(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 343 007 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **89305102.9**

(22) Date of filing: **19.05.89**

(51) Int. Cl.[4]: **D 21 H 1/28**
D 21 H 1/22

(30) Priority: **20.05.88 JP 123387/88**

(43) Date of publication of application:
23.11.89 Bulletin 89/47

(84) Designated Contracting States:
DE FR GB IT NL SE

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(54) Paper coating composition.

(57) An aqueous coating composition useful for the production of a coated paper is disclosed which includes
a white pigment,
a binder, and
an additive which is an acrylic acid/methacrylic acid copolymer and/or a copolymer of the following two monomers:

(a) an unsaturated acid of the formula:
$CH_2 = CR^1COOH$
wherein R^1 stands for hydrogen or a methyl group, and

(b) an unsaturated ester of the formula
$CH_2 = CR^2COOR^3$
wherein R^2 stands for hydrogen or a methyl group and R^3 stands for an alkyl group having 2-4 carbon atoms, the amount of the additive being 0.001-2 % based on the weight of the white pigment.

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Description

PAPER COATING COMPOSITION

This invention relates generally to a paper coating composition to be used for the production of coated papers and, more specifically, to an aqueous coating composition to be applied over the surface of a paper for improving its surface properties such as surface smoothness, gloss and printability. The present invention is also directed to a coated paper having a surface coated layer obtained from the above coating composition.

One known coating composition includes a white pigment such as kaolin, a binder, a latex and a dispersing agent. For the purpose of controlling the viscosity, fluidity and water retentivity of such a composition, it is also known to incorporate thereinto an additive such as sodium alginate or carboxymethylcellulose.

These known additives suffer from a drawback because, when they are used in an amount sufficient to obtain a desired water retentivity, the viscosity of the resulting composition becomes so high, with the simultaneous reduction of the fluidity, that it becomes impossible to effect a high speed coating. On the other hand, water retentivity of the coating composition is failed to be sufficiently improved when the additives are used in an amount providing suitable viscosity and fluidity. Poor water-retentivity is disadvantageous because when the coating composition is brought into contact with a paper to be coated, water tends to be separated from the coating composition and penetrates into the paper together with a portion of the binder, so that the resulting coat becomes poor in smoothness, printability and the like surface properties. The present invention has been made with the foregoing problems of the conventional paper coating compositions.

In accordance with one aspect of the present invention, there is provided an aqueous coating composition comprising:

a white pigment;

a binder; and

an additive which is at least one member selected from the group consisting of acrylic acid/methacrylic acid copolymers and copolymers of the following two monomers:

(a) an unsaturated acid of the formula:

$CH_2 = CR^1COOH$

wherein R^1 stands for hydrogen or a methyl group, and

(b) an unsaturated ester of the formula:

$CH_2 = CR^2COOR^3$

wherein R^2 stands for hydrogen or a methyl group and R^3 stands for an alkyl group having 2-4 carbon atoms, said additive being present in an amount of 0.001-2 % based on the weight of said white pigment.

In another aspect, the present invention provides a coated paper obtained by coating the above composition over the surface of a paper.

The present invention will now be described in detail below.

The paper coating composition according to the present invention is characterized by the inclusion of a specific additive, i.e. an acrylic acid/methacrylic acid copolymer and/or a copolymer of (a) acrylic acid or methacrylic acid and (b) an alkyl acrylate or alkyl methacrylate. The alkyl group of the monomer (b), i.e. alkyl acrylate or methacrylate has 2-4 carbon atoms. The additive preferably has an average molecular weight of 5,000 to 500,000. It is important that the additive should be present in an amount of 0.001 to 2 %, preferably 0.01 to 1 % based on the weight of the white pigment. Too small an amount of the additive below 0.001 % by weight is insufficient for attaining the object of the present invention. On the other hand, when the amount of the additive exceeds 2 % by weight, the resulting coating composition becomes considerably high in viscosity or gellation of the composition occurs.

The acrylic acid/methacrylic acid copolymer preferably has a molar ratio of the former acid to the latter acid of 9:1 to 3:2, more preferably 4:1 to 13:7 and an average molecular weight of 10,000 to 100,000. The copolymer of the acid (a) and the ester (b) preferably has a molar ratio of the acid (a) to the ester (b) of in the range of 19:1 to 1:1, more preferably 4:1 to 3:2, and an average molecular weight of 60,000 to 300,000.

Any known white pigment conventionally used for a paper coating composition may be used in the present invention. Illustrative of suitable pigments are clay, calcium carbonate, kaolin, talc, titanium oxide, aluminum hydroxide, silica, zinc oxide, activated terra alba, acid terra alba, lake, diatomaceous earth, plastic pigments and mixtures thereof. The content of the white pigment in the coating composition is generally 40-70 % by weight.

