

SPECIFICATION

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Title of the Invention:

Aqueous Coating Composition and Coat-Finishing Method by

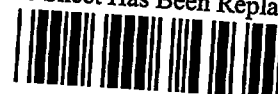
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Field of the Invention:

The present invention particularly relates to an aqueous coating composition which is useful as an elastic base coating composition used in applying onto both interior and exterior walls of buildings, and to a coat-finishing method which is capable of forming a multi-layer film having good finish appearance and good durability by use of the aqueous coating composition.

Background Art:

A multi-layer finish-coating method which comprises finishing in the form of a decorative uneven pattern by use of coating materials such as a primer, middle layer material, topcoating material and the like has generally been known in the art for coating wall surfaces of architectural structures. The above finish-coating method may include a synthetic resin emulsion based multi-layer finishing method and a cement based or polymer-cement based multi-layer finishing method. The former method comprises forming a four-layer film by use of a sealer, a primer, a middle layer material and a topcoating material, wherein the sealer is coated for the purpose of improving adhesion properties between a substrate and a



primer layer, the primer is coated for the purpose of uniformly controlling the substrate, the middle layer material is applied for the purpose of forming a three dimensional decorative pattern on a finished surface, and the topcoating material is applied for the purpose of imparting beautiful appearance and durability. The above method has such an advantage as to make it possible to form a highly decorative pattern with a large change in unevenness, but has disadvantages due to increased coating steps, cost and a term of works.

On the other hand, the latter method comprises forming a three-layer film by use of a sealer, a cement based middle layer material and a topcoating material, and is advantageous over the former method in that the latter method consists of less coating steps than the former method by one coating step. However, the latter method had such problems that a cement based coating material is usually rigid and shows poor elasticity, resulting in causing a problem of propagating crazings on a substrate surface, for example, walls of architectural structures. Neglect of the above crazings allows rain water and carbon dioxide to penetrate into the crazings and causes corrosion of an iron reinforcing rod used in an architectural structure and accompanying scaling of concrete therein. The coating material is such that a cement is used as a bonding material and a mixture of water with the cement or of a synthetic emulsion with the cement is hardened in one



to 4 hours, and that preparation of the mixture in a necessary amount is required each time, resulting in wasting much time for controlling use of the coating materials. On mixing the water or synthetic emulsion as a liquid with the cement as a powder, scattering of the cement and development of undissolved lumps of the cement powder in the mixture may easily take place, resulting in producing many problems on operation. Furthermore, in the case where the above coating materials are used, the cement powder contains large particles and a surface texture of a coated film formed therefrom becomes rough, resulting in producing such problems that coating of a topcoating material onto the surface of the above film accompanies the above feeling of roughness without forming a smooth pattern-coated surface and with poor final finish appearance.

Summary of the Invention:

It is an object of the present invention to provide an aqueous coating composition for use in an elastic base coating composition, which is capable of following crazings on a surface of a substrate and is also applicable to a surface of an exposed coating film.

It is another object of the present invention to provide a coat-finishing method which is capable of forming a multi-layer film having good finish appearance and good durability by simplified coating steps and by use of the aqueous coating composition.

That is, the present invention provides an



aqueous coating composition for use in an elastic base coating composition, containing (A) a carbonyl group-containing copolymer emulsion and (B) a pigment and free of a crosslinking agent crosslinkable with the carbonyl group, a pigment volume concentration in the aqueous coating composition being in the range of 30 to 70 %, a film formed therefrom having an elongation in the range of 30 to 150 % at an atmosphere of 20 °C; and a coat-finishing method, which consists of coating an aqueous coating composition for use in an elastic base coating composition, containing (A) a carbonyl group-containing copolymer emulsion and (B) a pigment and free of a crosslinking agent crosslinkable with the carbonyl group, a pigment volume concentration in the aqueous coating composition being in the range of 30 to 70 %, a film formed therefrom having an elongation in the range of 30 to 150 % at an atmosphere of 20 °C, onto a substrate or an exposed coating film, followed by coating a topcoating material thereonto.

