatile component is a dibenzoate or a dibenzoate blend and the high volatile component is 3-phenylpropanol.

~~7. The multifunctional additive blend according to claim 1, wherein the low volatile component is a dibenzoate and the high volatile component is benzyl benzoate.~~

~~8~~6. The multifunctional additive blend according to claim 1, wherein the low volatile component is a dibenzoate or a dibenzoate blend and the high volatile component is 2-methyl-3-phenyl propanol.

~~9~~7. A waterborne coating comprising the multifunctional additive blend according to any one of claims 1-~~8~~6.

~~10~~8. The waterborne coating according to claim ~~9~~7, comprising a styrene-acrylic binder, a vinyl acrylic binder, a 100% acrylic binder, a vinyl acetate ethylene binder or an alkyd based binder ~~and the multifunctional additive blend according to claim 1~~.

~~11~~9. The waterborne coating according to claim ~~9~~7, further comprising:

a. a binder,

~~b. the multifunctional additive blend according to any one of claims 1-8,~~

~~c~~b. a pigment,

~~d~~c. a surfactant, and

~~e~~d. a rheology modifier,

wherein the multifunctional additive blend is present in about 0.1 to 15 wt.% to binder, based on 100 grams of binder.

~~12~~10. A method of improving the antimicrobial properties of a waterborne coating, comprising the step of adding to the waterborne coating an additive preblend of:

a. at least one low volatile component ~~comprising~~ selected from a dibenzoate, a dibenzoate blend, a monobenzoate ester, a phthalate, a terephthalate, a 1,2-cyclohexane dicarboxylate ester, a citrate, an adipate, triethylene glycol dioctanoate, triethylene glycol bis(ethylhexanoate-2), or a mixture of refined diisobutyl esters of adipic acid, glutaric acid, and succinic acid, and

b. a high volatile component ~~comprising~~ selected from diethylene glycol monomethyl ether, ethylene glycol monobutyl ether, diethylene glycol monobutyl ether, ~~2,2,4-trimethyl-1,3-pentanediol monoisobutyrate,~~ benzylamine, phenoxyethanol, phenyl ethanol, benzyl alcohol, ~~benzyl benzoate, butyl benzoate,~~ 3-phenyl propanol, 2-methyl-3-phenyl propanol, or vanillin.

~~13~~11. The waterborne coating according to claim ~~9~~7, comprising:

~~a.~~ a binder comprising a polymer or resin chosen from vinyl polymers, polyurethanes, polyamides, polysulfides, nitrocellulose and other cellulosic polymers, polyvinyl acetate and copolymers thereof, polyacrylates and copolymers thereof, acrylics and copolymers thereof, epoxies, phenol-formaldehyde polymers, melamines, alkyds and vinyl esters of versatic acid~~; and~~

~~b. the multifunctional additive blend according to any one of claims 1-8~~,

wherein the multifunctional additive blend is present in about 0.1 to 15% to binder, based on 100 grams of binder.

~~14~~12. The waterborne coating according to claim ~~13~~ 11 wherein the vinyl polymers comprise vinyl acetate, vinylidene chloride, diethyl fumarate, diethyl maleate, or polyvinyl butyral; wherein the polyvinyl acetate and copolymers thereof comprise ethylene vinyl acetate or vinyl acetate-ethylene; wherein the polyacrylates and copolymers thereof comprise methyl methacrylate, ethyl methacrylate, butyl methacrylate, cyclohexyl methacrylate, allyl methacrylate, benzyl methacrylate, methyl acrylate, ethyl acrylate, butyl acrylate, or 2-ethylhexyl acrylate, wherein the acrylics and copolymers thereof comprise 100% acrylic acid, methacrylic acid, vinyl acrylics, styrenated acrylics, and acrylic-epoxy hybrids.

~~15~~13. The waterborne coating according to claim ~~9~~7, wherein the waterborne coating is a direct-to-metal coating.

~~16~~14. The waterborne coating according to claim ~~15~~13, wherein the high volatile component of the multifunctional additive blend is benzyl alcohol and the low volatile component is a dibenzoate.

~~17~~15. The waterborne coating according to claim ~~16~~14, wherein the dibenzoate is propylene glycol dibenzoate.

~~18~~16. The waterborne coating according to any one of claims ~~15~~13-~~17~~15, further comprising sodium benzoate.

~~19~~17. The waterborne coating according to any one of claims ~~15~~13-~~17~~15, further comprising benzoic acid.

~~20~~18. A method to incorporate benzoic acid into a waterborne coating of any of claims 13-17, wherein the low VOC component comprises a dibenzoate or a dibenzoate blend, comprising the step of synthesizing at least one dibenzoate with a percent molar excess of benzoic acid to form an excess-acid dibenzoate, wherein excess benzoic acid is present in a concentration sufficient for improved flash rust resistance when added to ~~a~~ the waterborne direct-to-metal coating formulation.

