DESCRIPTION

POLYMER, AQUEOUS SOLUTION, AND DISPERSANT FOR SUSPENSION POLYMERIZATION

[TECHNICAL FIELD]

[0001]

The present invention relates to a polymer, an aqueous solution, and a dispersant for suspension polymerization.

[BACKGROUND ART]

[0002]

Polyvinyl alcohol polymers (hereinafter, may be referred to as "PVAs") are used for a variety of intended usages such as: materials of films and fibers; additives for paper processing and fiber processing; adhesives; binders for inorganic substances; and dispersants for suspension polymerization (may be also referred to as "dispersion stabilizers", etc.) Patent Document 1 discloses a dispersant for suspension polymerization, the dispersant being powder comprising PVA having a certain end structure.

[PRIOR ART DOCUMENTS]

[Patent Documents]

[0003]

Patent Document 1: PCT International Publication No. 2021/100638

[SUMMARY OF THE INVENTION]

[Problems to be Solved by the Invention]

[0004]

PVAs may be stored, distributed, sold, or used, etc., in states of aqueous solutions. In storage, use and the like of a polymer as an aqueous solution, the aqueous solution is required to be highly concentrated and have low viscosity, particularly in light of productivity and handleability. However, there may be cases in which preparation per se of a high-concentration aqueous solution is impossible, owing to structures and/or the like of the polymer. Furthermore, in general, since viscosity increases as concentration increases, it is difficult to prepare an aqueous solution in which high concentration and low viscosity are both achieved. Here, when the degree of saponification of PVA is increased, there may be a case in which an aqueous solution having a high concentration and a comparatively low viscosity can be prepared. However, since PVA having a low degree of saponification may be demanded depending on the intended usage, and/or the like, development of an aqueous solution has been expected, having a low viscosity, while comprising a PVA having a comparatively low degree of saponification at a high concentration.

[0005]

One object of the present invention is to provide a polymer which is a vinyl alcohol polymer having a comparatively low degree of saponification, and which enables preparing an aqueous solution having a sufficiently low viscosity even in a case with high concentration.

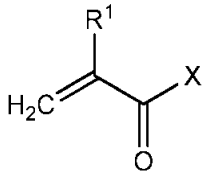
Furthermore, another object of the present invention is to provide an aqueous solution comprising the polymer as described above; and a dispersant for suspension polymerization comprising the polymer as described above, and having favorable performance.

[Means for Solving the Problems]

[0006]

The above-described objects are achieved by providing any one of the followings.

(1) A polymer comprising a vinyl ester unit, a vinyl alcohol unit, and a structural unit derived from a monomer (M), wherein the monomer (M) is a monomer represented by the following formula (1), a content of the structural unit derived from the monomer (M) is 2 mol% or more and 70 mol% or less, with respect to total structural units, and a degree of saponification is more than 0 mol% and less than 70 mol%,



(1)

wherein, in the formula (1): R^1 represents a hydrogen atom or a methyl group; X represents a hydroxy group, an amino group, a morpholino group, a polyethylene glycol group, or a group represented by $-OR^A$, wherein R^A represents an alkyl group having 1 to 12 carbon atoms or an aryl group having 6 to 12 carbon atoms;

(2) The polymer according to (1), wherein a viscosity-average degree of polymerization of the polymer (A) is 30 to 2,000;

(3) The polymer according to (1) or (2), wherein a total content of the vinyl ester unit, the vinyl alcohol unit, and the structural unit derived from the monomer (M) is 90 mol% or more with respect to the total structural units;

(4) The polymer according to any one of (1) to (3), wherein a solution obtained by dissolving 40 parts by mass of the polymer in 60 parts by mass of water has a viscosity at 20 °C of 2,000 mPa·s or less;

(5) An aqueous solution comprising the polymer according to any one of (1) to (4);

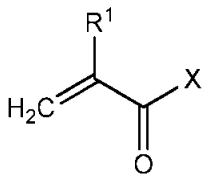
(6) The aqueous solution according to (5), wherein a content of the polymer is 10% by mass or more;

(7) The aqueous solution according to (5) or (6), having a viscosity at 20 °C of 2,000 mPa·s or less;

(8) The aqueous solution according to any one of (5) to (7), wherein a content of the polymer with respect to a total amount of solid matter is 90% by mass or more;

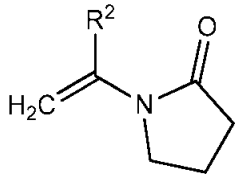
(9) A dispersant for suspension polymerization comprising the polymer according to any one of (1) to (4), or the aqueous solution according to any one of (5) to (8);