Detailed Description of the Invention:

The carbonyl group-containing copolymer emulsion (A) in the present invention may preferably include a copolymer emulsion prepared by subjecting a monomer mixture consisting of 0.1 to 30 % by weight of the carbonyl group-containing unsaturated monomer (a), 0 to 10 % by weight of a water-soluble unsaturated monomer (b) copolymerizable with the monomer (a) and 60 to 99.9 % by weight of an unsaturated monomer (c) other than both monomer (a) and monomer (b) to

emulsion polymerization in the presence of an emulsifier.

The monomer (a) is a monomer having at least one carbonyl group in one molecule, and may specifically include acrolein, diacetone acrylamide, diacetone methacrylamide, formylstyrol, vinyl alkyl ketone having 4 to 7 carbon atoms, for example, vinyl methyl ketone, vinyl ethyl ketone, vinyl butyl ketone and the like, and the like. Of these, diacetone acrylamide and diacetone methacrylamide are the most preferred.

The monomer (b) is copolymerizable with the monomer (a) and is a monomer which shows strong hydrophilic properties as it is, or by neutralization or as a quaternary salt, and may include anionic ones, cationic ones and nonionic ones.

Typical examples of the monomer (b) may include anionic ones such as (meth)acrylic acid, maleic acid, crotonic acid, β -carboxyethylacrylate, 2-acrylamide-2-methylpropane sulfonic acid, allylsulfonic acid, sodium styrene sulfonate, sulfoethyl methacrylate, sodium salt or ammonium salt thereof; cationic ones such as (meth)acrylamide, dimethylaminopropyl(meth)acrylamide, dimethylaminoethyl(meth)acrylate, adducts of glycidyl(meth)acrylate with amines, and the like; nonionic ones such as (meth)acrylate having a polyoxyethylene chain, and the like.

Typical examples of the monomer (c) may include C_1 - C_{24} alkyl or cycloalkyl ester of (meth)acrylic acid, for example, methyl(meth)acrylate, ethyl(meth)acrylate,



propyl(meth)acrylate, butyl(meth)acrylate, 2-ethylhexyl(meth)acrylate, cyclohexyl(meth)acrylate, lauryl(meth)acrylate, isobornyl(meth)acrylate, and the like; C₂-C₈ hydroxyalkylester of (meth)acrylic acid, for example, 2-hydroxyethyl(meth)acrylate, hydroxypropyl(meth)acrylate, and the like; vinyl aromatic compounds such as styrene and vinyltoluene; N-vinylpyrrolidone, ethylene, butylene, butadiene, chloroprene, vinyl propionate, vinyl acetate, (meth)acrylonitrile and the like. These monomers may be used depending on respective properties.

The copolymer emulsion (A) used in the present invention does not contain a crosslinking agent, particularly does not contain a crosslinking agent crosslinkable with the carbonyl group in the emulsion (A), for example, hydrazine compound and the like. Use of the crosslinking agent may undesirably reduce finish appearance depending on a combination between the substrate and the topcoating material. Therefore, a non-crosslinked film formed by use of the emulsion (A) is preferred.

A vehicle component in the composition of the present invention may include the emulsion (A) only, and may also include ones prepared by adding a known emulsion conventionally used in the field of the coating composition, for example, vinyl acetate emulsion, acrylic resin emulsion, vinyl acetate-acrylic resin emulsion, ethylene-vinyl acetate resin emulsion, etc. to the emulsion (A) in an amount of 50 % by weight or less based on a solid



content in all of the vehicle components. Since use of a crosslinkable resin emulsion such as an epoxy resin emulsion, urethane resin emulsion, alkyd resin emulsion or the like as the known emulsion may reduce finish appearance depending on a combination between the substrate and the topcoating material, a suitable selection of the known emulsions to be used is desirable.

Examples of the pigment (B) in the present invention may include color pigments such as titanium white, carbon black, red oxide and the like, extender pigments such as calcium carbonate, talc, mica, clay, diatomaceous earth, silica sand, barium sulfate and the like, aggregates, and the like. These pigments may optionally selected to be used.

