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A new coating composition comprising, by dry weight based on the total dry weight of the coating composition, i) from 12% to 80% of polymer particles comprising, as polymerized units, by dry weight based on the total dry weight of the polymer particles, from 25% to 90%, of a vinyl acetate; and from 5% to 75%, of a vinyl ester of versatic acid and/or a vinyl ester of 2-ethyl hexanoic acid; and ii) from 0.1% to 6% of a wax; and iii) from 14% to 55% of a pigment.

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(54) Title: COATING COMPOSITION WITH IMPROVED LIQUID STAIN REPELLENCY

(57) Abstract: A new coating composition comprising, by dry weight based on the total dry weight of the coating composition, i) from 12% to 80% of polymer particles comprising, as polymerized units, by dry weight based on the total dry weight of the polymer particles, from 25% to 90%, of a vinyl acetate; and from 5% to 75%, of a vinyl ester of versatic acid and/or a vinyl ester of 2-ethyl hexanoic acid; and ii) from 0.1% to 6% of a wax; and iii) from 14% to 55% of a pigment.



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COATING COMPOSITION WITH IMPROVED LIQUID STAIN REPELLENCY

FIELD OF THE INVENTION

The present invention relates to a coating composition with improved liquid stain repellency.

5

INTRODUCTION

Stain repellency, especially liquid stain repellency, is one of the key performance requirements for coating films. Stain repellency is the resistance to stains, including resistance to being wetted by liquid stain, resistance to being adhered by stains, and/or ease of stain removal.

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Stain repellency is achievable by the appropriate selection of binders and additives in a coating formulation. Wax is the most commonly used additive. Wax tends to migrate to the surface of dry coating films and reduces their surface tension, thereby improving their stain repellency.

15

Vinyl acetate (VA) is a relatively inexpensive monomer and its polymers with ethylene or acrylic monomers are usually used as a binder for architectural coatings. Because of its hydrophilicity, it is not commonly used in coating formulations with liquid stain repellency requirement. VA-based coating films tend to be more hydrophilic and therefore usually have poorer liquid stain repellency. To overcome it, more wax is needed in the formulations.

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It is therefore still desired in the technical art a coating composition with improved liquid stain repellency. It is also desired that this coating composition comprises a VA-based binder and a relatively low wax content.

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SUMMARY OF THE INVENTION

The present invention provides a coating composition comprising, by dry weight based on the total dry weight of the coating composition, i) from 12% to 80% of polymer particles comprising, as polymerized units, by dry weight based on the total dry weight of the polymer particles, from 25% to 90%, of a vinyl acetate; and from 5% to 75%, of a vinyl ester

of versatic acid and/or a vinyl ester of 2-ethyl hexanoic acid; and ii) from 0.1% to 6% of a wax; and iii) from 14% to 55% of a pigment.

In a preferred embodiment, the polymer particles further comprise, by dry weight based on the total dry weight of the polymer particles, from 0.1% to 50% of (meth)acrylate monomers.

DETAILED DESCRIPTION OF THE INVENTION

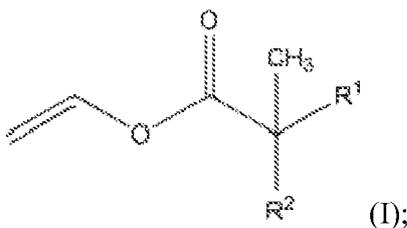
The coating composition of the present invention comprises, by dry weight based on the total dry weight of the coating composition, from 12% to 80%, preferably from 15% to 70%, and more preferably from 20% to 60%, of polymer particles; from 0.1% to 6%, preferably from 0.3% to 4%, and more preferably from 0.6% to 3%, of a wax; and from 14% to 55%, preferably from 17% to 50%, and more preferably from 20% to 40%, of a pigment.

In a preferred embodiment, the coating composition of the present invention further comprises from 0.1% to 70%, preferably from 0.5% to 60%, and more preferably from 1% to 50%, by dry weight based on the total dry weight of the coating composition, of an extender.