(10) A dispersant for suspension polymerization comprising a polymer comprising: a vinyl ester unit; a vinyl alcohol unit; and a structural unit derived from a monomer (M), wherein the monomer (M) is at least one selected from the group consisting of a monomer represented by the following formula (1) and a monomer represented by the following formula (2), a content of the structural unit derived from the monomer (M) in the polymer is 2 mol% or more and 70 mol% or less with respect to total structural units, and a degree of saponification of the polymer is more than 0 mol% and less than 70 mol%,



(1)

wherein, in the formula (1), R^1 represents a hydrogen atom or a methyl group; X represents a hydroxy group, an amino group, a morpholino group, a polyethylene glycol group, or a group represented by $-OR^A$, wherein R^A represents an alkyl group having 1 to 12 carbon atoms or an aryl group having 6 to 12 carbon atoms, and



(2)

in the formula (2), R^2 represents a hydrogen atom or a methyl group.

[Effects of the Invention]

[0007]

The present invention enables providing a polymer which is a vinyl alcohol polymer having a comparatively low degree of saponification, and which enables preparing an aqueous solution having a sufficiently low viscosity even in a case with high concentration.

Furthermore, the present invention enables providing an aqueous solution in which the polymer as described above is used, and which has sufficiently low viscosity.

In addition, the present invention enables providing a dispersant for suspension polymerization in which the polymer as described above is employed and which has favorable performance.

[DESCRIPTION OF EMBODIMENTS]

[0008]

In the present description, numerical value ranges described using "to" mean that numerical values before and after "to" are included as the lower limit value and the upper limit value, respectively. More specifically, "α to β" means "α or more and β or less". Furthermore, in the present description, the upper limit value and the lower limit value of the numerical value range can be combined ad libitum.

[0009]

Polymer

The polymer (hereinafter, may be also referred to as "polymer (A)") according to one embodiment of the present invention comprises a vinyl ester unit, a vinyl alcohol unit, and a structural unit derived from a monomer (M), wherein the monomer (M) is a monomer represented by the formula (1) described later, a content of the structural unit derived from the monomer (M) is 2 mol% or more and 70 mol% or less, with respect to total structural units, and a degree of saponification is more than 0 mol% and less than 70 mol%.

[0010]

The polymer (A) has a degree of saponification of less than 70 mol%, and is thus a vinyl alcohol polymer having a comparatively low degree of saponification. Due to having the structural unit derived from a monomer (M) at a specified content, the polymer (A) enables preparing an aqueous solution having a sufficiently low viscosity even in a case with high concentration. Therefore, the aqueous solution comprising the polymer (A) is superior in productivity, handleability, and the like. Moreover, due to having the degree of saponification falling within the specified range, and/or the like, the polymer (A) is favorable also in performance as a dispersant for suspension polymerization. Specifically, by using in suspension polymerization, the polymer (A) or the aqueous solution comprising the polymer (A) as a dispersant,

polymer particles having a small average particle diameter and being favorable in plasticizer absorptivity can be obtained.

[0011]

It is to be noted that water solubility of the polymer (A), and physical properties of the aqueous solution obtained may be affected by the degree of polymerization of the polymer (A). However, for example, even in the case in which the polymer (A) having a large degree of polymerization is used, a viscosity reducing effect is produced compared to a polymer having a similar level of degree of polymerization. Therefore, in the present specification, the problem is considered to be solved in cases in which an aqueous solution having a sufficiently low viscosity is obtained when compared with polymers having a similar level of degree of polymerization.

[0012]

The polymer (A) according to one embodiment of the present invention is described in detail below.

[0013]

The polymer (A) comprises a vinyl ester unit. The vinyl ester unit is a structural unit formed by polymerizing a vinyl ester monomer. Examples of the vinyl ester monomer include carboxylic acid vinyl esters such as vinyl formate, vinyl acetate, vinyl propionate, vinyl valerate, vinyl caprate, vinyl laurate, vinyl stearate, vinyl benzoate, vinyl pivalate, and vinyl versatate. Of these, vinyl acetate is preferred.

[0014]

The vinyl ester unit may be a structural unit represented by $-CH_2-CH(OCOR)-$ (wherein, R represents a hydrogen atom or a hydrocarbon group having 1 to 20 carbon atoms). R represents preferably a hydrocarbon group, more preferably an aliphatic hydrocarbon group, and still more preferably an alkyl group. The number of carbon atoms of R is preferably 1 to 6, and more preferably 1 to 3. It is particularly preferred that R represents a methyl group.

[0015]

The lower limit of the content of the vinyl ester unit in the polymer (A) with respect to the total structural units is preferably 10 mol%, more preferably 20 mol%, and still more preferably 30 mol%, or may be 40 mol%. When the content of the vinyl ester unit is equal to or more than the lower limit, the performance as a dispersant for suspension polymerization tends to be more favorable. The upper limit of the content of the vinyl ester unit in the polymer (A) with respect to the total structural units is preferably 90 mol%, or may be 80 mol%, 70 mol%, 60 mol%, or 50 mol%. When the content of the vinyl ester unit is equal to or less than the upper limit, the water solubility increases, and the aqueous solution obtained tends to have a reduced viscosity.