The pigment (B) is required to be used in such an amount that a pigment volume concentration (hereinafter may be referred to as "PVC") in the aqueous coating composition is in the range of 30 to 70 %, preferably 40 to 60 %. The pigment volume concentration (PVC) means a percentage of a volume of a pigment to a total volume of a mixed solids content of the pigment and a resin, and is represented by the following equation:

$$\text{PVC (\%)} = \frac{\text{volume of pigment}}{\text{volume of pigment} + \text{volume of resin solid content}} \times 100$$

When the above PVC is less than 30 %, the resulting film shows poor fattiness and the substrate controlling



power of the aqueous coating composition is reduced. On the other hand, when the PVC is more than 70 %, denseness of the resulting film is reduced, resulting in that coating of the topcoating material onto the resulting film may result non-uniform absorption of the topcoating material into the resulting film and poor finish appearance, and the resulting film per se shows poor film strength.

A film formed by use of the aqueous coating composition of the present invention is required to have an elongation of 30 to 150 %, preferably 40 to 140 % at an atmosphere of 20°C. The elongation of the film represents a value obtained by measuring by use of a universal tension testing machine with a thermostatic chamber (Autograph AG 2000 B type, trade name, marketed by SHIMADZU Corporation) under the conditions of a tensile speed of approximately 200 mm/min. until the test piece breaks at 20°C. The test piece used for the measurement was prepared in accordance with JIS-A-6909.

When the elongation is less than 30 %, the resulting film can not sufficiently follow the crazings on the substrate. On the other hand, when the elongation is more than 150 %, cracks may cause on a topcoat depending on the kind of a topcoating material to be coated onto the resulting film.

The aqueous coating composition of the present invention, if needed, may further contain additives for use in the coating composition, for example, a surface active



agent, dispersant, anti-foaming agent, thickening agent, film-forming aid, preserving agent, antifreezing agent, organic solvent and the like.

The present invention also provides a coat-finishing method which comprises coating the aqueous coating composition of the present invention onto a substrate or an exposed coating film, followed by coating a topcoating material thereonto.

The above substrate is not particularly limited, and may include, for example, concrete, mortar, slate, precast concrete panels, autoclaved lightweight aerated concrete panels, concrete block, wood, stone, plastic, metal and the like. The exposed coating film may include acrylic resin based one, acrylic urethane resin based one, polyurethane resin based one, fluorocarbon resin based one, silicone acrylic resin based one, vinyl acetate resin based one and the like, which have been applied onto the above substrate, the method of the present invention is most preferably applicable to an exposed coating film formed by use of an organic solvent based lacquer topcoating material and having low solvent resistance. The above substrate and exposed coating film may preferably be subjected to control of the substrate and, if needed, a pimer coating beforehand.

The aqueous coating composition of the present invention is used as an elastic base coating composition. The use of the conventionally used elastic base coating composition may reduce finish appearance depending on a



combination between the exposed coating film and the topcoating material, whereas the method of the present invention is applicable to the exposed coating surface having low solvent resistance.

The topcoating material used in the method of the present invention may include any known aqueous or organic solvent based coating compositions capable of imparting coloring and gloss to a finished film surface and imparting weather resistance, water proof and the like to the finished film without particular limitations, and specifically include, for example, ones containing as a major component acrylic resin, acrylic urethane resin, polyurethane resin, fluorocarbon resin, acrylic silicone resin and the like respectively.

The coat-finishing method of the present invention comprises coating the aqueous coating composition onto the substrate or the exposed coating film by use of a known coating equipment such as a roller, air spray gun, airless spray gun, lithin gun, universal gun, brush or the like to form an elastic base coated film layer, followed by coating thereonto a topcoating material by use of the same coating equipment as above to form a topcoating film layer.

A coverage of the aqueous coating composition for use in the elastic base coating composition in the present invention is in the range of 0.15 to 1.5 kg/m², preferably 0.3 to 1.3 kg/m². Coating of the aqueous coating composition may preferably be carried out so as to form a



smooth surface or a smooth uneven surface, for example, a pattern such as an orange peel-like surface, crater-like surface or the like all over a coating surface. A coverage of the topcoating material is suitably in the range of 0.1 to 0.5 kg/m².

