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(54) Titre : DISPERSANT A BASE DE GYPSE

(54) Title: GYPSUM DISPERSANT

(57) **Abrégé/Abstract:**

[Problem] To provide a gypsum dispersant and a gypsum additive that have an excellent improvement effect on the fluidity of a gypsum slurry even if raw gypsums of varying qualities are used, and that do not delay curing of the gypsum slurry. [Solution] This gypsum dispersant is characterized by containing: (A) a polycarboxylic acid polymer; and (B) a polyamide polyamine and/or an alkylene oxide adduct thereof, obtained by reacting a polyalkylene polyamine and a dibasic acid as essential components.

## ABSTRACT

There is provided a gypsum dispersant and a gypsum additive that improve the fluidity of gypsum slurry even if gypsum raw materials used are different in quality and that do not induce delay of curing of gypsum slurry. A gypsum dispersant, characterized by comprising: (A) a polycarboxylic acid polymer; and (B) a polyamide polyamine obtained by a reaction of a polyalkylene polyamine and a dibasic acid as essential components, and/or an alkylene oxide adduct of the polyamide polyamine.

## DESCRIPTION

## TITLE OF THE INVENTION: GYPSUM DISPERSANT

## 5 TECHNICAL FIELD

[0001] The present invention relates to a gypsum dispersant that is added when a variety of gypsum molded products such as gypsum boards are manufactured, in order to improve the fluidity of gypsum slurry composed of gypsum and water.

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## BACKGROUND ART

[0002] Gypsum boards have been widely used mainly as interior materials of buildings, because of their excellent fireproof, sound insulating, and heat insulating properties, as well as their availability at low prices. Gypsum boards are manufactured generally by a pouring method. In the method, gypsum slurry that is composed of calcined gypsum, water, a dispersant, and other additive(s), is stirred and kneaded with an expanded foam in a mixing machine; the mixture is poured between the sheets of base paper to be sandwiched; and the thickness and the width are adjusted, and then cured, cut, and dried to obtain a gypsum board. Different types of gypsum boards are available, such as normal boards, hard boards, reinforced boards, and decorative boards. Although types of additives, mixing amounts, addition of reinforced materials, and the like may be changed depending on characteristics required for each of the boards, the boards can be manufactured by the same method.

25 [0003] When the gypsum slurry is manufactured, a dispersant is used in order to enhance ductility of a gypsum board to base paper, as well as to reduce a unit water amount in the manufacture of slurry, which enhances drying efficiency of the slurry, and to increase the density of a molded board so that a high strength board is obtained.

Formaldehyde-based compounds such as a naphthalenesulfonate formaldehyde

condensate, a melaminesulfonate formaldehyde condensate, and a formaldehyde condensate of a bisphenol and aminobenzenesulfonic acid have been conventionally and widely used as dispersants for gypsum (see Patent Documents 1 and 2).

Patent Document 3 discloses a self leveling aqueous gypsum composition having a 5 high flow value and an excellent self leveling property, which is prepared by adding a polycarboxylic acid dispersant to an aqueous gypsum composition.

[0004] Patent Document 4 discloses a gypsum dispersant characterized by comprising a water soluble amphoteric polymer compound as a main component. The water soluble amphoteric polymer compound contains a structural unit having a nitrogen 10 atom selected from an amido group, an amino group, and an imino group; a structural unit having a carboxylic acid group; and a structural unit having a polyalkylene glycol group, and the compound is obtained by polymerization. However, due to impurities contained in gypsum raw materials, the effects of the dispersant may not be stably exerted, and thus an improvement has been needed.

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Prior Art Documents

Patent Documents

[0005] Patent Document 1: Japanese Patent No. 3067811 (JP 3067811 B2)

Patent Document 2: Japanese Patent No. 3733821 (JP 3733821 B2)

20 Patent Document 3: Japanese Examined Patent Application Publication No. S64-1426 (JP S64-1426 B)

Patent Document 4: Japanese Patent Application Publication No. 2007-320786 (JP 2007-320786 A)

25 SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

[0006] Although the above-mentioned conventional polycarboxylic acid dispersants show excellent dispersibility for gypsum slurry by properly selecting the

conditions for use, such as pH, it also causes delay of curing, which results in a decrease in productivity of gypsum boards.

There are a wide variety of gypsum raw materials such as imported natural gypsum, flue gas desulfurization gypsum emitted from desulfurization devices used in power 5 plants or smelters, by-product gypsum such as phosphoric acid gypsum and fluorogypsum, and recycled gypsum separated and recovered from waste gypsum boards. They are blended at factory original ratios for use in order to reduce transportation costs and the like. Accordingly, impurities and the like contained in gypsum are different between the factories, and thus the properties of a gypsum water reducing agent may not 10 be fully exercised.

[0007] In view of the above-described disadvantages such as a problem to be solved by the present invention, the present invention provides a gypsum dispersant and a gypsum additive that improve the fluidity of gypsum slurry even if gypsum raw materials used are different in quality and that do not induce delay of curing of gypsum slurry.

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#### Means for Solving the Problem

[0008] As a result of intensive study to solve the above problem, the inventors of the present invention have found the present invention.