[0016]

The polymer (A) comprises a vinyl alcohol unit ($-CH_2-CH(OH)-$). The vinyl alcohol unit is typically formed by saponifying a vinyl ester unit. Due to the polymer (A) having a vinyl alcohol unit, the water solubility increases, and the viscosity of the aqueous solution tends to be reduced.

[0017]

The degree of saponification of the polymer (A) is more than 0 mol% and less than 70 mol%. When the degree of saponification is more than 0 mol%, water solubility of the polymer (A) increases, and the viscosity of the aqueous solution is reduced. On the other hand, when the degree of saponification is less than 70 mol%,

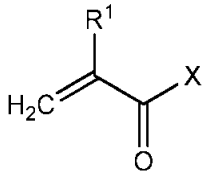
performance as a dispersant for suspension polymerization becomes favorable. The degree of saponification is preferably 10 mol% or more, more preferably 30 mol% or more, and still more preferably 43 mol% or more. The degree of saponification may be 65 mol% or less, or may be 60 mol% or less. The degree of saponification as referred herein to means a proportion (mol%) of the vinyl alcohol unit with respect to the total number of moles of the vinyl ester unit and the vinyl alcohol unit. The degree of saponification is a value measured in accordance with a method described in JIS K6726: 1994.

[0018]

The content of the vinyl alcohol unit in the polymer (A), with respect to the total structural units, is preferably 10 mol% or more and 80 mol% or less, more preferably 20 mol% or more and 75 mol% or less, still more preferably 30 mol% or more and 70 mol% or less, and even more preferably 40 mol% or more and 65 mol% or less.

The polymer (A) comprises the structural unit derived from the monomer (M). The monomer (M) is a monomer represented by the following formula (1).

[0020]



(1)

[0021]

In the formula (1), R^1 represents a hydrogen atom or a methyl group; X represents a hydroxy group, an amino group, a morpholino group, a polyethylene glycol group, or a group represented by $-OR^A$, wherein R^A represents an alkyl group having 1 to 12 carbon atoms or an aryl group having 6 to 12 carbon atoms.

[0022]

It is considered that the polymer (A) has high water solubility, and the viscosity of the aqueous solution obtained can be reduced, due to comprising, together with the vinyl alcohol unit, the structural unit derived from the monomer (M) having such a specified polar group.

[0023]

R^1 represents preferably a hydrogen atom.

[0024]

The polyethylene glycol group as X may be a group represented by $-O-(CH_2CH_2O)_n-H$ (wherein n is the number of 1 or more and 20 or less). n is an averaged value and may not be an integer. The upper limit of n is preferably 10, more preferably 6, and still more preferably 4.

[0025]

Examples of the alkyl group which may be represented by R^A include a methyl group, an ethyl group, a propyl group, a hexyl group, an octyl group, and the like. Examples of the aryl group which may be represented by R^A include a phenyl group, a tolyl group, a naphthyl group, and the like. R^A represents preferably an alkyl group, more preferably an alkyl group having 1 to 3 carbon atoms, and still more preferably a methyl group.

[0026]

X represents preferably a morpholino group, a polyethylene glycol group, or a group represented by $-OR^A$, more preferably a morpholino group or polyethylene

glycol group, and still more preferably a morpholino group. In the case in which X represents a morpholino group, the viscosity of the aqueous solution can be more reduced, and also the performance as a dispersant for suspension polymerization may be particularly favorable. It is to be noted that the morpholino group as referred to herein means a substituent, falling under morpholine from which hydrogen of the secondary amine is removed.

[0027]

The lower limit of the content of the structural unit derived from the monomer (M) in the polymer (A), with respect to the total structural units, is 2 mol%, preferably 3 mol%, more preferably 5 mol%, and still more preferably 10 mol%. The upper limit of the content of the structural unit derived from the monomer (M) in the polymer (A), with respect to the total structural units, is 70 mol%, preferably 60 mol%, more preferably 50 mol%, still more preferably 40 mol%, even more preferably 30 mol%, and particularly preferably 25 mol%. When the content of the structural unit derived from the monomer (M) is equal to or more than the lower limit, water solubility increases, and the aqueous solution tends to have a lowered viscosity. Furthermore, when the content of the structural unit derived from the monomer (M) falls within the above range, the performance as a dispersant for suspension polymerization may be more favorable. It is to be noted that the content of the structural unit derived from the monomer (M) with respect to the total structural units in the polymer (A) may be also referred to as a degree of modification (mol%).