The present invention makes it possible to obtain an aqueous coating composition for use in the elastic base coating composition, which is capable of following crazings on the surface of the substrate and is also applicable to the surface of the exposed coating film.

The present invention makes it possible to prevent shrinkages which may cause in the case where the topcoating material is a solvent based one and the aqueous coating composition is coated onto an exposed coating film applied by use of an organic solvent based lacquer coating composition and having low solvent resistance, resulting in making it possible to provide a multi-layer coat-finishing having good finish appearance and good durability.

The present invention is particularly useful for coating onto both interior and exterior walls of architectural structures.

Example

The present invention will be explained more in detail by the following Examples and Comparative Examples, in which "part" and "%" mean by weight respectively.

Preparation of Aqueous Emulsion:

Preparation Example 1

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A 2-liter four-necked flask was charged with 312 parts of deionized water and 2.3 parts of Newcol 707SF (Nippon Nyukazai Co., Ltd., trade name, surfactant, solid content : 30%), followed by purging with nitrogen, and keeping at 80 °C. Thereafter, 0.7 part of ammonium persulfate was added, immediately thereafter followed by dropping a preemulsion prepared by emulsifying the following composition over 3 hours.

deionized water	338 parts
diacetone acrylamide	32 parts
acrylic acid	6 parts
styrene	97 parts
methyl metacrylate	260 parts
2-ethylhexyl acrylate	100 parts
n-butyl acrylate	150 parts
Newcol 707SF	62 parts
ammonium persulfate	1.2 parts

Thirty minutes after the completion of dropping, 7.7 parts of a solution prepared by dissolving 0.7 part of ammonium persulfate into 7 parts of deionized water was added over 30 minutes, followed by keeping at 80 °C for 2 hours, lowering the temperature to about 40 to 60 °C, controlling pH at 8 to 9 with ammonia water to obtain an emulsion (A) having a solid content of 50.7%, and a pH of 8.2.

Preparation Example 2

Experiments were carried out in the same method as in



Preparation Example 1 except that a preemulsion having the following composition was dropped to obtain an emulsion (B) having a solid content of 51.2 % and a pH of 8.2.

deionized water	338 parts
diacetone acrylamide	16 parts
acrylic acid	6 parts
styrene	97 parts
methyl methacrylate	276 parts
2-ethylhexyl acrylate	100 parts
n-butyl acrylate	150 parts
Newcol 707SF	62 parts
ammonium persulfate	1.2 parts

Preparation Example 3

Experiments were carried out in the same method as in Preparation Example 1 except that a preemulsion having the following composition was dropped to obtain an emulsion (C) having a solid content of 51.2 % and a pH of 8.2.

deionized water	338 parts
acrylic acid	6 parts
styrene	97 parts
methyl methacrylate	292 parts
2-ethylhexyl acrylate	100 parts
n-butyl acrylate	150 parts
Newcol 707SF	62 parts
ammonium persulfate	1.2 parts

Preparation of Aqueous Coating Composition for Use in Elastic Base Coating Composition:

Examples 1-4 and Comparative Examples 1-4

To the emulsions obtained in the above Preparation Examples 1-3 were added other components as shown Table 1, followed by mixing with agitation to obtain respective aqueous coating compositions. Results of characteristic properties of respective aqueous coating compositions are shown in Table 1, in which (Note 1) to (Note 5) represent as follows.

(Note 1) Extender pigment: calcium carbonate, specific gravity 2.7

(Note 2) Thickening agent: 2.5 % hydroxyethyl cellulose

(Note 3) Anti-foaming agent: SN defoamer A63
(Trade name, marketed by SAN NOPCO Co., Ltd.)

(Note 4) Dispersant: NOPCOSANT K (Trade name, marketed by SAN NOPCO Co., Ltd.)