Specifically, the present invention relates to a gypsum dispersant, characterized by 20 comprising: (A) a polycarboxylic acid polymer; and (B) a polyamide polyamine obtained by a reaction of a polyalkylene polyamine and a dibasic acid as essential components, and/or an alkylene oxide adduct of the polyamide polyamine.

[0009] The present invention also relates to a gypsum additive comprising: a polyamide polyamine obtained by a reaction of a polyalkylene polyamine and a dibasic 25 acid as essential components, and/or an alkylene oxide adduct of the polyamide polyamine, which is mixed in order to improve the fluidity of gypsum slurry.

#### Effects of the Invention

[0010] (A) the polycarboxylic acid polymer is used in combination with (B) the

polyamide polyamine obtained by condensing a polyalkylene polyamine and a dibasic acid, and/or an alkylene oxide adduct of the polyamide polyamine, in a gypsum dispersant of the present invention. Because of this, even if gypsum raw materials used are different in quality, sufficient fluidity can be stably imparted regardless of the types.

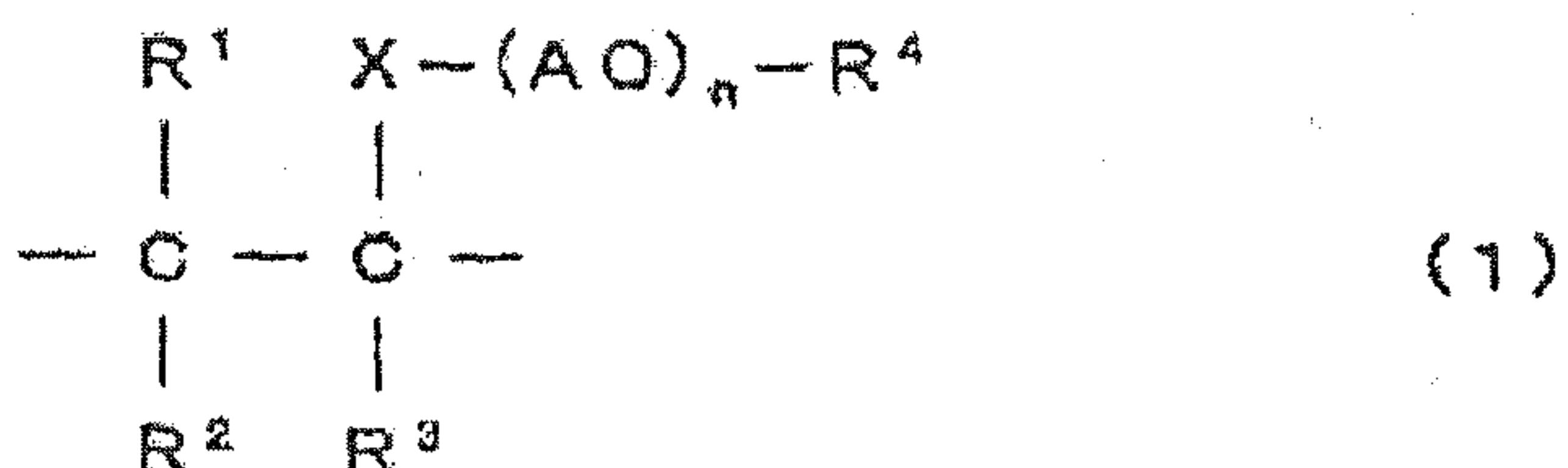
5 Furthermore, by adding the gypsum dispersant to gypsum slurry, gypsum boards can be manufactured without decreasing productivity.

#### MODES FOR CARRYING OUT THE INVENTION

10 [0011] Hereinafter, the present invention will be explained in detail.

[0012] As (A) the polycarboxylic acid polymer, a polymer having a structural unit derived from (a) a polyalkylene glycol unsaturated monomer and a structural unit derived from (b) an unsaturated carboxylic acid monomer can preferably be used.

[0013] The structural unit derived from (a) the polyalkylene glycol unsaturated monomer can be represented by General Formula (1):



(where each of R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, and R<sup>4</sup> is independently a hydrogen atom or a C<sub>1-22</sub> hydrocarbon group, X is -COO- or -(CH<sub>2</sub>)<sub>a</sub>O-, a is an integer of 1 to 20, AO is a C<sub>2-4</sub> alkylene oxy group, and n is the number of moles of added alkylene oxy groups and is 1 to 200).

[0014] In Formula (1), each of R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, and R<sup>4</sup> is independently a hydrogen atom or a C<sub>1-22</sub> hydrocarbon group, preferably a hydrogen atom or a C<sub>1-8</sub> alkyl group, and more preferably a hydrogen atom, a methyl group, an ethyl group, a propyl group, or a butyl group.

25 AO is a C<sub>2-4</sub> alkylene oxy group, and specific examples thereof include an ethylene oxy group, a propylene oxy group, and a butylene oxy group. When AO is composed of

two or more types of alkylene oxy groups, these alkylene oxy groups can be any of a block addition or a random addition.

n is the number of moles of added alkylene oxy groups and is 1 to 200, preferably 5 to 120, more preferably 10 to 100, and still more preferably 40 to 100.

5 [0015] The followings are specific examples of (a) the polyalkylene glycol unsaturated monomer.