[0028]

The lower limit of the total content of the vinyl alcohol unit and the structural unit derived from the monomer (M) in the polymer (A), with respect to the total structural units, is preferably 20 mol%, more preferably 30 mol%, and still more preferably 40 mol%, or may be 50 mol%. When the total content of these structural units having specified groups is equal to or more than the lower limit, water solubility of the polymer (A) is more increased, and the viscosity of the aqueous solution tends to be reduced. The upper limit of the total content of the vinyl alcohol unit and the structural unit derived from the monomer (M) in the polymer (A), with respect to the total structural units, is preferably 80 mol%, or may be 75 mol%, 70 mol%, or 65 mol%.

The polymer (A) may further comprise other structural unit(s) aside from the vinyl ester unit, the vinyl alcohol unit, and the structural unit derived from the monomer (M). Examples of the monomer that gives the other structural unit include: α-olefins such as ethylene, propylene, 1-butene, isobutene, and 1-hexene; acrylamide derivatives such as N-methylacrylamide and N-ethylacrylamide; methacrylamide derivatives such as N-methylmethacrylamide and N-ethylmethacrylamide; vinyl ethers such as methyl vinyl ether, ethyl vinyl ether, n-propyl vinyl ether, isopropyl vinyl ether, and n-butyl vinyl ether; hydroxy group-containing vinyl ethers such as ethylene glycol vinyl ether, 1,3-propanediol vinyl ether, and 1,4-butanediol vinyl ether; allyl acetate; allyl ethers such as propyl allyl ether, butyl allyl ether, and hexyl allyl ether; isopropenyl acetate; hydroxy group-containing α-olefins such as 3-buten-1-ol, 4-penten-1-ol, 5-hexen-1-ol, 7-octen-1-ol, 9-decen-1-ol, and 3-methyl-3-buten-1-ol; monomers having a silyl group, such as vinyltrimethoxysilane, vinylmethyldimethoxysilane, vinyldimethylmethoxysilane, vinyltriethoxysilane, vinylmethyldiethoxysilane, vinyldimethylethoxysilane, 3-(meth)acrylamidepropyltrimethoxysilane, and 3-(meth)acrylamidepropyltriethoxysilane; and the like.

[0030]

The lower limit of the total content of the vinyl ester unit, the vinyl alcohol unit, and the structural unit derived from the monomer (M) in the polymer (A) is, with respect to the total structural units, preferably 90 mol%, more preferably 95 mol%, and still more preferably 99 mol%, or may be 99.9 mol%. In the case in which the content of the other structural unit(s) aside from the vinyl ester unit, the vinyl alcohol unit, and the structural unit derived from the monomer (M) is thus low, the viscosity of the aqueous solution may be more reduced, and the performance as a dispersant for suspension polymerization tends to be more enhanced. The upper limit of the total content of the vinyl ester unit, the vinyl alcohol unit, and the structural unit derived from the monomer (M) in the polymer (A) may be 100 mol% with respect to the total structural units.

[0031]

The lower limit of the viscosity-average degree of polymerization of the polymer (A) is preferably 30, more preferably 50, and still more preferably 100. The upper limit of the viscosity-average degree of polymerization of the polymer (A) is preferably 2,000, more preferably 1,200, still more preferably 600, even more preferably 400, and particularly preferably 300. When the viscosity-average degree of polymerization of the polymer (A) falls within the above range, the viscosity of the aqueous solution may be more reduced, and the performance as a dispersant for suspension polymerization tends to be more enhanced. The viscosity-average degree of polymerization of the polymer (A) is a value measured in accordance with JIS K6726: 1994.

[0032]

When 40 parts by mass of the polymer (A) are dissolved in 60 parts by mass of water, the polymer (A) resulting in the viscosity at 20 °C of 2,000 mPa·s or less is preferred, and more preferably, resulting in the viscosity of 1,500 mPa·s or less. In other words, the viscosity at 20 °C of an aqueous solution of the polymer (A) at a concentration of 40% by mass is preferably 2,000 mPa·s or less, and more preferably 1,500 mPa·s or less. In such a case, the viscosity of the aqueous solution can be particularly sufficiently reduced. The viscosity at 20 °C when 40 parts by mass of the polymer (A) are dissolved in 60 parts by mass of water may be 10 mPa·s or more, or 100 mPa·s or more, or may be 300 mPa·s or more.

[0033]

The viscosity is defined as a value measured by using a B-type viscometer (spindle: LV-03 to LV-04) under a condition involving the number of rotor revolution of 60 rpm, and a temperature of 20 °C.