(Note 5) Elongation of the resulting film (%):

A test piece was prepared in accordance with JIS-A-6909, and an elongation of a dry film was measured by use of a universal tension testing machine (Autograph AG 2000 B type, trade name, marketed by SHIMADZU Corporation) under the conditions of a tensile speed of approximately 200 mm/min. until the test piece breaks at 20°C.

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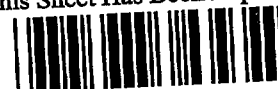


Table 1

		Examples				Comparative Examples			
		1	2	3	4	1	2	3	4
Formulation	Emulsion A	200	150	150		200	100		200
	Emulsion B				200				
	Emulsion C			50				200	
	Adipic acid dihydrazide								2.0
	Extender pigment (Note 1)	276	311	276	276	69	553	276	276
	Thickening agent (Note 2)	25	25	25	25	25	25	25	25
	Anti-foaming agent (Note 3)	5	5	5	5	5	5	5	5
	Dispersant (Note 4)	2.5	2.8	2.5	2.5	0.6	5.0	2.5	2.5
PVC (%)		50	60	50	50	20	80	50	50
Elongation of resulting film (Note 5)		110	70	100	105	250	10	100	100



Coating Examples:

Examples 5-11 and Comparative Examples 5-7

Respective aqueous coating compositions for use in the elastic base coating composition as shown in Table 2 were diluted with water so as to be a suitable coating viscosity, followed by coating onto mortar panels (90 × 300 × 20 mm) to be a coverage of about 1.0 kg/m² by use of a mastic roller, drying for one day at 20 °C and 75 RH% to form base films. Thereafter, respective topcoating materials as shown in Table 2 were coated onto respective base films formed as above and as shown in Table 2 at a coverage of about 0.2 kg/m² by airless spraying, and drying for 7 days at 20 °C and 75 RH% to obtain coat-finished panels. Performance test results of the coat-finished panels are shown in Table 2.

Examples 12-19 and Comparative Examples 8-12

Respective topcoating materials as shown in Table 3 were coated respective mortar panels (90 × 300 × 20 mm) to be a coverage of about 0.2 kg/m² by airless spraying, followed by drying for 7 days at 20°C and 75 RH% to prepare coated panels to be used as exposed coating film test panels respectively. Respective aqueous coating compositions as shown in Table 3 were diluted with water so as to be a suitable coating viscosity, followed by being coated onto respective exposed coating film test panels to be a coverage of about 0.3 to 0.5 kg/m² by use of a wool roller, drying for one day at 20 °C and 75 RH% to form base



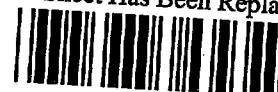
films, coating respective topcoating materials as shown in Table 3 onto respective base films to be a coverage of about 0.2 kg/m² by airless spraying, drying for 7 days at 20 °C and 75 RH% to obtain coat-finished panels. Performance test results of the coat-finished panels are shown in Table 3.

In Tables 2 and 3, respective topcoating materials are represented in (*1) to (*5) as follows, and performance test methods are represented in (Note 6) and (Note 7) as follows respectively.

- (*1) AQUA GLOSS White: Acrylic resin based aqueous topcoating material, trade name, marketed by Kansai Paint Co., Ltd.
- (*2) CELA ACRYL White: Acrylic resin based solvent type topcoating material, trade name, marketed by Kansai Paint Co., Ltd.
- (*3) ALES RETAN White: Polyurethane resin based solvent type topcoating material, trade name, marketed by Kansai Paint Co., Ltd.
- (*4) ALES SILICONE White: Acrylic silicone resin based solvent type topcoating material, trade name, marketed by Kansai Paint Co., Ltd.
- (*5) ALES FRON White: Fluorocarbon resin based solvent type topcoating material, trade name, marketed by Kansai Paint Co., Ltd.

Test Methods

(Note 6) Finish appearance: Finish appearances of surfaces



of the coated films on respective coated panels were evaluated by visual inspection as follows.

- : Nothing abnormal in finish appearance with uniform and smooth finish.
- ×: Nonuniform finish with nonuniformity due to picking up the coating surface such as the substrate and the exposed coating film, and with shrinkage.