Alkoxy poly alkylene glycol mono(meth)acrylates such as methoxy polyethylene glycol mono(meth)acrylate, methoxy{polyethylene glycol(poly)propylene glycol}mono(meth)acrylate, ethoxy polyethylene glycol mono(meth)acrylate, 10 ethoxy{polyethylene glycol(poly)propylene glycol}mono(meth)acrylate, propoxy polyethylene glycol mono(meth)acrylate, propoxy{polyethylene glycol(poly)propylene glycol}mono(meth)acrylate, butoxy polyethylene glycol mono(meth)acrylate, and butoxy{polyethylene glycol(poly)propylene glycol}mono(meth)acrylate; and unsaturated 15 alcohol polyalkylene glycol adducts such as a vinylalcohol alkylene oxide adduct, a (meth)allyl alcohol alkylene oxide adduct, a 3-buten-1-ol alkylene oxide adduct, an isoprene alcohol(3-methyl-3-buten-1-ol)alkylene oxide adduct, a 3-methyl-2-buten-1-ol alkylene oxide adduct, a 2-methyl-3-buten-2-ol alkylene oxide adduct, a 20 2-methyl-2-buten-1-ol alkylene oxide adduct, and a 2-methyl-3-buten-1-ol alkylene oxide adduct. Note that, in the present invention, (meth)acrylate refers to both acrylate and methacrylate, and (meth)allyl alcohol refers to both allyl alcohol and methallyl alcohol.

[0016] Specific examples of (b) the unsaturated carboxylic acid monomer include acrylic acid, methacrylic acid, maleic acid, fumaric acid, itaconic acid, and an unsaturated fatty acid, as well as acid anhydrides thereof, such as maleic anhydride. Among them, methacrylic acid is particularly preferable.

25 [0017] In (A) the polycarboxylic acid polymer, examples of (c) a copolymerizable monomer other than the above-mentioned monomers (a) and (b), include the following known monomers; (1) (non)aqueous monomers: methyl (meth)acrylate, ethyl (meth)acrylate, butyl (meth)acrylate, styrene, and the like; (2) anion monomers: vinyl sulfonates, styrene sulfonates, methacrylic acid phosphoesters, and the

like; (3) amide monomers: acrylamide, an alkylene oxide adduct of acrylamide, and the like; (4) polyamide polyamine monomers: a compound of a condensate of the polyamide polyamine to be described later and (meth)acrylic acid, which contains an alkylene oxide if desired.

5 [0018] A copolymerization ratio of the monomers (a) to (c) is preferably (a) : (b) : (c) = 50 to 95 : 5 to 50 : 0 to 40, and more preferably (a) : (b) : (c) = 70 to 90 : 10 to 30 : 0 to 20, based on mass.

10 [0019] A method of manufacturing (A) the polycarboxylic acid polymer is not particularly limited, and known polymerization methods, such as solution polymerization and block polymerization that utilize polymerization initiators can be used. Although a molecular weight is also not particularly limited, it is preferably within a range of 5,000 to 100,000 as a weight-average molecular weight (determined by gel permeation chromatography, in terms of polyethylene glycol) to achieve good dispersibility.

15 Preferably, (A) the polycarboxylic acid polymer is contained in a gypsum dispersant of the present invention as a partially or fully neutralized form, which has been neutralized with a neutralizer, such as lithium hydroxide, potassium hydroxide, sodium hydroxide, ammonia, an alkylamine, or an organic amine.

20 [0020] (B) the polyamide polyamine obtained by the reaction of a polyalkylene polyamine and a dibasic acid as essential components, and/or an alkylene oxide adduct of the polyamide polyamine will be explained.

[0021] Examples of the polyalkylene polyamine include diethylene triamine, triethylene tetramine, tetrachethylene pentamine, pentaethylene hexamine, dipropylene triamine, tripropylene tetramine, tetrapropylene pentamine, and other high molecular weight polyalkylene polyamine mixtures.

25 [0022] Examples of the dibasic acid include a dibasic acid having malonic acid, succinic acid, fumaric acid, maleic acid, glutaric acid, adipic acid, pimelic acid, phthalic acid, azelaic acid, or sebacic acid as a basic backbone; and alkyl esters and dibasic acid halides of these dibasic acids.

[0023] The reaction molar ratio of the polyalkylene polyamine and the dibasic

acid, which compose the polyamide polyamine, is preferably within a range of 2 : 1 to 21 : 20. When the reaction is conducted at a molar ratio within this range, the polyamide polyamine will have a molecular weight of suitable viscosity, and thus good dispersibility can be obtained. The weight-average molecular weight of polyamide 5 polyamine is usually 500 to 100,000, preferably 1,000 to 50,000, more preferably 1,000 to 30,000, and particularly preferably 1,000 to 10,000.

[0024] As the component (B), a polyamide polyamine to which an alkylene oxide is added (alkylene oxide adduct) can also be used. In this case, the type of polyamide polyamines that can be used is the same as that described above.

10 [0025] An alkylene oxide used for the polyamide polyamine to which an alkylene oxide is added is a C<sub>2-4</sub> alkylene oxide. The C<sub>2-4</sub> alkylene oxide is ethylene oxide, propylene oxide, or butylene oxide. One type of these alkylene oxides may be used, or two or more types of them may be used in combination. When two or more types of alkylene oxides are added, the form of addition may be either block or random.