As the binder, there may be used a latex or a solution of synthetic or natural high molecular weight polymers. Illustrative of suitable polymers to be used as the binder are styrene/butadiene copolymers, styrene/acryl copolymers, vinyl acetate/acryl copolymers, ethylene/vinyl acetate copolymers, butadiene/methyl methacrylate copolymers, vinyl acetate/butyl acrylate copolymers, styrene/maleic anhydride copolymers, isobutene/maleic anhydride copolymers, acrylic acid/methylmethacrylate copolymers, water-soluble starch, casein and soy bean protein. The content of the binder is preferably 3 to 30 %, more preferably 7 to 20 % based on the weight of the pigment.

The coating composition according to the present invention preferably contains a dispersing agent such as sodium polyacrylate, sodium hexametaphosphate or sodium pyrophosphate.

Because of the use of a specific copolymer as an additive, the coating composition according to the present invention exhibits excellent water-retentivity, viscosity and fluidity and can give coated paper having excellent

properties such as printability and gloss.

Such properties may be further improved when the copolymer is used in conjunction with a polyol. Examples of the polyol include glycerin, alkylene glycols such as ethylene glycol and propylene glycol, and polyalkylene glycols such as polyethylene glycol and polypropylene glycol. The use of glycerin is particularly preferred. The polyol is preferably used in an amount of 1-20 %, more preferably 5-15 % based on the weight of the copolymer.

The coating composition according to the present invention is suitably applied over one or both sides of a paper such as a wood-free paper, a ground wood paper or a paper board to give a coated paper. Coating may be effected in a manner known per se using, for example, a blade coater, a roll coater, an air knife coater or a short dwell coater.

The following examples will further illustrate the present invention.

Preparation of Coating Liquid:

Example 1

A coating liquid having the following composition was prepared:

Ingredient	Amount (parts by weight)
Pigment	
Clay	90
Heavy calcium carbonate	10
Binder	
Latex *1	10
Oxidized starch	7
Dispersant *2	0.1
Additive *3	0.1
Water	78

*1 Styrene/butadiene latex (L-1622 manufactured by Asahi Kasei Kogyo K. K.)
*2 Sodium polyacrylate (SDA-40N, manufactured by Somar Corporation)
*3 Methacrylic acid/ethyl acrylate copolymer (manufactured by Rohm & Haas), referred to as Copolymer A

Example 2

A coating liquid was obtained by replacing the additive of Example 1 with a methacrylic acid/butyl acrylate copolymer (manufactured by Rohm & Haas, referred to as Copolymer B).

Example 3

A coating liquid was obtained by replacing the additive of Example 1 with a mixture of 10 parts by weight of the methacrylic acid/ethyl acrylate copolymer (Copolymer A) with 1 part by weight of glycerin.

Example 4

A coating liquid was obtained by replacing the additive of Example 1 with a mixture of 10 parts by weight of the methacrylic acid/butyl acrylate copolymer (Copolymer B) with 1 part by weight of glycerin.

Example 5

A coating liquid was obtained by replacing the additive of Example 3 with a mixture of 10 parts by weight of an acrylic acid/methacrylic acid copolymer (Copolymer C, average molecular weight: 70,000) with 1 part by weight of glycerin.

Example 6

A coating liquid was obtained by replacing Copolymer C of Example 5 with an acrylic acid/methacrylic acid copolymer (Copolymer D, average molecular weight: 40,000).

Comparative Example 1

A coating liquid was obtained by replacing the additive of Example 1 with carboxymethylcellulose (CMC).

Comparative Example 2

A coating liquid was obtained by replacing the additive of Example 1 with sodium alginate.

Comparative Example 3

A coating liquid was obtained by replacing the additive of Example 1 with water.

Properties of Coating Liquids

The above coating liquids were tested for their viscosity, fluidity and water retentivity in the following manner:

(1) B-Type viscosity (cps):

Measured in accordance with TAPPI Standard T648 Su-72 at a revolution speed of 60 rpm.

(2) HS (High Share) viscosity (cps):

Measured with a High Share Viscosimeter (manuafactured by d Seiki K. K.) at a revolution speed of 4000 rpm.

(3) Fluidity:

Defined by the following equation (smaller, the better):

Fluidity = (viscosity of the coating composition) / (viscosity of the aqueous phase of the coating composition*)

(*: The composition is first separated into a liquid (aqueous) phase and a solid phase by centrifugation. Then, the viscosity of the liquid phase is measured.)

(4) Water-retentivity:

Measured in accordance with the S&D Warren method (greater, the better).

The test results were as summarized in Table 1.

Production of Coated Paper:

Each of the above coating liquids was applied over one side of a paper having a basis weight of 60 g/m^2 and then dried to obtain a coated paper having a basis weight of 75 g/m^2.

Properties of the Coated Paper:

The thus obtained coated papers were tested for their gloss, brightness, smoothness and resistance to picking in the following manner:

(1) Gloss:

Measured in accordance with Japan Industrial Standard JIS P8142 (1965).