~~21~~19. A method to incorporate benzoic acid into a waterborne coating of any of claims 7-9 or 11-17, wherein the low VOC component comprises a dibenzoate or a dibenzoate blend, by dissolving benzoic acid in at least one dibenzoate at a concentration sufficient for improved flash rust resistance when added to ~~a~~ the waterborne coating ~~direct-to-metal coating formulation~~.

~~22~~20. The method according to claim ~~20~~18, further comprising adding benzyl alcohol to the excess-acid dibenzoate to form ~~a~~ the low VOC multifunctional additive blend.

~~23~~21. A method of improving the properties of a waterborne coating or other waterborne polymer film-forming composition of any of claims 1-6, comprising the step of:

adding during formulation of the coating or composition ~~a~~ the low VOC multifunctional additive blend ~~comprising triethylene glycol dioctanoate, triethylene glycol bis(ethylhexanoate-2), or a dibenzoate to a high VOC component comprising 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate, benzylamine,~~

~~phenoxyethanol, phenyl ethanol, benzyl alcohol, benzyl benzoate, 3-phenyl propanol, 2-methyl-3-phenyl propanol, vanillin, or β-methylcinnamyl alcohol,~~

~~wherein the low VOC multifunctional additive blend does not include a blend of 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate with triethylene glycol bis(ethylhexanoate-2) or a blend of 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate with triethylene glycol dioctanoate, and~~

wherein the method provides a low VOC content to the formulation.

~~24~~22. A colorant dispersion for use in a waterborne coating, comprising a colorant dispersed in the low VOC multifunctional additive according to any one of claims 1-~~8~~6.

~~25~~23. The multifunctional additive blend according to claim 1, consisting essentially of:

a. benzyl alcohol and a dibenzoate blend, wherein the ratio by weight of benzyl alcohol to dibenzoate blend is 1:1; or

b. benzyl alcohol and a dibenzoate blend, wherein the ratio by weight of benzyl alcohol to dibenzoate blend is 1:2; or

c. benzyl alcohol and a dibenzoate blend, wherein the ratio by weight of benzyl alcohol to dibenzoate is 1:3; or

d. benzyl alcohol and triethylene glycol bis(ethylhexanoate-2), wherein the ratio by weight of benzyl alcohol to triethylene glycol bis(ethylhexanoate-2) is 1:1,

wherein the dibenzoate blend comprises a mixture of diethylene glycol dibenzoate and dipropylene glycol dibenzoate or a mixture of diethylene glycol dibenzoate, dipropylene glycol dibenzoate and 1,2-propylene glycol dibenzoate.

~~26~~24. The multifunctional additive blend according to claim 1, consisting essentially of: benzyl alcohol and triethylene glycol dioctanoate, wherein the ratio by weight of benzyl alcohol to triethylene glycol dioctanoate is 1:1.

~~27. The multifunctional additive blend according to claim 1, consisting essentially of: 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate and a dibenzoate, wherein the ratio of 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate to dibenzoate is 10:90 or 20:80.~~

2825. The multifunctional additive blend according to any one of claims 1-86, wherein the ratio by weight of the at least one high volatile component to the at least one low volatile component ranges from 10:1 to 1:10.

2926. The multifunctional additive blend according to claim 2825, wherein the ratio by weight of the at least one high volatile component to the at least one low volatile component is 1:1.

3027. A waterborne colorant, comprising:

a. a pigment or colorant,

b. a dispersant,

c. the low VOC multifunctional additive blend according to any one of claims 1-86, and

d. water.

3128. A solvent-borne colorant, comprising:

a. a pigment or colorant,

b. a dispersant,

c. the low VOC multifunctional additive blend according to any one of claims 1-86, and

d. a solvent.

3229. Use of the low VOC multifunctional additive blend according to any one of claims 1-8 6 in waterborne polymer film-forming compositions comprising: architectural coatings, industrial coatings, OEM coatings, interior and exterior paints, metal coatings, direct-to-metal coatings, marine coatings, film coatings, vinyl film compositions, wood coatings, wood treatments, paper coatings, fabric coatings, textile coatings, wallpaper coatings, decorative coatings, textile coatings, construction coatings, cement coatings, concrete coatings, floor coatings, varnishes, inks, graphic inks, waterborne colorants, solvent-borne colorants, adhesive compositions, glues, sealants or caulks.

~~33~~30. An adhesive composition comprising the low VOC multifunctional additive blend according to any one of claims 1-~~8~~6.

~~34~~31. A sealant composition comprising the low VOC multifunctional additive blend according to any one of claims 1-~~8~~6.

~~35~~32. An ink composition comprising the low VOC multifunctional additive blend according to any one of claims 1-~~8~~6.