

DESCRIPTION

WATERBORNE BASECOAT COMPOSITION

TECHNICAL FIELD

[0001] The present invention relates to a waterborne basecoat composition.

BACKGROUND ART

[0002] Generally, the outer plate of a car body is required to prevent the deterioration of a coated film and the generation of lust and have durability so as to maintain the gloss or color of the coated film. Accordingly, the painting process of cars is generally conducted through the electrodeposition coating of a car body which has undergone a pre-treatment process, primer coating for improving adhesiveness and smoothness, and basecoat coating of the car body which has undergone the primer coating for the appearance of the car body. After that, generally, a clear coat film is coated to protect the color and improve the appearance of the basecoat film, and protect the basecoat film from the outside.

[0003] The painting of a basecoat and the painting of a clear coat are generally performed by applying and drying a basecoat composition, applying a clear coat composition, and curing the clear coat and basecoat together during curing (130-150°C) the clear coat. Due to this, the conventional basecoat composition is designed based on curing conditions at a high temperature. However, requirement on a composition which may reduce a process and is curable at a low temperature is growing trend for saving the costs of a

painting process.

[0004] In this regard, Korean Registration Patent No. 158,534 (Patent document 1) discloses a 2-liquid type acrylic urethane composition composed of a main mixture containing an acrylic polyol, an ester-based solvent, an additive composed of a leveling agent, a slip agent and wax, and an alcohol-based solvent; a curing agent mixture containing a polyisocyanate and an ester-based solvent. However, though there are coating paints for repairing cars and compositions for coating parts as the conventional basecoat compositions which may be used under low-temperature firing conditions, particularly, heat curing conditions of 120°C or less as in Patent document 1, the mechanical properties of a coated film formed are insufficient, and the application as a paint for a car body is limited.

[0005] Accordingly, research and development on a basecoat composition which is curable at a low temperature of 120°C or less, could serve a coated film having excellent mechanical properties and could be suitably applied for painting a car body, is required.

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEM

[0006] There is provided in the present invention a basecoat composition which is curable at a low temperature of 120°C or less and could form a coated film having excellent mechanical properties.

TECHNICAL SOLUTION

[0007] The present invention provides a waterborne basecoat composition, including an acrylic resin, a polyurethane dispersion resin, a polyester resin, a urethane resin, a melamine-based curing agent and an oxazoline-based curing

agent.

ADVANTAGEOUS EFFECTS

[0008] In regard of the basecoat composition according to the present invention, the heat curing temperature of a coating process may be a low temperature of 120°C or less which is lower than the conventional temperature, and costs consumed during a painting process may be saved economically. In addition, the mechanical properties, particularly, gloss, impact resistance, water resistance and cold chipping resistance of a cured film formed from the composition are excellent, and the composition may be usefully used for painting a car body.

BEST MODE FOR CARRYING OUT THE INVENTION

[0009] The basecoat composition according to the present invention includes an acrylic resin, a polyurethane dispersion resin, a polyester resin, a urethane resin, a melamine-based curing agent and an oxazoline-based curing agent.

[0010]

[0011] Acrylic resin

[0012] The acrylic resin plays the role of improving the rheology and hardness of a coated film formed from a basecoat composition including the same.

[0013] The acrylic resin may use a synthesized one in practice by a well-known method or a commercial product. For example, the acrylic resin may include one or more units derived from a monomer selected from the group consisting of allyl methacrylate (AMA), methyl methacrylate (MMA), ethyl acrylate (EA), hydro ethyl acrylate (HEA) and methacrylic acid (MAA). For example, the acrylic resin may be prepared

from a mixture including as monomers, allyl methacrylate (AMA), methyl methacrylate (MMA), ethyl acrylate (EA), hydro ethyl acrylate (HEA) and methacrylic acid (MAA).

[0014] In addition, the mixture may further include a divalent acrylic monomer. The divalent acrylic monomer may include, for example, 1,4-butanediol diacrylate, 1,4-butanediol dimethacrylate, 1,5-pentanediol dimethacrylate, 1,6-hexanediol diacrylate, 1,6-hexanediol dimethacrylate, 1,9-nonanediol dimethacrylate, 1,10-decanediol dimethacrylate, ethylene glycol diacrylate, ethylene glycol dimethacrylate, etc.