(2) Brightness:

Measured in accordance with Japan Industrial Standard JIS P8123 (1961).

(3) Smoothness:

Measured in accordance with Japan Industrial Standard JIS P8119 (1976).

(4) Resistance to Picking:

Dry pick and wet pick were measured using a printability tester (RI tester manufactured by Akira Seisakusho K.K.) and evaluated in terms of 5-level rating (greater, the better).

The test results are also summarized in Table 1.

Table 1

Coating Liquid	Additive	Properties of Coating Liquid				Properties of Coated Paper				
		B-type viscosity (cps)	HS viscosity (cps)	Fluidity	Water-retentivity (sec)	Gloss	Brightness	Smoothness (sec)	Dry pick	Wet pick
Ex. 1	Copolymer A	2050	63	220	24.0	52.7	71.0	35.0	3.8	4.0
Ex. 2	Copolymer B	1900	63	198	25.0	52.7	71.0	36.0	3.8	4.1
Ex. 3	Copolymer A & glycerin	1800	60	172	25.7	52.6	71.3	36.6	4.5	4.3
Ex. 4	Copolymer B & glycerin	1750	61	168	25.8	53.2	71.0	37.0	4.5	4.4
Ex. 5	Copolymer C & glycerin	2850	62	158	26.2	54.0	70.8	43.0	4.0	4.2
Ex. 6	Copolymer D & glycerin	2620	60	162	26.0	54.0	70.8	42.8	4.0	4.2
Comp.1	CMC	2850	70	350	23.6	46.5	71.1	36.0	3.8	4.0
Comp.2	sodium alginate	2900	66	240	22.5	48.0	71.2	36.0	4.0	4.0
Comp.3	-	1140	52	1558	20.7	50.7	71.0	32.6	3.5	4.0

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Claims

1. An aqueous coating composition comprising:a white pigment;
a binder; and
an additive which is at least one member selected from the group consisting of acrylic acid/methacrylic acid copolymers and copolymers of the following two monomers:
(a) an unsaturated acid of the formula:
$CH_2 = CR^1COOH$
wherein R^1 stands for hydrogen or a methyl group, and
(b) an unsaturated ester of the formula:
$CH_2 = CR^2COOR^3$
wherein R^2 stands for hydrogen or a methyl group and R^3 stands for an alkyl group having 2-4 carbon atoms, said additive being present in an amount of 0.001-2 % based on the weight of said white pigment.

2. A coating composition according to claim 1, wherein said additive is a copolymer of the acid (a) and the ester (b) with a molar ratio of the acid (a) to the ester (b) being in the range of 19:1 to 1:1.

3. A coating composition according to claim 1, wherein said additive is a copolymer of acrylic acid and methacrylic acid with a molar ratio of the former acid to the latter acid being 9:1 to 6:4.

4. A coating composition according to claim 1, wherein said additive has an average molecular weight of 5,000 to 500,000.

5. A coating composition according to claim 2, wherein said copolymer of the acid (a) and the ester (b) has an average molecular weight of 60,000 to 300,000.

6. A coating composition according to claim 3, wherein wherein said acrylic acid/methacrylic acid copolymer has an average molecular weight of 10,000 to 100,000.

7. A coating composition according to claim 1, wherein the content of said additive is 0.01-1 % based on the weight of said pigment.

8. A coating composition according to claim 1, wherein said white pigment is at least one member selected from the group consisting of clay, calcium carbonate, kaolin, talc, titanium oxide, aluminum hydroxide, silica, zinc oxide, activated terra alba, acid terra alba, lake, diatomaceous earth and plastic pigments.

9. A coating composition according to claim 1, wherein said binder is at least one member selected from the group consisting of styrene/butadiene copolymers, styrene/acryl copolymers, vinyl acetate/acryl copolymers, ethylene/vinyl acetate copolymers, butadiene/methyl methacrylate copolymers, vinyl acetate/butyl acrylate copolymers, styrene/maleic anhydride copolymers, isobutene/maleic anhydride copolymers, acrylic acid/methylmethacrylate copolymers, water-soluble starch, casein and soy bean protein.

10. A coating composition according to claim 1, wherein the content of said binder is 3 to 30 % based on the weight of said pigment.

11. A coating composition according to claim 1, further comprising a dispersing agent.

12. A coating composition according to claim 1, further comprising a polyol.

13. A coating composition according to claim 12, wherein said polyol is a member selected from the group consisting of ethylene glycol, propylene glycol, polyethylene glycol, polypropylene glycol and glycerin.

14. A coating composition according to claim 12, wherein said polyol is used in an amount of 1-20 % based on the weight of said copolymer.

15. A coated paper obtained by a method comprising coating a composition according to claim 1 over the surface of a paper, and drying the resulting coated layer.

16. A coated paper obtained by a method comprising coating a composition according to claim 12 over the surface of a paper, and drying the resulting coated layer.