(Note 7) Resistance against repeated warming and cooling actions: In accordance with JIS A 6909, respective coated panels were immersed for 18 hours in water at 20 °C, cooled for 3 hours in a thermostatic tank at -20°C and heated for 3 hours in another thermostatic tank at 50°C. After this operation, taking this 24 hours as a cycle, was repeated 10 times, the presence was observed by visual inspection as follows.

- : No developments of peeling, crazing and blistering are observed without serious discoloration and reduction in gloss.
- ×: At least one of the above drawbacks is observed.

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Table 2

	Examples							Comparative Examples		
	5	6	7	8	9	10	11	5	6	7
Substrate	Mortar	Mortar	Mortar	Mortar	Mortar	Mortar	Mortar	Mortar	Mortar	Mortar
Aqueous coating composition for use in elastic base coating composition	Example 1	Example 1	Example 1	Example 2	Example 2	Example 3	Example 4	Comparative Example 1	Comparative Example 2	Comparative Example 3
Topcoating materials	ALES RETAN (*3)	AQUA GLOSS (*1)	CELA ACRYL (*2)	ALES SILICONE (*4)	ALES FRON (*5)	ALES RETAN (*3)	ALES RETAN (*3)	ALES RETAN (*3)	ALES RETAN (*3)	ALES RETAN (*3)
Finish appearance (Note 6)	○	○	○	○	○	○	○	○	×	○
Resistance against repeated warming and cooling actions (Note 7)	○	○	○	○	○	○	○	×	○	×

Table 3

	Examples								Comparative Examples				
	1 2	1 3	1 4	1 5	1 6	1 7	1 8	1 9	8	9	1 0	1 1	1 2
Exposed coating film	AQUA GLOSS	CELA ACRYL	CELA ACRYL	ALES RETAN	ALES SILICONE	ALES FRON	CELA ACRYL	CELA ACRYL	AQUA GLOSS	CELA ACRYL	CELA ACRYL	CELA ACRYL	CELA ACRYL
Aqueous coating compositions for use in elastic base coating composition	Example 1	Example 1	Example 1	Example 1	Example 2	Example 2	Example 3	Example 4	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 4
Topcoating materials	ALES RETAN (*3)	ALES RETAN (*3)	CELA ACRYL (*2)	ALES RETAN (*3)	ALES RETAN (*3)	ALES RETAN (*3)	ALES RETAN (*3)	ALES RETAN (*3)	ALES RETAN (*3)	ALES RETAN (*3)	AQUA GLOSS (*1)	ALES RETAN (*3)	CELA ACRYL (*2)
Finish appearance (Note 6)	○	○	○	○	○	○	○	○	○	×	○	×	×
Resistance against repeated warming and cooling actions (Note 7)	○	○	○	○	○	○	○	○	×	○	×	○	○



What is claimed is:

1. An aqueous coating composition for use in an elastic base coating composition, containing (A) a carbonyl group-containing copolymer emulsion and (B) a pigment and free of a crosslinking agent crosslinkable with the carbonyl group, a pigment volume concentration in the aqueous coating composition being in the range of 30 to 70 %, a film formed therefrom having an elongation in the range of 30 to 150 % at an atmosphere of 20°C .
2. A coat-finishing method, which consists of coating an aqueous coating composition for use in an elastic base coating composition, containing (A) a carbonyl group-containing copolymer emulsion and (B) a pigment and free of a crosslinking agent crosslinkable with the carbonyl group, a pigment volume concentration in the aqueous coating composition being in the range of 30 to 70 %, a film formed therefrom having an elongation in the range of 30 to 150 % at an atmosphere of 20 °C , onto a substrate or an exposed coating film, followed by coating a topcoating material thereonto.
3. A method as claimed in claim 2, wherein the aqueous coating composition is coated onto the exposed coating film.
4. A method as claimed in claim 3, wherein the aqueous coating composition is coated onto the exposed coating film applied by an organic solvent based lacquer topcoating material.

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