15 The polyamide polyamine to which an alkylene oxide is added can be obtained by adding an alkylene oxide directly to the polyamide polyamine, or can be obtained in a water solution.

The amount of the alkylene oxide is preferably 0 to 8 mol to 1 equivalent of amino residues (an amino group, an imino group, and an amide group) of the polyamide 20 polyamine.

[0026] The component (B) also includes a mixture of the polyamide polyamine and the polyamide polyamine to which an alkylene oxide is added.

[0027] Although the ratio of the component (A) and the component (B) is not particularly limited, it is preferably (A) : (B) = 1 : 1 to 30 : 1, and more preferably 2 : 1 to 25 20 : 1, as a mass ratio.

[0028] Although the mechanism how fluidity is constantly imparted to gypsum slurry using a gypsum dispersant of the present invention is unknown, it is supposed that the component (B) selectively adsorb to impurities that are in gypsum raw materials and inhibit function of the dispersant. Accordingly, the component (B) can be used as a

gypsum additive, together with a dispersant other than the component (A), such as lignin sulfonate, a naphthalenesulfonic acid formalin high condensated salt, a melamine sulfonic acid formalin high condensated salt, a polystyrene sulfonate, and an aqueous vinyl copolymer.

5 [0029] To gypsum raw materials, usually 0,01% by mass to 5% by mass (the solid mass ratio of the dispersant) of a gypsum dispersant of the present invention may be added for use. Although a variety of methods are used for addition of the dispersant, generally the dispersant is added in water to be diluted firstly, and then gypsum is kneaded with the water to prepare gypsum slurry. The component (A) and the  
10 component (B) can be mixed prior to addition, or each of them can be added individually without mixing. When each of them is added individually, any order of addition can be taken.

Gypsum includes anhydrous gypsum, gypsum hemihydrate, and gypsum dihydrate. As the gypsum raw materials, natural gypsum, or chemical gypsum such as neutralized  
15 gypsum and by-product gypsum can be used alone, or two or more of them can be used upon mixing. Main examples of the chemical gypsum include phosphoric acid gypsum, fluorogypsum, titanium gypsum, and flue gas desulfurization gypsum. The gypsum raw materials may contain recycled gypsum. The recycled gypsum may be a recycled gypsum collected from waste gypsum boards generated in gypsum board manufacturers,  
20 or a recycled gypsum collected from waste gypsum boards or the like generated upon construction or scrapping. A gypsum dispersant of the present invention can suitably be used for any of such gypsum raw materials, and shows excellent effects even for gypsum blended at various ratios.

[0030] Examples of an additive that is used for gypsum boards and the like in  
25 addition to a gypsum dispersant of the present invention, include a universal water reducing agent, a foaming agent such as an alkyl sulfate, an alkyl ether sulfate, and an alkyl sulfonate, an antifoaming agent, a foam stabilizer, a curing control agent, a water repellent, an adhesive, and a retardant. In addition, glass fiber, carbon fiber, waste paper, virgin pulp, and the like may be added as reinforced fiber, or gypsum boards may be

prepared with a lightweight aggregate, such as perlite and foamed steel.

A dispersant of the present invention can easily be applied to gypsum plaster that is used in finishing coat.

## 5 Examples

[0031] The present invention will be explained according to specific examples; however, the present invention is not limited to these examples. Unless otherwise noted, copolymerization ratios and mixing ratios are based on mass.

### [0032] [(A) Polycarboxylic acid Polymer]

10 (A) a polycarboxylic acid polymer used in Examples herein will be explained below.

<A1> A copolymerized material of (a1) a methacrylic acid ester of polyethylene glycol (46 mol) monomethylether and (b1) a methacrylic acid ((a1) : (b1) = 9 : 1; the weight-average molecular weight was 25,000).

15 <A2> A copolymerized material of (a2) a methacrylic acid ester of polyethylene glycol (90 mol) monomethylether, (b1) a methacrylic acid, and (c1) a polyamide polyamine monomer ((a2) : (b1) : (c1) = 77 : 13 : 10; the weight-average molecular weight was 44,000; the copolymer disclosed in Example 2 in Japanese Patent Application Publication No. 2007-320786).

20 <A3> A copolymerized material of (a3) a 3-methyl-3-buten-1-ol 50EO2PO adduct and (b2) fumaric acid ((a3) : (b2) = 8 : 2; the weight-average molecular weight was 30,000).

### [0033] [(B) Manufacture of Polyamide Polyamine]

25 (B) polyamide polyamines used in Examples herein (B1 to B8) were manufactured by the procedure described below.

#### <Measuring Condition of Molecular Weight>

Column: OHpacSB-806MHQ, OHpacSB-804HQ, OHpacSB-803HQ (manufactured by Showa Denko K.K.)