[0034]

The polymer (A) is preferably a saponification product of a random copolymer of a vinyl ester monomer and the monomer (M). In other words, it is preferred that the polymer (A) has a structure in which the structural unit derived from the monomer (M) are present at random. In such a cases, a water solubility-improving effect and a viscosity-reducing effect due to the structural unit derived from the monomer (M) can be particularly sufficiently exerted. The random copolymer may include other monomer(s) aside from the vinyl ester monomer and the monomer (M) by random copolymerization. The random copolymer of the vinyl ester monomer and the monomer (M) can be produced by a procedure or the like in which each monomer as described later is subjected to radical copolymerization.

[0035]

In the case in which the polymer (A) is a saponification product of the random copolymer of the vinyl ester monomer and the monomer (M), this saponification

product is preferably an alkaline saponification product. In general, PVA obtained by alkaline saponification tends to have inferior randomness of the vinyl alcohol unit and low water solubility, and result in a high viscosity of the aqueous solution to be obtained. Therefore, in the case in which the present invention is applied to the alkaline saponification product, the water solubility increases, whereby an advantage of enabling the reduction in viscosity of the resultant aqueous solution to be contemplated may be particularly prominently achieved.

[0036]

The polymer (A) can be suitably used as a dispersant for suspension polymerization. The polymer (A) may be used other intended usage aside from the dispersant for suspension polymerization. The polymer (A) may be used as a dispersant for emulsion polymerization, or may be used for other intended usage aside from dispersants. The other intended usage aside from the dispersant is exemplified by the intended usage similar to each intended usage of conventional PVAs such as: materials of films and fibers; additives for paper processing and fiber processing; adhesives; and binders for inorganic substances.

[0037]

Process for Producing Polymer (A)

The polymer (A) can be produced by, for example, copolymerizing a vinyl ester monomer and the monomer (M), and saponifying the copolymer thus obtained. The copolymerization of the vinyl ester monomer and the monomer (M) is preferably random copolymerization.

[0038]

The procedure of polymerizing the vinyl ester monomer and the monomer (M) is exemplified by a well-known procedure such as a bulk polymerization procedure, a solution polymerization procedure, a suspension polymerization procedure, an emulsion polymerization procedure, and the like. Of these procedures, the bulk polymerization procedure performed without a solvent or the solution polymerization procedure performed with a solvent such as an alcohol or the like are preferred, and the solution polymerization procedure in which the polymerization is performed in the presence of a lower alcohol is more preferred. The lower alcohol is preferably an alcohol having 3 or fewer carbon atoms; more preferably methanol, ethanol, n-propanol, or isopropanol; and still more preferably methanol. In carrying out a polymerization reaction by the bulk polymerization procedure or the solution polymerization procedure, in terms of a reaction system, either of a batchwise system or a continuous system can be employed.

[0039]

Examples of the polymerization initiator for use in the polymerization reaction include well-known polymerization initiators, e.g., azo initiators such as 2,2'-azobisisobutyronitrile, 2,2'-azobis(2,4-dimethylvaleronitrile), and 2,2'-azobis(4-methoxy-2,4-dimethylvaleronitrile); organic peroxide initiators such as benzoyl peroxide, n-propyl peroxycarbonate, cumyl peroxyneodecanoate, and t-butyl peroxyneodecanoate; and the like. The polymerization temperature when conducting the polymerization reaction is not particularly limited, and preferably falls within the range of 5 °C or more and 200 °C or less.

[0040]

In copolymerizing the vinyl ester monomer and the monomer (M), a copolymerizable other monomer(s) may be further copolymerized. Examples of the other monomer include those exemplified for the monomer that gives the other structural unit, and the like.

[0041]

Upon copolymerization, a certain chain transfer agent may be coexisted. Examples of the chain transfer agent include: aldehydes such as acetaldehyde, propionaldehyde, and butylaldehyde; ketones such as acetone and methyl ethyl ketone; mercaptans such as 2-hydroxyethanethiol and 3-mercaptopropionic acid; thiocarboxylic acids such as thioacetic acid; halogenated hydrocarbons such as trichloroethylene and perchloroethylene; and the like.

[0042]

The saponification of the copolymer thus obtained can be execute by, for example, subjecting the vinyl ester polymer to a treatment using an alkali catalyst or an acid catalyst, in an alcohol solution. For the saponification reaction of the vinyl ester polymer, an alcoholysis or hydrolysis reaction using a conventionally well-known alkali catalyst such as sodium hydroxide, potassium hydroxide, or sodium methoxide, or an acid catalyst such as p-toluenesulfonic acid can be adopted. Examples of the solvent to be used in the saponification reaction include: alcohols such as methanol and ethanol; esters such as methyl acetate and ethyl acetate; ketones such as acetone and methyl ethyl ketone; aromatic hydrocarbons such as benzene and toluene; and the like. These can be used alone, or as a combination of two or more types thereof. Of these, due to convenience, it is preferred to use as the solvent, methanol or a mixed solution of methanol and methyl acetate, and to conduct the saponification reaction in the presence of sodium hydroxide that serves as the alkali catalyst. The saponification can be carried out with a belt-type reactor, a kneader-type reactor, a tower-type reactor, or the like.