[0015] Further, the acrylic resin may have a hydroxyl value (OHv) of 5 to 50 mgKOH/g, an acid value (Av) of 5 to 50 mgKOH/g, a glass transition temperature (T_g) of -30 to 30°C, and a viscosity at 25°C of 20 to 600 cps. In another embodiment, the acrylic resin may have a hydroxyl value of 5 to 30 mgKOH/g, or 8 to 20 mgKOH/g, an acid value of 5 to 30 mgKOH/g, or 8 to 20 mgKOH/g, a glass transition temperature of greater than 0°C and 30°C or less, or 10 to 30°C, and a viscosity at 25°C of 20 to 400 cps, or 40 to 200 cps. If the hydroxyl value of the acrylic resin is within the aforementioned range, the curability of the composition may be improved, and impact resistance, water resistance, adhesiveness and cold chipping resistance may be secured, if the acid value is within the aforementioned range, storage stability and coated film hardness may be secured, if the glass transition temperature is within the aforementioned range, storage stability may be excellent, and suitable coating properties may be secured, and if the viscosity at 25°C is within the aforementioned range, effects of favorable

workability may be achieved.

[0016] In addition, the acrylic resin may be an emulsion type dispersed in deionized water. For example, the acrylic resin may be an emulsion type dispersed in a solvent, and may have an average diameter of 50 to 300 nm, or 70 to 170 nm. If the acrylic resin is an emulsion type dispersed in deionized water, effects of reducing the content of volatile organic compounds (VOC) of a paint may be achieved, and if the average diameter is within the aforementioned range, appearance and particle stability may be good.

[0017] In addition, the emulsion-type acrylic resin may have the solid content (NV) of 15 to 50 wt% based on the total weight of the resin. In another embodiment, the emulsion-type acrylic resin may have the solid content of 20 to 45 wt%, or 30 to 40 wt% based on the total weight of the resin. If the solid content of the emulsion-type acrylic resin is within the aforementioned range, workability is good.

[0018] The acrylic resin may be included in an amount of 20 to 30 parts by weight in the composition with respect to 5 to 10 parts by weight of a polyurethane dispersion resin. In another embodiment, the acrylic resin may be included in an amount of 22 to 27 parts by weight in the composition with respect to 5 to 10 parts by weight of a polyurethane dispersion resin. If the amount of the acrylic resin is within the aforementioned range, suitable rheology may be secured, and excellent effects of appearance, water resistance, impact resistance and cold chipping resistance may be achieved.

[0019]

[0020] Polyurethane dispersion resin

[0021] The polyurethane dispersion resin plays the role of improving the dryness of a basecoat composition including the same and improving the flexibility of a coated film formed from the composition.

[0022] The polyurethane dispersion resin may be a polyurethane dispersion resin derived from a polyester-polycarbonate. For example, the polyurethane dispersion resin may be a polyurethane dispersion resin derived from a polyester-polycarbonate diol.

[0023] In addition, the polyurethane dispersion resin may be a dispersion type dispersed in deionized water. For example, the polyurethane dispersion resin may be a dispersion type dispersed in deionized water, and may have an average diameter of 200 nm or less, or 50 to 200 nm.

[0024] The polyurethane dispersion resin may have a viscosity at 25°C of 10 to 50 cps, and the solid content (NV) of 20 to 50 wt% based on the total weight of the dispersion resin. In another embodiment, the polyurethane dispersion resin may have a viscosity at 25°C of 20 to 45 cps, or 30 to 40 cps, and the solid content of 25 to 45 wt%, or 27 to 40 wt% based on the total weight of the dispersion resin. If the viscosity at 25°C of the polyurethane dispersion resin is within the aforementioned range, excellent effects of appearance and workability may be achieved, and if the solid content is within the aforementioned range, improving effects of workability may be achieved.

[0025] In addition, the polyurethane dispersion resin may be included in an amount of 5 to 10 parts by weight in the composition based on 20 to 30 parts by weight of the acrylic resin. In another embodiment, the polyurethane dispersion

resin may be included in an amount of 6 to 9 parts by weight in the composition based on 20 to 30 parts by weight of the acrylic resin. If the amount of the polyurethane dispersion resin is within the aforementioned range, excellent effects of dryness, cold chipping resistance and impact resistance may be achieved.

[0026]

[0027] Polyester resin

[0028] The polyester resin plays the role of improving the flexibility and appearance characteristics of a coated film formed from a basecoat composition including the same.

[0029] The polyester resin may be prepared by reacting a carboxylic acid compound and a diol compound. For example, the polyester resin may be prepared by reacting one or more carboxylic acid compounds selected from the group consisting of adipic acid (AA), isophthalic acid (IPA), trimellitic anhydride (TMA), an alicyclic acid, phthalic anhydride, isophthalic acid, terephthalic acid, succinic acid, adipic acid, fumaric acid, maleic anhydride, tetrahydrophthalic anhydride, hexahydrophthalic anhydride and derivatives thereof; and one or more diol compounds selected from the group consisting of 1,6-hexanediol (1,6-HD), neopentyl glycol (NPG), trimethylol propane (TMP), ethylene glycol, propylene glycol, diethylene glycol, butanediol, 1,4-hexanediol, and 3-methylpentanediol.