Eluent: 0.5M acetic acid and sodium nitrate aqueous solution

Detector: Differential refractometer

Standard Curve: Based on pullulan

[0034] Synthesis Example 1

103 g of diethylenetriamine was placed in a glass reaction container equipped with a thermometer, a nitrogen introduction tube, an agitator, and a condenser having a water measuring tube, and the resultant mixture was stirred while nitrogen was introduced into the liquid. As stirring, 121 g of adipic acid was added (the molar ratio of polyalkylene polyamine/dibasic acid was 6 mol/5 mol), heated to raise the temperature to 150°C, and the reaction was continued for five hours at the same temperature while drained water was removed. After the reaction was completed, 138 g of ion exchanged water was added to obtain 345 g of a 60% by mass polyamide polyamine aqueous solution (Compound B1; the weight-average molecular weight was 1,300).

[0035] Synthesis Example 2

The same procedure was conducted until the amidation reaction of Compound B1 was completed, and then 230 g of ion exchanged water was added and stirred for 30 minutes. The content was transferred into a pressure-resistant glass container equipped with a nitrogen introduction tube and an ethylene oxide introduction tube. After sufficiently substituted by nitrogen, the container was heated to raise the temperature to 60°C. 146 g of ethylene oxide was gradually blown into the container as the temperature was maintained at 60°C to 70°C, and then the content was matured for one hour at the same temperature to obtain 570 g of a 60% by mass polyethylene oxide added polyamide polyamine aqueous solution (Compound B2; the weight-average molecular weight was 2,000).

[0036] Synthesis Example 3

134 g of pentaethylenehexamine was placed in a glass reaction container equipped with a thermometer, a nitrogen introduction tube, an agitator, and a condenser having a water measuring tube, and the resultant mixture was stirred while nitrogen was introduced into the liquid. As stirring, 50 g of adipic acid was added (the molar ratio of polyalkylene polyamine/dibasic acid was 5 mol/3 mol), heated to raise the temperature to

150°C, and the reaction was continued for five hours at the same temperature while drained water was removed. After the reaction was completed, 115 g of ion exchanged water was added to obtain 288 g of a 60% by mass polyamide polyamine aqueous solution (Compound B3; the weight-average molecular weight was 1,500).

5 [0037] Synthesis Example 4

The same procedure was conducted until the amidation reaction of Compound B3 was completed, and then 197 g of ion exchanged water was added and stirred for 30 minutes. The content was transferred into a pressure-resistant glass container equipped with a nitrogen introduction tube and an ethylene oxide introduction tube. After 10 sufficiently substituted by nitrogen, the container was heated to raise the temperature to 60°C. 122 g of ethylene oxide was gradually blown into the container as the temperature was maintained at 60°C to 70°C, and then the content was matured for one hour at the same temperature to obtain 504 g of a 60% by mass polyethylene oxide added polyamide polyamine aqueous solution (Compound B4; the weight-average molecular 15 weight was 1,900).

[0038] Synthesis Example 5

128 g of tetraethylenepentamine was placed in a glass reaction container equipped with a thermometer, a nitrogen introduction tube, an agitator, and a condenser having a water measuring tube, and the resultant mixture was stirred while nitrogen was 20 introduced into the liquid. As stirring, 89 g of adipic acid was added (the molar ratio of polyalkylene polyamine/dibasic acid was 10 mol/9 mol), heated to raise the temperature to 150°C, and the reaction was continued for five hours at the same temperature while drained water was removed. After the reaction was completed, 131 g of ion exchanged water was added to obtain 328 g of a 60% by mass polyamide polyamine aqueous 25 solution (Compound B5; the weight-average molecular weight was 2,900).

[0039] Synthesis Example 6

The same procedure was conducted until the amidation reaction of Compound B5 was completed, and then 330 g of ion exchanged water was added and stirred for 30 minutes. The content was transferred into a pressure-resistant glass container equipped

with a nitrogen introduction tube and an ethylene oxide introduction tube. After sufficiently substituted by nitrogen, the container was heated to raise the temperature to 60°C. 300 g of ethylene oxide was gradually blown into the container as the temperature was maintained at 60°C to 70°C, and then the content was matured for one hour at the same temperature to obtain 850 g of a 60% by mass polyethylene oxide added polyamide polyamine aqueous solution (Compound B6; the weight-average molecular weight was 4,800).

[0040] Synthesis Example 7

199 g of a polyalkylene polyamine (manufactured by Tosoh Corporation, the product name: Poly-8) was placed in a glass reaction container equipped with a thermometer, a nitrogen introduction tube, an agitator, and a condenser having a water measuring tube, and the resultant mixture was stirred while nitrogen was introduced into the liquid. As stirring, 68 g of adipic acid was added (the molar ratio of polyalkylene polyamine/dibasic acid was 4 mol/3 mol), heated to raise the temperature to 150°C, and the reaction was continued for five hours at the same temperature while drained water was removed. After the reaction was completed, 125 g of ion exchanged water was added to obtain 412 g of a 60% by mass polyamide polyamine aqueous solution (Compound B7; the weight-average molecular weight was 2,200).

[0041] Synthesis Example 8

20 The same procedure was conducted until the amidation reaction of Compound B7 was completed, and then 290 g of ion exchanged water was added and stirred for 30 minutes. The content was transferred into a pressure-resistant glass container equipped with a nitrogen introduction tube and an ethylene oxide introduction tube. After sufficiently substituted by nitrogen, the container was heated to raise the temperature to 60°C. 180 g of ethylene oxide was gradually blown into the container as the temperature was maintained at 60°C to 70°C, and then the content was matured for one hour at the same temperature to obtain 716 g of a 60% by mass polyethylene oxide added polyamide polyamine aqueous solution (Compound B8; the weight-average molecular weight was 2,500).