[0043]

The PVA (A) obtained via saponification may be subjected to a washing treatment or drying treatment.

[0044]

Aqueous Solution

The aqueous solution according to one embodiment of the present invention comprises the polymer (A). Due to comprising the polymer (A) having a structural unit derived from a monomer (M) represented by the following formula (1), the aqueous solution has sufficiently low viscosity. Therefore, the aqueous solution is superior in productivity, handleability, and the like. In addition, the aqueous solution is also favorable in performance as a dispersant for suspension polymerization. Specifically, by using the aqueous solution for suspension polymerization, as a dispersant, polymer particles having a small average particle diameter and being favorable in plasticizer absorptivity can be obtained. Since the aqueous solution is a liquid, it is not necessary to dissolve the polymer (A) when used as the dispersant for suspension polymerization, thereby leading to superior handleability.

[0045]

The aqueous solution according to one embodiment of the present invention comprises the polymer (A) and water (B). The aqueous solution may further comprise other component(s), aside from the polymer (A) and water (B).

[0046]

Polymer (A)

The polymer (A) to be comprised in the aqueous solution according to one embodiment of the present invention is the polymer according to one embodiment of the present invention described above. The aqueous solution may comprise one type, or two or more types of the polymer (A).

[0047]

The lower limit of the content of the polymer (A) in the aqueous solution according to one embodiment of the present invention is preferably 10% by mass, preferably 15% by mass, and more preferably 20% by mass, or may be still more preferably 25% by mass, 30% by mass, 35% by mass, or 40% by mass. When the content of the polymer (A) is equal to or more than the lower limit, a high-concentration aqueous solution is provided, thereby enabling efficient distribution, storage, and the like to be performed. The upper limit of the content of the polymer (A) may be 70% by mass, or may be 60% by mass, 50% by mass, 45% by mass, or 40% by mass. When the content of the polymer (A) is equal to or less than the upper limit, e.g., reduction in viscosity of the aqueous solution can be contemplated.

[0048]

Water (B) and Other Component, and the like

The aqueous solution according to one embodiment of the present invention comprises water (B) that serves as a solvent. Moreover, examples of the other component aside from the polymer (A) and water (B) which may be comprised in the aqueous solution include solid matter other than the polymer (A), solvents other than the water (B), and the like. The solid matter other than the polymer (A) is exemplified by a resin aside from the PVA (A), a surfactant, a plasticizer, each compound used in production, and the like. The solvent other than the water (B) is exemplified by alcohols such as ethanol. The solid matter as referred to herein means a component aside from the water (B) and other solvent(s). The solid matter may be a component which is in a solid state at 20 °C.

[0049]

The lower limit of the content of the polymer (A) with respect to the total amount of the solid matter in the aqueous solution according to one embodiment of the present invention is preferably 90% by mass and more preferably 95% by mass, or may be 99% by mass. Due to the main solid matter being the polymer (A) in the aqueous solution, the viscosity can be more reduced, and performance as a dispersant for suspension polymerization tends to be more favorable. The upper limit of the content of the polymer (A) with respect to the total amount of the solid matter in the aqueous solution may be 100% by mass, may be 99.9% by mass, or may be 99% by mass.

[0050]

The aqueous solution according to one embodiment of the present invention may comprise insoluble matter. The upper limit of the content of the insoluble matter in the aqueous solution is preferably 0.1% by mass, and more preferably 0.01% by mass. The insoluble matter may be a part of the polymer (A), or may be other component not originally having water solubility, and/or the like.

[0051]

The upper limit of the viscosity at 20 °C of the aqueous solution according to one embodiment of the present invention may be, for example, 10,000 mPa·s, may be 4,000 mPa·s, or may be 2,500 mPa·s, and is preferably 2,000 mPa·s and more preferably 1,500 mPa·s. When the viscosity of the aqueous solution is equal to or less than the upper limit, enhancing handleability and the like can be realized. The lower limit of the viscosity may be 10 mPa·s, or may be 100 mPa·s or 300 mPa·s.

[0052]

The aqueous solution according to one embodiment of the present invention can be suitably used as a dispersant for suspension polymerization. The aqueous solution may be used for other intended usage aside from the dispersant for suspension polymerization. The aqueous solution may be used as a dispersant for emulsion

polymerization, or may be used for other intended usage aside from the dispersant. The other intended usage aside from the dispersant is exemplified by intended usage similar to each of intended usages of conventional PVAs, such as: materials of films and fibers; additives for paper processing and fiber processing; adhesives; and binders for inorganic substances.