Polymer Particles

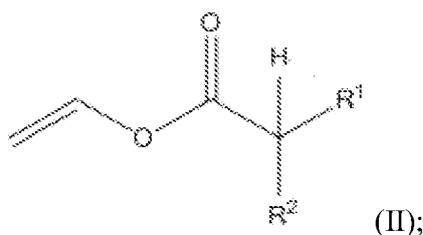
The polymer particles comprises, as polymerized units, by dry weight based on the total dry weight of the polymer particles, from 25% to 90%, preferably from 40% to 80%, and more preferably from 55% to 70%, of a vinyl acetate; and from 5% to 75%, preferably from 10% to 50%, and more preferably from 15% to 30%, of a vinyl ester of versatic acid and/or a vinyl ester of 2-ethyl hexanoic acid.

The vinyl ester of versatic acid is a compound having a formula (I):



wherein R¹ or R² is each independently C₁-C₁₀ alkyl. Suitable examples include the formula (I) compound with R¹ and R² being alkyl groups each containing a total of 6 carbon atoms, and the formula (I) compound with R¹ and R² being alkyl groups each containing a total of 7 carbon atoms, respectively as commercially available under the trademarks of VEOVATM 10, and VEOVA 9 from Momentive Specialty Chemicals Management (Shanghai) Co., Ltd.

The vinyl ester of 2-ethyl hexanoic acid is a compound having a formula (II):



wherein R^1 is a C_4 alkyl, and R^2 is a C_2 alkyl. Suitable example is commercially available under the trademark of VEOVA EH from Momentive Specialty Chemicals Management
5 (Shanghai) Co., Ltd.

In a preferred embodiment, the polymer particles of the present invention further comprises, as polymerized units, from 0.1% to 50%, preferably from 1% to 30%, and more preferably from 5% to 20%, by dry weight based on the total dry weight of the polymer particles, of (meth)acrylate monomers.

10 Suitable examples of the (meth)acrylate monomers include butyl (meth)acrylate, ethylhexyl (meth)acrylate, ethyl (meth)acrylate, methyl methacrylate, n-heptyl (meth)acrylate, n-octyl (meth)acrylate, n-nonyl (meth)acrylate, n-decyl (meth)acrylate, stearyl (meth)acrylate, lauryl (meth)acrylate, maleic anhydride, and acrylonitrile.

In a preferred embodiment, the polymer particles further comprise, as polymerized
15 units, from 0.01% to 2%, preferably from 0.05% to 1.5%, and most preferably from 0.1% to 1%, by dry weight based on the total dry weight of the polymer particles, of a stabilizer monomer.

In a preferred embodiment, the binder composition further comprises, from 0.01% to 5%, preferably from 0.05% to 3%, and most preferably from 0.1% to 2%, by dry weight
20 based on the total dry weight of the polymer particles, of a colloidal stabilizer.

Suitable examples of the colloidal stabilizer include hydroxyethyl cellulose (HEC) and its derivatives, and polyvinyl alcohol (PVOH).

Suitable examples of the stabilizer monomer include sodium styrene sulfonate (SSS), sodium vinyl sulfonate (SVS), 2-acrylamido-2-methylpropanesulfonic acid (AMPS),
25 acrylamide (AM), acrylic acid (AA), methylacrylic acid (MAA), and itaconic acid (IA).

The polymerization of the polymer particles can be any method known in the art, including emulsion polymerization, mini-emulsion polymerization, and mechanical

dispersing technology. Suitable examples of polymerization process include those disclosed in US 7,579,081 B2, US 7,357,949 B2 and WO 2010074865 A1.

Wax

The wax used in the present invention is preferably a paraffin wax, and more preferably a melted refined paraffin wax or its blend with other materials such as polyethylene wax, carnauba wax, or ethylene acrylic acid. The preferred wax has a melt point temperature of 46 to 71°C.

Wax can be added into the coating composition as a wax emulsion, or added by dissolving into the monomers as in US 4368077, or added by blending with other coating components.