[0042] The compositions of the gypsum raw materials used in a performance test are shown in Table 1.

The gypsum dispersants of Examples 1 to 51 and Comparative Examples 1 to 3 were prepared at the composition ratios shown in Table 2, and dispersibility of gypsum and delay of gypsum curing were tested by the method described below.

[0043] Table 1 Calcined Gypsum Mixing Ratio (mass%)

No.	Natural	Flue Gas Desulfurization	Other By-product (Containing Recycled Gypsum)
1	55	25	20
2	45	30	25
3	35	30	35
4	25	30	45
5	25	40	35

As calcined gypsum of No. 6, commercially available Cherry Mark calcined gypsum A-grade manufactured by YOSHINO GYPSUM Co., Ltd. was used.

[0044] [Performance Test]

<Dispersibility of Gypsum>

The component (A) and the component (B) were mixed at each of the mixing ratios (mass ratios) as shown in Table 2 (Tables 2-1 and 2-2) to prepare gypsum dispersants of Examples 1 to 51 and Comparative Examples 1 to 3 as follows: 0.18 g of each of the dispersants was weighed based on a solid content (to gypsum, 0.06% by mass), and water was added thereto as kneading water so that the total amount was adjusted to 195 g. To the mixture, 300 g of calcined gypsum having a mixing composition shown in Table 1 or of a commercially available calcined gypsum (No. 6) was added (65% of a water/gypsum ratio), and the resultant mixture was kneaded in a small juicer/blender for 10 seconds.

At the center of an urethane board (35 cm × 35 cm), a hollow cylinder having an upper inner diameter of 75 mm, a lower inner diameter of 85 mm, and a height of 40 mm was prepared in advance, and the kneaded gypsum slurry was immediately poured into a container (hollow cylinder) until the container became full. Then, the hollow cylinder was pulled up to the direction perpendicular to the urethane board, and the spread of the

gypsum slurry was measured. A first diameter that may represent the maximum spread and a second diameter perpendicular to the first diameter were measured, and an average value thereof was evaluated as an index of dispersibility.

The obtained results (average values of diameters) are shown in Table 2 (Tables 2-1  
5 and 2-2).

[0045] <Delay of Gypsum Curing>

Similarly to the dispersibility test, 0.18 g of each of the gypsum dispersants of Examples 1 to 51 and Comparative Examples 1 to 3 was accurately weighed based on a solid content (to gypsum, 0.06% by mass), and kneading water was added thereto so that 10 the total amount was adjusted to 195 g. To the mixture, 300 g of calcined gypsum having a mixing composition shown in Table 1 or of a commercially available calcined gypsum (No. 6) was added (65% of a water/gypsum ratio), and the resultant mixture was kneaded in a small juicer/blender for 10 seconds.

After kneading, the prepared gypsum slurry was immediately transferred in a paper 15 cup, and a digital thermometer was placed therein, in order to measure a temperature according to exothermic heat resulting from curing of gypsum, every ten seconds. The time spent to reach the maximum temperature was identified as the time for the peak temperature, and was used as an index to evaluate delay of curing.

The obtained results (time for the peak temperatures) are shown in Table 2 (Tables 20 2-1 and 2-2).