[0053]

Preparation of Aqueous Solution

The procedure of preparing the aqueous solution according to one embodiment of the present invention is not particularly limited. The aqueous solution can be obtained by, for example, adding the polymer (A) to the water (B), and dissolving the polymer (A). The polymer (A) may be added in multiple portions. Also, other component(s) may be further added, and heating may be conducted in the dissolving.

[0054]

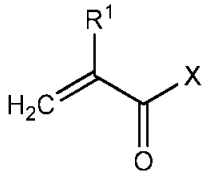
Dispersant for Suspension Polymerization

The dispersant for suspension polymerization (X) according to one embodiment of the present invention comprises the polymer according to one embodiment of the present invention, or the aqueous solution according to one embodiment of the present invention, each described above. The dispersant for suspension polymerization (X) may further comprise other component(s) aside from the polymer according to one embodiment of the present invention, and the aqueous solution according to one embodiment of the present invention. The dispersant for suspension polymerization (X) may be the polymer according to one embodiment of the present invention, or may be the aqueous solution according to one embodiment of the present invention.

[0055]

The dispersant for suspension polymerization (Y) according to other embodiment of the present invention comprises a polymer (A) comprising a vinyl ester unit, a vinyl alcohol unit, and a structural unit derived from a monomer (M), wherein the monomer (M) is at least one selected from the group consisting of a monomer represented by the following formula (1) and a monomer represented by the following formula (2), and a content of the structural unit derived from the monomer (M) in the polymer (A), with respect to the total structural units, is 2 mol% or more and 70 mol% or less, and the degree of saponification of the polymer (A) is more than 0 mol% and less than 70 mol%.

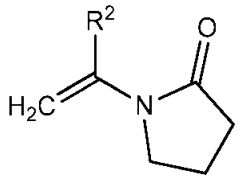
[0056]



(1)

In the formula (1), R^1 represents a hydrogen atom or a methyl group; and X represents a hydroxy group, an amino group, a morpholino group, or a polyethylene glycol group.

[0057]



(2)

In the formula (2), R^2 represents a hydrogen atom or a methyl group.

[0058]

Specific modes and suitable modes of the polymer (A) comprised in the dispersant for suspension polymerization (Y) are similar to specific modes and suitable modes of the polymer according to one embodiment of the present invention described above, except that the monomer (M) may be a monomer represented by the formula (2). The dispersant for suspension polymerization (Y) may comprise an aqueous solution comprising the polymer (A), or may be the aqueous solution comprising the polymer (A). In the case in which the dispersant for suspension polymerization (Y) comprises the aqueous solution, or the dispersant is the aqueous solution, specific modes and suitable modes of the aqueous solution comprised in the dispersant for suspension polymerization (Y) are similar to specific modes and suitable modes of the aqueous solution according to one embodiment of the present invention described above, except that the monomer (M) may be a monomer represented by the formula (2).

[0059]

It is preferred that R^2 represents a hydrogen atom.

[0060]

In the dispersant for suspension polymerization (Y), the monomer (M) is preferably: a monomer represented by the formula (1), wherein X represents a morpholino group, a polyethylene glycol group, or a group represented by $-OR^A$; or a monomer represented by the formula (2), and more preferably: a monomer represented by the formula (1), wherein X represents a morpholino group; or a monomer represented by the formula (2).

[0061]

The dispersant for suspension polymerization (Y) may further comprise other component(s) aside from the polymer (A). Examples of the other component aside from the polymer (A) include water, as well as other components exemplified as those which may be comprised in the aqueous solution according to one embodiment of the present invention, and the like. Also in the case in which the dispersant for suspension polymerization (Y) comprises the aqueous solution described above, the dispersant may further comprise other component(s) (for example, other polymer(s), etc.) aside from the aqueous solution described above. The dispersant for suspension polymerization (Y) may be in a solid form (for example, a powder form), or may be in a liquid form.

[0062]

The dispersant for suspension polymerization (X) and the dispersant for suspension polymerization (Y) according to embodiments of the present invention (hereinafter, the dispersant for suspension polymerization (X) and the dispersant for suspension polymerization (Y) may be abbreviated to “dispersant”) are superior in performance as a dispersant for suspension polymerization. The dispersant is suitable as a dispersant for suspension polymerization of a vinyl compound, and polymer particles having a small average particle diameter can be efficiently obtained.

Furthermore, the polymer particles obtained by suspension polymerization using the dispersant are also favorable in plasticizer absorptivity.

[0063]

The lower limit of the content of the polymer (A) in the dispersant in the case of the liquid form is preferably 10% by mass, more preferably 15% by mass, and still more preferably 20% by mass, or may be even more preferably 25 mass%, 30% by mass, 35% by mass, or 40% by mass. When the content of the polymer (A) is equal to or more than the lower limit, a high-concentration dispersant is provided, thereby enabling efficient distribution, storage, and the like to be performed. The upper limit of the content of the polymer (A) in the dispersant in the case of the liquid form may be 70% by mass, or may be 60% by mass, 50% by mass, 45% by mass, or 40% by mass. When the content of the polymer (A) is equal to or less than the upper limit, e.g., reduction in viscosity of the dispersant can be contemplated. The dispersant can also be used after dilution.