[0030] In addition, the polyester resin may have a liquid phase type of which solid content (NV) is 50 to 85 wt% based on the total weight of the resin. In another embodiment, the polyester resin may have a liquid phase type of which solid content is 60 to 80 wt%, or 65 to 75 wt% based on the total

weight of the resin. If the polyester resin is used in a liquid phase type, effects of favorable workability may be achieved during forming, and if the liquid phase type polyester resin having the solid content in the aforementioned range is used, effects of favorable workability may be achieved during forming.

[0031] The polyester resin may have a hydroxyl value (OHv) of 50 to 150 mgKOH/g, an acid value (Av) of 10 to 100 mgKOH/g, a Gardner viscosity of P to U, and a weight average molecular weight (Mw) of 500 to 2,000 g/mol. In another embodiment, the polyester resin may have a hydroxyl value of 80 to 130 mgKOH/g, or 100 to 120 mgKOH/g, an acid value of 10 to 80 mgKOH/g, or 20 to 50 mgKOH/g, a Gardner viscosity of Q to T, and a weight average molecular weight of 700 to 1,500 g/mol, or 800 to 1,300 g/mol. If the hydroxyl value of the polyester resin is within the aforementioned range, excellent effects of dispersibility in water and coating properties may be achieved, if the acid value is within the aforementioned range, storage stability and crosslinking density are excellent and excellent effects of cold chipping resistance may be achieved, if the Gardner viscosity is within the aforementioned range, effects of favorable workability may be achieved, and if the weight average molecular weight is within the aforementioned range, excellent effects of coating properties and appearance may be achieved.

[0032] In addition, the polyester resin may be included in an amount of 1 to 10 parts by weight in the composition with respect to 20 to 30 parts by weight of the acrylic resin. In another embodiment, the polyester resin may be included in an amount of 3 to 8.5 parts by weight in the composition with

respect to 20 to 30 parts by weight of the acrylic resin. If the amount of the polyester resin is within the aforementioned range, excellent appearance, impact resistance and cold chipping resistance may be achieved.

[0033]

[0034] Urethane resin

[0035] The urethane resin plays the role of improving the workability of a basecoat composition including the same and improving the appearance characteristics of a coated film formed from the composition.

[0036] The urethane resin may be a urethane diol-based compound. For example, the urethane resin may be a urethane diol obtained through the reaction of a primary alcohol such as amino ethanol and amino isopropanol; or a primary diamine such as ethylene diamine, propylene diamine, 2-methyl-pentane diamine-(1,5) or hexane diamine-(1,6), with an alkylene carbonate such as ethylene and propylene carbonate.

[0037] In another embodiment, the urethane resin may be a urethane diol-based compound, and may have a viscosity at 25°C of 2,000 to 4,000 cps, and a hydroxyl value (OHv) of 200 to 500 mgKOH/g. In another embodiment, the urethane resin may be a urethane diol-based compound, may have a viscosity at 25°C of 2,200 to 3,800 cps, or 2,500 to 3,500 cps, and a hydroxyl value of 250 to 400 mgKOH/g, or 280 to 350 mgKOH/g, and may have a liquid phase type of which solid content (NV) is 80 to 95 wt%, or 84 to 92 wt% based on the total weight of the resin. If the viscosity at 25°C of the urethane resin is within the aforementioned range, effects of favorable workability may be achieved, and if the liquid phase type including the solid content within the aforementioned range

is used, improving effects of workability may be achieved. In addition, if the hydroxyl value of the urethane resin is within the aforementioned range, excellent effects of gloss and appearance characteristics of a coated film formed may be achieved.

[0038] In addition, the urethane resin may be included in an amount of 0.1 to 5 parts by weight in the composition with respect to 20 to 30 parts by weight of the acrylic resin. In another embodiment, the urethane resin may be included in an amount of 0.1 to 3 parts by weight, or 0.5 to 2 parts by weight in the composition with respect to 20 to 30 parts by weight of the acrylic resin. If the amount of the urethane resin is within the aforementioned range, improving effects of the flexibility and appearance of a coated film may be achieved.

[0039]

[0040] Melamine-based curing agent

[0041] The melamine-based curing agent plays the role of curing through crosslinking reaction with the components of a basecoat composition, and plays the role of improving the appearance characteristics and gloss of a coated film formed from the basecoat composition including the same.