Suitable examples of the wax include wax emulsions such as MICHEM™ Emulsion 62330 (a blend emulsion of paraffin wax and polyethylene), MICHEM Emulsion 34935 (a blend emulsion of paraffin wax and ethylene acrylic acid), MICHEM Lube 180 (a blend emulsion of paraffin wax and carnauba wax), MICHEM Emulsion 70950, and MICHEM Emulsion 71450 commercially available from Michaelman Inc., and ULTRALUBE™ E-340 commercially available from Keim Additec Surface GmbH.

The wax emulsion can be prepared by melting refined wax to a temperature above its melting point (the elevated temperature). Appropriate emulsifiers such as stearic acid, oleic acid, diethylamine ethanol, 2-amino-2-methyl-1-propanol, can then be stirred into the molten wax at the elevated temperature. A base, such as potassium hydroxide or ammonium hydroxide, can separately be dissolved in ethylene glycol or water at the elevated temperature and then slowly added to the molten wax with an increasing agitation speed of the mixer. After all the water/base mixture has been added to the molten wax, the resulting wax emulsion can be passed through a homogenizer. After homogenization, the resulting wax emulsion is cooled, for example, through a heat exchanger, and then filtered and packaged.

Pigments and Extenders

Pigments of the present invention are typically inorganic pigment particles, and preferably particulate inorganic materials which are capable of materially contributing to the opacity or hiding capability of a coating. Such materials typically have a refractive index of equal to or greater than 1.8 and include titanium dioxide (TiO₂), zinc oxide, zinc sulfide, barium sulfate, and barium carbonate. Titanium dioxide (TiO₂) is preferred.

Extenders are typically particulate inorganic materials having a refractive index of less than or equal to 1.8 and greater than 1.3 and include calcium carbonate, clay, calcium sulfate, aluminosilicate, silicate, zeolite, mica, diatomaceous earth, solid or hollow glass, and ceramic bead.

5 **Coating Composition Additives**

The coating composition of the present invention may further contain at least one conventional coating additives such as coalescing agents, cosolvents, surfactants, buffers, neutralizers, thickeners, non-thickening rheology modifiers, dispersants, humectants, wetting agents, mildewcides, biocides, plasticizers, antifoaming agents, defoaming agents, anti-
10 skinning agents, colorants, flowing agents, crosslinkers, and anti-oxidants. The uses of these additives are common knowledge in the art.

Preparation of the Coating Composition

The preparation of the coating composition involves the process of selecting and admixing appropriate coating ingredients in the correct proportions to provide a coating with
15 specific processing and handling properties, as well as a final dry coating film with the desired properties.

Application of the Coating Composition

The coating composition may be applied by conventional application methods such as brushing, roller application, and spraying methods such as air-atomized spray, air-assisted
20 spray, airless spray, high volume low pressure spray, and air-assisted airless spray.

Suitable substrates include concrete, cement board, medium-density fiberboard (MDF) and particle board, gypsum board, wood, stone, metal, plastics, wall paper and textile. Preferably, all the substrates are pre-primed by waterborne or solvent borne primers.

25

EXAMPLES

I. Raw materials

Table 1a

Compound	Company
DISPONIL TM FES-32 surfactant (FES-32)	BASF Chemical Co., Ltd.
ECOSURF TM SA-9 surfactant (SA-9)	The Dow Chemical Company
CELLOSIZ TM QP-3L stabilizer (QP-3L)	The Dow Chemical Company

TERGITOL™ 15-S-40 surfactant (15-S-40)	The Dow Chemical Company
VEOVA™ 10 monomer (VEOVA 10)	Momentive Specialty Chemicals Management (Shanghai) Co., Ltd.
SILQUEST™ A-171 Cross-linker (A-171)	Momentive Specialty Chemicals Management (Shanghai) Co., Ltd.
PRIMAL™ E-2086 binder (E-2086)	The Dow Chemical Company
TEGO™ Foamex 825 defoamer	Evonik Degussa (China) Co., Ltd.
KATHON™ LXE biocide	The Dow Chemical Company
NOPCO™ NXZ defoamer	San Nopco Ltd.
AMP-95 base	The Dow Chemical Company
OROTAN™ 1288 dispersant	The Dow Chemical Company
TRITON™ EF-106 wetting agent	The Dow Chemical Company
ACRYSOL™ TT-935 rheology modifier	The Dow Chemical Company
NATROSOL™ 250 HBR rheology modifier	Aqualon Biotechnology Co., Ltd.
TI-PURE™ R-706 pigment	Dupont China Holding Co., Ltd.
CC-700 extender	Guangfu Building Materials Group (China)
CC-1000 extender	Guangfu Building Materials Group (China)
TEXANOL™ coalescent	Eastman Chemical Company
ULTRALUBE™ E-340 wax emulsion	Keim Additec Surface GmbH