[0046] Table 2-1 Evaluation Result of Dispersion and Curability

Example No.	A	B	A:B*1	Dispersion (mm)*2						Curability*2							
				1	2	3	4	5	6	1	2	3	4	5	6		
1	1:1	174	175	176	177	177	177	14'40"	14'50"	14'30"	14'20"	14'30"	14'20"	28'10"	28'10"		
2	5:1	180	184	186	191	191	193	14'20"	14'10"	13'40"	13'10"	13'10"	13'40"	28'00"	28'00"		
3	B1	10:1	176	179	182	188	191	194	14'20"	14'20"	14'00"	13'50"	14'10"	14'10"	28'10"	28'10"	
4	30:1	179	182	186	192	192	198	15'20"	15'20"	14'50"	14'30"	15'00"	15'00"	28'30"	28'30"		
5		1:1	174	174	177	179	176	178	14'40"	14'10"	14'20"	14'00"	14'00"	14'20"	28'00"	28'00"	
6		5:1	183	188	191	195	189	195	14'20"	13'50"	13'30"	13'00"	13'00"	13'40"	28'10"	28'10"	
7		B2	10:1	180	183	186	190	189	194	14'10"	13'30"	13'40"	13'20"	13'20"	13'30"	27'40"	27'40"
8		30:1	184	187	190	197	194	198	15'30"	14'50"	14'40"	14'40"	14'20"	14'30"	28'20"	28'20"	
9		1:1	176	178	180	181	180	180	14'40"	14'40"	14'30"	14'00"	14'00"	14'10"	28'00"	28'00"	
10		B3	5:1	182	185	189	194	189	196	14'40"	14'30"	14'10"	13'40"	14'00"	14'00"	27'50"	27'50"
11		10:1	181	184	193	197	193	197	14'20"	14'20"	14'00"	13'30"	13'20"	13'20"	13'50"	13'50"	
12		30:1	182	186	190	196	195	198	15'50"	15'30"	15'30"	14'40"	14'40"	14'50"	28'10"	28'10"	
13		A1	1:1	177	179	180	181	181	182	14'10"	14'00"	13'40"	13'10"	13'10"	13'30"	27'50"	27'50"
14		5:1	182	186	192	194	194	196	14'20"	14'00"	13'30"	13'30"	13'30"	13'40"	27'40"	27'40"	
15		B4	10:1	181	189	190	194	192	198	14'30"	13'40"	13'30"	13'00"	13'00"	13'10"	28'00"	28'00"
16		30:1	183	188	195	199	198	200	15'20"	14'50"	14'40"	14'10"	14'10"	14'20"	28'20"	28'20"	
17		1:1	177	181	182	183	183	185	14'40"	14'20"	14'20"	14'00"	14'00"	13'50"	27'40"	27'40"	
18		B5	5:1	179	183	187	194	192	195	14'30"	14'10"	14'10"	13'30"	13'30"	13'50"	28'00"	28'00"
19		10:1	180	186	191	195	193	197	14'30"	14'00"	13'40"	13'30"	13'30"	13'10"	28'10"	28'10"	
20		30:1	181	185	189	193	194	199	15'30"	15'00"	14'30"	14'00"	14'50"	14'50"	28'10"	28'10"	
21		B6	1:1	177	179	182	183	180	182	14'20"	14'10"	14'00"	13'30"	13'40"	13'40"	27'40"	27'40"
22		5:1	178	188	190	195	196	196	14'00"	13'50"	13'30"	13'10"	13'20"	13'20"	27'30"	27'30"	
23		10:1	180	188	193	197	195	199	14'10"	13'40"	13'30"	13'20"	13'50"	13'50"	28'20"	28'20"	
24		30:1	179	184	190	195	194	198	15'00"	14'40"	14'20"	14'00"	14'20"	14'20"	28'30"	28'30"	

\*1 Mass ratio

\*2 The numbers 1 to 6 in the columns of Dispersion and Curability refer to the numbers of calcined gypsum used (see Table 1 and the like).

[0047] Table 2-2 Evaluation Result of Dispersion and Curability

Example No.	A	B	A:B <sup>1</sup>	Dispensibility (mm) <sup>2</sup>						Curability <sup>2</sup>				
				1	2	3	4	5	6	1	2	3	4	
25	1:1	175	177	176	179	178	179	14'50"	14'30"	14'20"	14'00"	14'40"	27'30"	
26	5:1	178	187	188	192	190	192	14'50"	14'30"	14'00"	13'40"	14'10"	27'40"	
27	10:1	182	186	189	195	193	196	14'40"	14'50"	14'20"	13'50"	13'50"	27'50"	
28	30:1	181	184	185	194	192	198	15'50"	15'00"	14'50"	14'20"	14'30"	28'20"	
29	1:1	177	178	182	183	181	183	14'50"	14'20"	14'10"	13'30"	14'00"	27'30"	
30	5:1	184	186	189	193	193	196	14'20"	14'00"	13'50"	13'20"	14'00"	27'28"	
31	10:1	181	183	188	192	192	196	14'00"	13'40"	14'00"	13'40"	14'30"	27'40"	
32	30:1	180	182	185	190	194	198	15'20"	15'00"	15'00"	14'20"	14'30"	28'00"	
33	B1	190	196	201	205	200	209	14'10"	13'50"	13'30"	13'20"	13'20"	27'00"	
34	B2	192	199	203	207	205	213	14'20"	14'00"	14'00"	13'40"	13'50"	26'30"	
35	B3	189	200	201	205	206	210	14'20"	14'00"	13'40"	13'30"	13'30"	26'50"	
36	B4	190	200	203	207	205	211	14'00"	13'50"	13'40"	13'20"	13'20"	26'50"	
37	B5	190	198	204	210	205	213	14'00"	13'40"	13'30"	13'30"	13'40"	26'30"	
38	B6	188	196	203	207	204	212	13'50"	13'40"	13'30"	13'20"	13'40"	26'20"	
39	B7	187	193	193	199	198	208	14'20"	14'10"	14'00"	13'40"	13'50"	26'50"	
40	B8	188	191	194	196	200	209	14'00"	13'30"	13'30"	13'10"	13'30"	26'40"	
44	B1	185	191	196	198	195	200	15'00"	14'40"	14'30"	14'00"	14'20"	28'30"	
45	B2	191	192	198	199	197	203	15'00"	14'20"	14'00"	13'40"	13'50"	28'20"	
46	B3	188	189	195	196	197	201	15'20"	15'00"	14'40"	14'20"	14'30"	28'00"	
47	B4	190	192	196	199	198	202	14'50"	14'50"	14'20"	14'00"	14'20"	28'00"	
48	B5	192	195	198	198	196	203	14'50"	14'20"	14'00"	13'30"	13'40"	27'40"	
49	B6	190	197	198	203	200	205	14'50"	14'30"	13'40"	13'20"	13'20"	27'30"	
50	B7	188	192	195	200	198	200	15'00"	15'00"	14'40"	14'30"	14'30"	27'50"	
51	B8	192	195	198	202	201	203	14'50"	14'40"	14'20"	14'30"	14'50"	27'40"	
Comparative Example 1	A1	-	-	135	138	143	147	145	200	16'40"	16'30"	16'20"	16'00"	28'30"
Comparative Example 2	A2	-	-	145	148	153	155	157	215	15'30"	15'10"	15'00"	15'10"	27'30"
Comparative Example 3	A3	-	-	150	152	156	157	156	208	16'30"	16'30"	16'00"	15'50"	28'50"

\*1 Mass ratio

\*2 The numbers 1 to 6 in the columns of Dispensibility and Curability refer to the numbers of calcined gypsum used (see Table 1 and the like).