[0042] The melamine-based curing agent may include a hydrophilic melamine resin including an imino group. For example, the melamine-based curing agent may have a liquid phase type containing a hydrophilic melamine resin including an imino group. In another embodiment, the melamine-based curing agent may include a hydrophilic melamine resin including an imino group, and may have a liquid phase type of which solid content (NV) is 85 to 95 wt% based on the total

weight of the melamine-based curing agent.

[0043] In addition, the commercial product of the melamine-based curing agent may include Cymnel-325, Cymel-327 and Cymel-385 of Cytec Co., Resimene HM-2608, Resimene 718 and Resimene 717 of INEOS Co., and Luwipal 052, 072, etc., of BASF Co.

[0044] Further, the melamine-based curing agent may be included in an amount of 1 to 5 parts by weight in the composition with respect to 20 to 30 parts by weight of the acrylic resin. In another embodiment, the melamine-based curing agent may be included in an amount of 1 to 4 parts by weight, or 1.5 to 3.5 parts by weight in the composition with respect to 20 to 30 parts by weight of the acrylic resin. If the amount of the melamine-based curing agent is within the aforementioned range, suitable coating properties may be secured.

[0045]

[0046] Oxazoline-based curing agent

[0047] The oxazoline-based curing agent plays the role of curing through the crosslinking reaction with the components of a basecoat composition, and plays the role of improving the appearance characteristics of a coated film formed from a basecoat composition including the same.

[0048] The oxazoline-based curing agent may be an oxazoline group-containing polymer. For example, the oxazoline-based curing agent may have an emulsion type of an oxazoline group-containing polymer. If the oxazoline-based curing agent is used in an emulsion type of the oxazoline group-containing polymer, the content of the volatile organic compounds (VOC) of a paint may be reduced.

[0049] In addition, the oxazoline-based curing agent may have a glass transition temperature (T_g) of -70 to 10°C, and the solid content (NV) of 20 to 60 wt% based on the total weight of the oxazoline-based curing agent. In another embodiment, the oxazoline-based curing agent may have a glass transition temperature of -60 to 0°C, and the solid content of 30 to 50 wt% based on the total weight of the oxazoline-based curing agent. If the glass transition temperature of the oxazoline-based curing agent is within the aforementioned range, curing rate and crosslinking density may be improved, and mechanical properties may be improved, and if the solid content is within the aforementioned range, workability may be improved, and the VOC content may be reduced.

[0050] The oxazoline-based curing agent may be included in an amount of 1 to 5 parts by weight in the composition with respect to 20 to 30 parts by weight of the acrylic resin. For example, the oxazoline-based curing agent may be included in an amount of 2 to 5 parts by weight, or 2.5 to 4.5 parts by weight in the composition with respect to 20 to 30 parts by weight of the acrylic resin. If the amount of the oxazoline-based curing agent is within the aforementioned range, crosslinking density may be increased, and improving effects of harness may be achieved.

[0051]

[0052] Solvent

[0053] The basecoat composition may additionally include a solvent. In this case, the solvent plays the role of controlling the viscosity of the composition and reducing the generation of volatile organic compounds (VOC). For example, the solvent may include one or more types of water selected

from the group consisting of deionized water, pure water, ultrapure water and distilled water. Further, the solvent may additionally include an organic solvent in addition to the water.

[0054] The basecoat composition may include the solvent in 20 to 95 parts by weight based on 100 parts by weight of the acrylic resin. For example, the basecoat composition may include the solvent in 25 to 90 parts by weight based on 100 parts by weight of the acrylic resin. If the amount of the solvent in the composition is within the aforementioned range, defects of degrading the dispersibility of resins in the composition, defects of degrading environmental affinity which is the advantage of an aqueous paint, and coated film defects of generating pin holes and defects of generating stains in a final coated film due to insufficient vaporization of water, may be prevented.

[0055]

[0056] Pigment

[0057] The basecoat composition may additionally include a pigment. The pigment plays the role of providing a coated film formed with color. For example, the basecoat composition may use an effect pigment for providing a coated film with metallic effects, a coloring pigment for providing color and concealment effects in combination with materials for forming a coated film, or a combination thereof.

[0058] In this case, examples of the effect pigment may include a hydrated aluminum flake, a mica pigment, or a mixture thereof. Examples of the color pigment may include an oxide-based inorganic pigment, a polycyclic-based organic pigment containing an azo, a vat pigment, an anthraquinone-

based organic pigment, or mixtures thereof.