Table 1b Abbreviation

Compound	Chemical description
SVS	sodium vinyl sulfonate (25% active)
SSS	sodium styrene sulfonate
AMPS	2-acrylamido-2-methylpropanesulfonic acid
BA	butyl acrylate
VA	vinyl acetate
ST	styrene
AM	acrylamide
MAA	methylacrylic acid
AA	acrylic acid
IA	itaconic acid

SPS	sodium persulfate
IAA	isoascorbic acid
SBS	sodium bisulfite
t-BHP	t-butyl hydroperoxide
EDTA	ethylenediaminetetraacetic acid

II. Test procedures

Liquid stain repellency

Liquid stain repellency evaluates the difficulty of wetting a coating surface with liquid stains. To determine the liquid stain repellency, test coatings were casted on black vinyl charts (The Leneta Co., Form P121-10N Leneta Scrub Test Panels), or on substrates of ceramic, metal, plastic and cementitious panels. The coatings were dried for 7 days. The coated substrates were kept vertically so that the liquid stain drops flew from the upper to the bottom side of substrates coated with the test coatings. Liquid stain repellency was observed by naked eyes and was represented by the liquid stain repellency scores shown in Table 2.

TABLE 2

Score	State
10	No wetting nor adhesion of water droplets observed on the coating surface
8	1/3 wetting area observed by individual small circular water
6	3/4 wetting area observed by individual small circular water
5	Wetting observed by individual small circular water droplets observed on the coating surface
4	Wetting observed by individual small elliptic water droplets observed on the coating surface
3	Wetting observed by individual large water droplets observed on the coating surface
2	Wetting observed along the discrete track of hydrophilic stains on the coating surface
1	Wetting observed along the thinner track of hydrophilic stains on the coating surface
0	Wetting observed along the entire track of hydrophilic stains on coating surface

III. Examples

15 Dispersions of polymer particles

Dispersion 1

A monomer emulsion was prepared by first mixing 204.90g DI water, 16.72g FES-32 and 14.84g 15-S-40, and followed by adding 8.29g SVS, 689.43g VA, 296.36g BA, and 52.00g VEOVA 10. 2.08g QP-3L, 0.21g sodium acetate and 390.37g DI water were charged to a 3-L 4-necked round bottom flask equipped with a mechanical stirrer, a nitrogen gas

blanket, a thermometer, a condenser, a heating mantel and a temperature controller. The contents of the flask were heated to 84°C under a nitrogen atmosphere. 5g FeSO₄·7H₂O (0.2%), 1g EDTA (1%) were added to the stirred flask, and followed by adding 1.55g SPS in 20.86g DI water and 15.25g E-2086, and rinsed with 11.37g DI water. The monomer emulsion, a solution of 1.00g SPS dissolved in 44.04g DI water and a solution of 0.50g IAA and 1.90g sodium acetate in 44.04g DI water were then added to the flask over 180 minutes. Reaction temperature was maintained at 75°C. 13.16g DI water was used to rinse the emulsion feed line. After the contents of the flask were cooled to 70°C, 0.10g t-BHP in 1.93g DI water, and 0.07g SBS in 1.93g DI water were added to the flask, and were held for 15 minutes. The flask temperature was cooled to 65°C, then 1.50g t-BHP in 12.55g DI water, and 1.15g SBS in 12.55g DI water were added to the flask over 30 minutes. When the flask temperature was lower than 50°C, the contents of the flask were neutralized to a pH of 4.64 using 12.0g NaOH solution (5.0%). After the solution of 6.79g KATHON LX in 3.73g DI water and 0.89g TEGO 825 were added to the flask, the gel was removed by filter and the resulting dispersion 1 had a 55.28% solid and a 359nm particle size.