[0048] As shown in Table 2 (Tables 2-1 and 2-2), gypsum slurry to which each of the gypsum dispersants of Examples 1 to 51 was added showed excellent dispersibility and reduced delay of curing, even if the gypsum raw materials used are different in quality.

5 On the other hand, although some of the gypsum dispersants of Comparative Examples 1 to 3, which contain no polyamide polyamine, showed results comparable to those of Examples when commercially available calcined gypsum No. 6 was used, both dispersibility and delay of curing were inferior compared to the examples in the use of the calcined gypsum of No. 1 to No. 5, which reflect actual gypsum blending performed  
10 in factories for manufacturing gypsum boards.

## CLAIMS

1. A gypsum dispersant, characterized by comprising:

(A) a polycarboxylic acid polymer; and

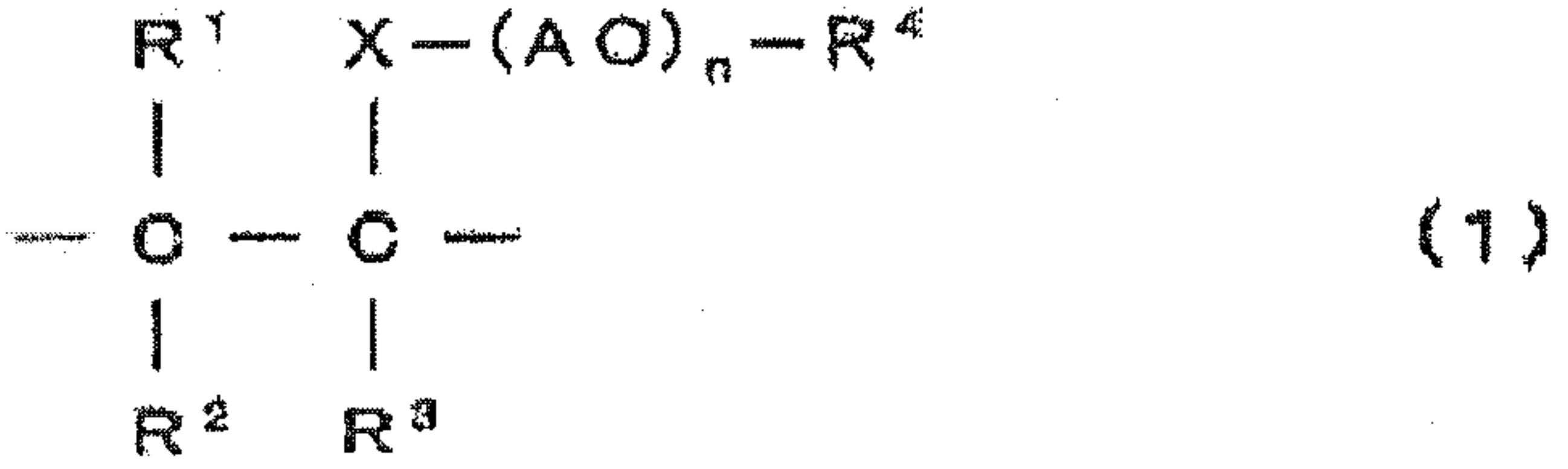
(B) a polyamide polyamine obtained by a reaction of a polyalkylene polyamine and a dibasic acid as essential components, and/or an alkylene oxide adduct of the polyamide polyamine.

2. The gypsum dispersant according to claim 1, wherein

(A) the polycarboxylic acid polymer includes a structural unit derived from (a) a polyalkylene glycol unsaturated monomer and a structural unit derived from (b) an unsaturated carboxylic acid monomer.

3. The gypsum dispersant according to claim 2, wherein

the structural unit derived from (a) the polyalkylene glycol unsaturated monomer is represented by General Formula (1):



(where each of R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, and R<sup>4</sup> is independently a hydrogen atom or a C<sub>1-22</sub> hydrocarbon group, X is -COO- or -(CH<sub>2</sub>)<sub>a</sub>O-, a is an integer of 1 to 20, AO is a C<sub>2-4</sub> alkylene oxy group, and n is the number of moles of added alkylene oxy groups and is 1 to 200).

4. The gypsum dispersant according to any one of claims 1 to 3, wherein

the ratio of the component (A) and the component (B) is (A) : (B) = 1 : 1 to 30 : 1, as a mass ratio.

5. A gypsum additive comprising:

a polyamide polyamine obtained by a reaction of a polyalkylene polyamine and a dibasic acid as essential components, and/or an alkylene oxide adduct of the polyamide polyamine.