[0059] The basecoat composition may include the pigment in 10 to 50 parts by weight based on 100 parts by weight of the acrylic resin. For example, the basecoat composition may include the pigment in 20 to 40 parts by weight based on 100 parts by weight of the acrylic resin. If the amount of the pigment in the basecoat composition is within the aforementioned range, defects of insufficient concealment of a film formed, and defects of the deterioration of the stability of a composition and the deterioration of the dispersibility of a pigment may be prevented.

[0060]

[0061] Additives

[0062] The basecoat composition may additionally include one or more additives selected from the group consisting of a cosolvent, a neutralizing agent, a catalyst, a ultraviolet absorbent, a leveling agent, a defoaming agent, a wetting agent and wax.

[0063] The basecoat composition may include the additives in 50 to 150 parts by weight based on 100 parts by weight of the acrylic resin. For example, the basecoat composition may include the additives in 60 to 120 parts by weight based on 100 parts by weight of the acrylic resin.

[0064] The cosolvent plays the role of influencing the smoothness of a coated film formed, providing a basecoat composition with storage stability, reducing the lowest temperature for forming a coated film, and controlling the volatility of a solvent during a painting process.

[0065] In addition, the cosolvent may include, for example, ethylene glycol monobutyl ether, diethylene glycol monobutyl

ether, propylene glycol, N-methyl-2-pyrrolidone, n-propyl alcohol, i-propyl alcohol, n-butanol, propylene glycol monomethyl ether, butyl glycol, hexyl glycol, 2-ethylhexyl alcohol, butyl carbitol, etc., without limitation.

[0066] The neutralizing agent plays the role of improving the storage stability of a basecoat composition and controlling pH (to a level of pH 7.5-9.0).

[0067] Further, the neutralizing agent may include a tertiary amine compound including trialkylamines such as trimethylamine, triethylamine and tributylamine, N,N-dialkylalkanolamines such as N,N-dimethylethanolamine, N,N-dimethylpropanolamine, N,N-dipropylethanolamine and 1-dimethylamino-2-methyl-2-propanol, N-alkyl-N,N-dialkanolamines and trialkanolamines such as triethanolamine; ammonia; trimethylammonium hydroxide; sodium hydroxide; potassium hydroxide; and lithium hydroxide.

[0068] The catalyst plays the role of preventing incomplete curing of a basecoat composition to improve the mechanical properties of a coated film formed therefrom. In addition, the catalyst may include, for example, an amine group-containing phosphate-based compound.

[0069] The ultraviolet absorbent plays the role of blocking ultraviolet reaching a coated film to improve the weather resistance of a final coated film.

[0070] In addition, the ultraviolet absorbent may be a benzotriazole-based ultraviolet absorbent. For example, the benzotriazole-based ultraviolet absorbent may include α -[3-[3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxyphenyl]-1-oxopropyl]- ω -hydroxypoly(oxy-1,2-ethanediyl), α -[3-[3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-

hydroxyphenyl]-1-oxopropyl]- ω -[3-[3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxyphenyl]-1-oxopropoxy]poly(oxy-1,2-ethanediyl), 3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxy-methyl ester, etc.

[0071] The leveling agent plays the role of providing a coated film formed with leveling properties and wettability. In addition, the leveling agent may include a cationic, anionic, or nonionic surfactant, for example, a nonionic surfactant.

[0072] The defoaming agent plays the role of restraining the generation of bubbles during preparing a paint and restraining and removing the phenomenon of pin holes or popping induced during forming a coated film. In addition, the defoaming agent may use any one commonly used in a paint composition without specific limitation. For example, the defoaming agent may use BYK-011, BYK-015 and BYK-072 of BYK Co., DF-21 of Air Product Co., agitan 281 of Munzing Co., Foamster-324 of San Nopco Co., etc.

[0073] The wetting agent plays the role of improving the leveling properties and wettability of a coated film formed from a composition including the same, and may use any one commonly used in a paint composition without specific limitation. For example, the wetting agent may include a polyether-modified polysiloxane-based or acetylene alcohol-type wetting agent.

[0074] The wax plays the role of preventing the defects of generating sagging due to the slow drying of a coated film formed from a composition including the same, and may use any one commonly used in a paint composition without specific limitation. For example, the wax may include an ethylene-

vinyl-acetate-based wax.

[0075]

[0076] The basecoat composition may have a viscosity at 25°C of 30 to 100 seconds based on ford cup number 4 and may have the solid content of 15 to 50 wt% based on the total weight of the composition. In another embodiment, the basecoat composition may have a viscosity at 25°C of 50 to 70 seconds based on ford cup number 4 and may have the solid content of 20 to 30 wt% based on the total weight of the composition.