Dispersion 2

In a similar procedure as in preparing dispersion 1, dispersion 2 was prepared from a monomer emulsion containing 615.59g VA, 206.93g VEOVA 10, 207.97g BA, 8.29g SVS, 12.96g AM, and 1.07g A-171. The resulting dispersion 2 had a 55.58wt% solid and a 342nm particle size.

Dispersion 3

In a similar procedure as in preparing dispersion 1, dispersion 3 was prepared from a monomer emulsion containing 712.31g VA, 310.40g VEOVA 10, 10.45g AM, 3.21g A-171, and 8.29g SVS. The resulting dispersion 3 had a 51.30wt% solid and a 362nm particle size.

Dispersion 4

In a similar procedure as in preparing dispersion 1, dispersion 4 was prepared from a monomer emulsion containing 517.85g VA, 519.93g VEOVA 10, and 8.29g SVS. The resulting dispersion 4 had a 55.24wt% solid and a 366nm particle size.

Dispersion 5

In a similar procedure as in preparing dispersion 1, dispersion 5 was prepared from a monomer emulsion containing 257.89g VA, 779.90g VEOVA 10, and 8.29g SVS. The resulting dispersion 5 had a 50.40wt% solid and a 340nm particle size.

Dispersion 6

Dispersion 6 is a polymer particle dispersion comprising by dry weight, 15% BA and 85% VA.

10

The compositions of the dispersions were summarized in Table 3.

TABLE 3

Dispersion	monomers (dry weight % based on the total dry weight of the polymer particles)					
	VA	VEOVA 10	BA	SVS	AM	A-171
1	66.3	5	28.5	0.2	-	-
2	59.2	20	20	0.2	0.5	0.1
3	68.5	30	-	0.2	1	0.3
4	49.8	50	-	0.2	-	-
5	25.0	75	-	0.2	-	-
6	85.0	-	15	-	-	-

15 Coating compositions

Coating 1

A coating containing dispersion 1 was prepared using the ingredients listed in Table 4. Grind materials were mixed using a high speed Cowles disperser, and letdown materials were added using a conventional lab mixer. Appropriate adjustment of weights of ACRY SOL™ TT-935 rheology modifier and AMP-95 base in letdown process was done such that the resulting coating had a KU viscosity of 90 to 95, and a pH of 8.5 to 9.0. The PVC of the resulting coating was 35.7%. The volume solid of the resulting coating was 32.1%.

20

TABLE 4

Coating formulation	
Material	Weight(g)
Grind	
Water	110.69
NATROSAL™ 250 HBR rheology modifier	2.01
AMP-95 base	0.51
OROTAN™ 1288 dispersant	3.23
KATHON™ LXE biocide	1.00
TRITON™ EF-106 wetting agent	1.00
FOAMASTER™ NXZ defoamer	1.00
TI-PURE™ R-706 pigment	149.99
CC-1000 extender	33.73
CC-700 extender	106.38
Letdown	
Latex 1	336.55
Dispersion 1	13.03
TEXANOL™ coalescent	1.00
TEGO™ Foamex 825 defoamer	1.60
AMP-95 base	1.00
KATHON™ LXE biocide	183.28
Water	14.00
ACRYSOL™ TT-935 rheology modifier	40
Total	1000
Coating characteristics	
Total PVC	35.7%
Volume solids	32.1%
Weight solids	47.3%

Coating 2

- 5 Coating 2 containing dispersion 1 was prepared following the procedure of preparing Coating 1 except that the paraffin wax emulsion (ULTRALUBE™ E-340) loading in Coating 2 was 3%. In addition, appropriate adjustment of weights of ACRYSOL TT-935 rheology modifier and AMP-95 base in letdown process was done such that the resulting coating had a KU viscosity of 90 to 95, and a pH of 8.5 to 9.0. The PVC of the resulting coating was 35.7%.
- 10 The volume solid of the resulting coating was 32.2%.

Coating 3 to coating 8

Coating 3 to Coating 8 containing Dispersion 2 to Dispersion 6 (as shown in Table 5) were prepared following the procedure of preparing Coating 1 except that the paraffin wax emulsion (ULTRALUBE E-340) loadings in Coatings 3 to 8 were respectively 1.5%, 3.7%, 2.2%, 0.4%, 0.2%, and 4.6%. Appropriate adjustment of weights of ACRY SOL TT-935 rheology modifier and AMP-95 base in letdown process was done such that the resulting coatings had KU viscosities of 90 to 95, and pHs of 8.5 to 9.0. In addition, appropriate adjustment of water and binder weights was done such that the resulting coatings had volume solids of 32.1% and PVCs of 35.7%.

10 Coating 8 was a comparative example.

TABLE 5

Coatings	Dispersions	Wax (dry weight % based on the total dry weight of the coating composition)	Liquid stain repellency (film dried for 4 days at RT)
1	1	4.23%	5
2	1	3.17%	4
3	2	1.59%	5
4	3	3.91%	5
5	4	2.33%	6
6	5	0.42%	6
7	5	0.21%	4
8*	6	4.86%	4

* *Comparative example.*

15 The results in the above table indicated that coatings 1-7, comprising respectively dispersions 1-5 provided good liquid stain repellency. Coating 8 was a comparative example comprising dispersion 6 consisted of 15% BA and 85% VA. Without using VEOVA 10, coating 8 would need a much higher wax loading to achieve acceptable liquid stain repellency. The results of coatings 1-7 indicated that to achieve similar liquid stain repellency,
20 less wax was needed in high VEOVA 10 loading coatings.

What is claimed is:

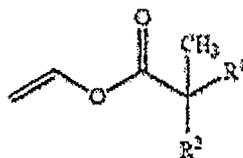
1. A coating composition comprising, by dry weight based on total dry weight of the coating composition,

i) from 12% to 80% of polymer particles comprising, as polymerized units, by dry weight based on the total dry weight of the polymer particles, from 25% to 90%, of a vinyl acetate; and from 5% to 75%, of a vinyl ester of versatic acid and/or a vinyl ester of 2-ethyl hexanoic acid; and

ii) from 0.1 % to 6% of a wax; and

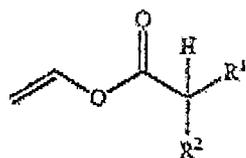
iii) from 14% to 55% of a pigment;

wherein the vinyl ester of versatic acid is a compound having a formula (I):



(I);

wherein R¹ and R² are each independently C₁-C₁₀ alkyl; and the vinyl ester of 2-ethyl hexanoic acid is a compound having a formula (II):



(II);

wherein R¹ is a C₄ alkyl, and R² is a C₂ alkyl.

2. The coating composition according to claim 1 wherein the polymer particles comprise, as polymerized units, by dry weight based on the total dry weight of the polymer particles, from 40% to 80% of the vinyl acetate; and from 10% to 50% of the vinyl ester of versatic acid.

3. The coating composition according to claim 1 wherein R¹ and R² of formula (I) are alkyl groups containing a total of 6 carbon atoms, or are alkyl groups containing a total of 7 carbon atoms.

4. The coating composition according to claim 1 further comprising from 0.1% to 70%, by dry weight based on total dry weight of the coating composition, of an extender.

5. The coating composition according to claim 1 wherein the polymer particles further comprise, by dry weight based on the total dry weight of the polymer particles, from 0.1% to 50% of (meth)acrylate monomers.

6. The coating composition according to claim 1 wherein the polymer particles further comprises, as polymerized units, from 0.01% to 2% by dry weight based on the total dry weight of the polymer particles, of a stabilizer monomer.

7. The coating composition according to claim 1 wherein it further comprises, from 0.01% to 5% by dry weight based on the total dry weight of the polymer particles, of a colloidal stabilizer.