[0077] The above-described basecoat composition according to the present invention may undergo curing at a low temperature of 120°C or less which is lower than the conventional heat curing temperature and save the costs consumed during a coating process, and it is economical. In addition, a coated film formed from the composition has excellent mechanical properties, particularly, gloss, impact resistance, water resistance, and cold chipping resistance, and may be usefully used for coating a car body.

MODE FOR CARRYING OUT THE INVENTION

[0078] Hereinafter, the present invention will be explained more particularly referring to embodiments. However, the embodiments are only for assisting the understanding of the present invention, and the scope of the present invention is not limited thereto in any sense.

[0079] In the present invention, the functional group value such as the "acid value" and "hydroxyl value" of a resin may be measured by a method well-known in the art, for example, may represent a value measured by a titration method.

[0080] In addition, the "weight average molecular weight" of a resin may be measured by a method well-known in the art,

for example, may represent a value measured by a gel permeation chromatography (GPC) method.

[0081] In addition, the "glass transition temperature" of a resin may be measured by a method well-known in the art, for example, may represent a value measured by a differential scanning calorimetry (DSC) method.

[0082] [Examples]

[0083] Examples 1 to 10 and Comparative Examples 1 to 5.
Preparation of basecoat composition

[0084] Basecoat compositions were prepared by stirring and mixing the components in the compositions described in Tables 1 and 2 below so that a viscosity at 25°C became 55 seconds based on ford cup number 4.

[0085] [Table 1]

Component (parts by weight)	Examp e 1	Examp e 2	Examp e 3	Examp e 4	Examp e 5	Examp e 6	Examp e 7	Examp e 8
Acrylic resin	25.7	26.7	29	25.7	24.6	25.7	25.7	35
Polyurethane dispersion resin	8.4	8	6.4	8.4	9.4	8.4	8.4	6.5
Polyester resin	5.7	6	5.1	9	5.7	5.7	5.7	5.7
Urethane resin	1.1	1.2	1.1	1.1	1.2	1.1	1.1	2.1
Melamine-based curing agent	2.6	3.2	2.6	2.6	2.6	2.6	3.5	3.2
Oxazoline-based curing agent	4	4.8	4	4	4	7	0.5	4
Cosolvent 1	1	1	1	1	1	1	1	1
Cosolvent 2	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Cosolvent 3	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Cosolvent 4	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Neutralizing agent	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Wax	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Catalyst	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Ultraviolet absorbent	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Pigment	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Defoaming agent	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Wetting agent	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Distilled water	19.4	17	18.7	16.1	19.4	16.4	22	10.4
Total	100	100	100	100	100	100	100	100

[0086]

[0087] [Table 2]

Component (parts by weight)	Example 9	Example 10	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5
Acrylic resin	25.7	23.4	29	29.7	—	29	26.9
Polyurethane dispersion resin	13	6.3	8.4	8.4	10	—	8
Polyester resin	5.7	12	5.7	5.7	9	8	
Urethane resin	1.1	1.1	1.1	1.1	1.1	1.5	1.1
Melamine-based curing agent	2.6	2.6	—	5	5	4.2	3.4
Oxazoline-based curing agent	4	4	5	—	4	4	4
Cosolvent 1	1	1	1	1	1	1	1
Cosolvent 2	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Cosolvent 3	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Cosolvent 4	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Neutralizing agent	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Wax	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Catalyst	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Ultraviolet absorbent	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Pigment	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Defoaming agent	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Wetting agent	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Distilled water	14.8	17.5	17.7	17	37.8	20.2	23.5
Total	100	100	100	100	100	100	100

[0088]

[0089] Hereinafter, the manufacturers and product names of the components used in the Comparative Examples and Examples are shown in Tables 3 and 4 below.

[0090] [Table 3]

Division		Note
Acrylic resin	Emulsion type	Hydroxyl value of 12 mgKOH/g, acid value of 11 mgKOH/g, glass transition temperature of 21°C, viscosity at 25°C of 60 cps, solid content of 35 wt%
Polyurethane dispersion resin	Dispersion type	Allnex Co., Daotan TW1236 (viscosity at 25°C of 35 cps, solid content of 30 wt%)
Polyester resin	Liquid phase	Hydroxyl value of 110 mgKOH/g, acid value of 35 mgKOH/g, Gardner viscosity of Q-T, weight average molecular weight of 1,050 g/mol, solid content of 70 wt%
Urethane resin	Urethane diol	King Industries Co., K-FLEX UD-350W (viscosity at 25°C of 3,000 cps, hydroxyl value of 325 mgKOH/g, solid content of 88 wt%)
Melamine-based curing agent		Imino group-containing melamine resin (Cymel 325, Cytec)
Oxazoline-based curing		EPOCROS Co., K-2010E

agent	
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[0091]

[0092] [Table 4]

Component	Note
Cosolvent 1	Butyl cellosolve
Cosolvent 2	N-methyl pyrrolidone
Cosolvent 3	Butyl carbitol
Cosolvent 4	n-propanol
Neutralizing agent	Dimethylethanol amine (BASF)
Wax	Ethylene-vinyl-acetate (EVA) wax, BYK
Catalyst	Dodecylbenzene sulfonic acid type acid catalyst (XP-221, King Industries)
Ultraviolet absorbent	Absorbent having benzotriazole series structure (Tinuvin 384, Ciba)
Pigment	Aluminum paste (metal pigment EMR D5620 (TOYO))
Defoaming agent	Inorganic defoaming agent containing oil component (agitan281, Munzing)
Wetting agent	Acetylene alcohol-type wetting agent (Surfynol 104BC, Air Product)

[0093]

[0094] Experimental Example: Evaluation of properties of coated film formed

[0095] On a specimen, a paint for primer coating (manufacturer: KCC, product name: FU2290) was applied and dried to form a primer coated film, and on an even place, bell spraying of each basecoat composition of the Examples and Comparative Examples was performed to a thickness of 15 μm . After that, remaining water in the paint was vaporized (dried) by blowing air at 80°C for 3 minutes. On the basecoat, a low-temperature-curable clear paint (manufacturer: KCC) was applied to a thickness of 40 μm and cured at 100°C for 25 minutes in an oven to form a final coated film. The appearance characteristics and physical properties of a final coated film were measured by methods below, and the results are shown in Table 5.

[0096] (1) Coating workability

[0097] The coating workability was evaluated by the spraying

state of a composition during bell spraying of a basecoat composition, and judgment was made on the spraying state, and comparison and evaluation was made according to an atomization state.

[0098] (2) Appearance

[0099] With respect to a final coated film, a CF value was measured using a car appearance measurement apparatus of Wave Scan DOI (BYK Gardner), and it was judged that if the CF value increased, the appearance characteristics of a coated film became better. Particularly, the results were assessed excellent (◎) if the CF value was 65 or more, good (O) with 60 to less than 65, common (Δ) with 55 to less than 60, and bad (x) with less than 55.

[00100] (3) Gloss

[00101] The 20° gloss of a final coated film was measured, and the results were assessed excellent (◎) if the gloss value measured was 90 or more, good (O) with 88 to less than 90, common (Δ) with 86 to less than 88, and bad (x) with less than 86.

[00102] (4) Repaint adhesiveness

[00103] After delaminating a basecoat and a clear coat from a final coated film, each of the basecoat compositions of Examples 1 to 10 and Comparative Examples 1 to 5 and a clear paint were repainted and cured to form a repainting coated film. Then, the adhesiveness was evaluated by a baduk board method.

[00104] Particularly, by the baduk board method, on the repainting coated film, 100 squares (length of 2 mm x width of 2 mm) were formed using a knife, and then, the squares were detached using a tape to measure the adhesiveness. In

this case, the results were assessed excellent (◎) in case where 100% of 100 squares were attached completely, good (O) in case where remaining squares were 70% to less than 100%, common (Δ) in case of 50% to less than 70%, and bad (x) in case of less than 50%.

[00105] (5) Impact resistance

[00106] A pendulum of 500 g was dropped on a final coated film from a height of 30 cm, and the surface of the final coated film was observed, and the impact resistance was evaluated. Particularly, the results were assessed excellent (◎) if no crack or impact trace was observed, common (Δ) with a trace, and bad (x) with crack or gap of on final coated film.

[00107] (6) Water resistance

[00108] A final coated film was immersed in a constant-temperature water bath at 40°C for 10 days, and adhesiveness was measured by the same method as the baduk-board method of item (4). The same evaluation standard was applied to evaluate the water resistance of a coated film.

[00109] (7) Paint flowability

[00110] A specimen with a primer coated film formed thereon was hung vertically, and each of the basecoat compositions of the Examples and Comparative Examples was painted, dried and cured by the same method as described above, and the surface of a coated film formed was observed to evaluate the paint flowability of a composition.

[00111] On an electrodeposition coated steel sheet having a hole with a diameter of 5 mm, the primer and clear painting were performed as described above, and the formation of paint droplets at the bottom of the hole was observed. The film

thickness of a final coated film at which the flowing was observed was recorded by μm as a flow critical film thickness. In this case, it was judged that if the numerical of the flow critical film thickness measured decreased, the paint flowability became worse.

[00112] Particularly, the results were assessed excellent (◎) if the flow critical film thickness was 40 μm or more, good (O) with 35 μm to less than 40 μm , common (Δ) with 30 μm to less than 35 μm , and bad (x) with less than 30 μm .

[00113] (8) Cold chipping resistance

[00114] A final coated film was stood at -20°C for 3 hours, and a chipping stone of 50 g was pushed with a pressure of 4 bar to hit the surface of the final coated film. In this case, the results were assessed by excellent (◎) in case where the damaged portion of the final coated film was 1mm or less, good (O) with greater than 1 mm to 2 mm, common (Δ) with greater than 2 mm to 3 mm, and bad (x) with greater than 3 mm.

[00115]

[00116] [Table 5]

Evaluation item	Coating workability	Coated film appearance	Gloss	Repaint adhesiveness	Impact resistance	Water resistance	Paint flowability	Cold chipping resistance
Example 1	◎	◎	◎	◎	◎	◎	◎	◎
Example 2	◎	◎	◎	◎	◎	O	◎	◎
Example 3	◎	◎	◎	◎	O	◎	◎	◎
Example 4	◎	◎	◎	◎	◎	◎	◎	O
Example 5	◎	◎	◎	◎	◎	◎	◎	O
Example 6	◎	◎	◎	◎	O	O	O	◎
Example	◎	O	◎	◎	O	O	◎	O

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Example 8	◎	○	○	◎	○	○	◎	○
Example 9	◎	○	○	◎	○	◎	◎	○
Example 10	◎	○	◎	◎	○	◎	◎	○
Comparative Example 1	○	△	△	○	x	x	○	x
Comparative Example 2	○	△	○	△	x	x	△	△
Comparative Example 3	△	x	○	○	x	x	△	△
Comparative Example 4	○	△	x	○	x	○	○	x
Comparative Example 5	x	○	x	○	x	○	○	x

[00117]

[00118] As shown in Table 5, it could be found that the basecoat compositions of Examples 1 to 10 showed excellent coating workability and paint flowability and at the same time, coated films formed therefrom showed excellent mechanical properties including appearance characteristics, gloss, repaint adhesiveness, impact resistance, water resistance, and cold chipping resistance.

[00119] On the contrary, the compositions of Comparative Examples 1 and 2, including only one type of the melamine-based curing agent or oxazoline-based curing agent showed deteriorated curability and insufficient workability, and coated films formed therefrom showed insufficient appearance characteristics, impact resistance and water resistance. In addition, it could be found that the composition of

Comparative Example 3, not including the acrylic resin showed inferior physical properties on the whole. Further, it could be found that a coated film formed from the composition of Comparative Example 4, not including the polyurethane dispersion resin showed insufficient gloss, impact resistance and cold chipping resistance and inferior physical properties on the whole. Also, the composition of Comparative Example 5, not including the polyester resin showed insufficient coating workability, and a coated film formed therefrom showed insufficient gloss, impact resistance and cold chipping resistance.

CLAIMS

1. A waterborne basecoat composition comprising an acrylic resin, a polyurethane dispersion resin, a polyester resin, a urethane resin, a melamine-based curing agent and an oxazoline-based curing agent.

2. The waterborne basecoat composition according to claim 1, wherein the acrylic resin has a hydroxyl value of 5 to 50 mgKOH/g, an acid value of 5 to 50 mgKOH/g, a glass transition temperature of -30 to 30°C, and a viscosity at 25°C of 20 to 600 cps.

3. The waterborne basecoat composition according to claim 1, wherein the polyurethane dispersion resin has a viscosity at 25°C of 10 to 50 cps, and the solid content of 20 to 50 wt% based on the total weight of the dispersion resin.

4. The waterborne basecoat composition according to claim 1, wherein the polyester resin has a hydroxyl value of 50 to 150 mgKOH/g, an acid value of 10 to 100 mgKOH/g, a Gardner viscosity of P to U, and a weight average molecular weight of 500 to 2000 g/mol.

5. The waterborne basecoat composition according to claim 1, wherein the urethane resin is a urethane diol-based compound and has a viscosity at 25°C of 2,000 to 4,000 cps, a hydroxyl value of 200 to 500 mgKOH/g, and the solid content of 80 to 95 wt% based on the total weight of the resin.

6. The waterborne basecoat composition according to claim 1, wherein the basecoat composition comprises 20 to 30 parts by weight of the acrylic resin, 5 to 10 parts by weight of the polyurethane dispersion resin, 1 to 10 parts by weight of the polyester resin, 0.1 to 5 parts by weight of the urethane resin, 1 to 5 parts by weight of the melamine-based curing agent and 1 to 5 parts by weight of the oxazoline-based curing agent.