[0064]

The upper limit of the viscosity at 20 °C of the dispersant in the case of the liquid form may be, for example, 10,000 mPa·s, may be 4,000 mPa·s, or may be 2,500 mPa·s, and is preferably 2,000 mPa·s and more preferably 1,500 mPa·s. When the viscosity of the dispersant is equal to or less than the upper limit, improvement of handleability and the like can be achieved. The lower limit of the viscosity may be 10 mPa·s, or may be 100 mPa·s or 300 mPa·s.

[0065]

The lower limit of the content of the polymer (A) with respect to the total amount of the solid matter in the dispersant according to an embodiment of the present invention is preferably 90% by mass and more preferably 95% by mass, or may be 99% by mass. Due to the main solid matter being the polymer (A) in the dispersant, performance as a dispersant for suspension polymerization tends to be more favorable. The upper limit of the content of the polymer (A) with respect to the total amount of the solid matter in the dispersant may be 100% by mass, may be 99.9% by mass, or may be 99% by mass.

[0066]

The dispersant according to an embodiment of the present invention may comprise insoluble matter. The upper limit of the content of the insoluble matter in the dispersant is preferably 0.1% by mass, and more preferably 0.01% by mass. The insoluble matter may be a part of the polymer (A), or may be other component not originally having water solubility, and/or the like.

[0067]

Polymerization Procedure of Vinyl Compound

As a method in which the dispersant according to an embodiment of the present invention is used, a polymerization procedure of a vinyl compound is described below in which the dispersant is used. The polymerization procedure of the vinyl compound comprises a step of polymerizing a vinyl compound in the presence of the dispersant according to an embodiment of the present invention. The polymerization procedure is similar to polymerization procedures of vinyl compounds which are conventionally well-known, except that the dispersant according to an embodiment of the present invention is used as the dispersant.

[0068]

In the polymerization procedure, a vinyl compound is typically subjected to suspension polymerization in an aqueous medium. As the aqueous medium, pure water, as well as an aqueous solution comprising any one of various types of additive

components, or an aqueous medium comprising other organic solvent can be used. The dispersant is added to this aqueous medium. To the aqueous medium may further added a polymerization initiator and a vinyl compound, and suspension polymerization is performed with stirring.

[0069]

The amount of the dispersant according to one embodiment of the present invention to be added in performing the suspension polymerization of the vinyl compound is not particularly limited, and on mass basis equivalent to the solid content with respect to the vinyl compound, preferably 1 ppm or more and 50,000 ppm or less, more preferably 10 ppm or more and 10,000 ppm or less, still more preferably 30 ppm or more and 5,000 ppm or less, and even more preferably 50 ppm or more and 1,000 ppm or less.

[0070]

The dispersant according to an embodiment of the present invention may be used alone, or may be used in combination with other dispersant and/or the like. The other dispersant and/or the like are/is exemplified by various types of dispersants to be commonly employed in performing suspension polymerization of a vinyl compound in an aqueous medium. Specific examples include: water-soluble cellulose ethers such as methyl cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, and hydroxypropylmethyl cellulose; PVAs other than the polymer (A), water-soluble polymers such as gelatin; oil-soluble emulsifying agents such as sorbitan monolaurate, sorbitan trioleate, glycerin tristearate, and an ethylene oxide-propylene oxide block copolymer; water soluble emulsifying agents such as polyoxyethylene sorbitan monolaurate, polyoxyethylene glycerin oleate, and sodium laurate; and the like.

[0071]

As a polymerization initiator to be used the polymerization procedure, a polymerization initiator which is conventionally used in polymerization of a vinyl compound may be used; and specifically, a polymerization initiator similar to those exemplified in relation to the polymerization of the vinyl ester monomer described above may be used.

[0072]

In the polymerization procedure, other various types of additives may be added to the polymerization system as necessary. Examples of the additives include: polymerization modifiers such as aldehydes, halogenated hydrocarbons, and mercaptans; polymerization inhibitors such as phenol compounds, sulfur compounds, and N-oxide compounds; and the like. Furthermore, a pH adjusting agent, a scale inhibitor, a cross-linking agent, and/or the like may also be added. A plurality of the additives may be used in combination.

[0073]

Examples of the vinyl compound which can be subjected to the suspension polymerization in the polymerization procedure of the present invention include: halogenated vinyls such as vinyl chloride; vinyl esters such as vinyl acetate and vinyl propionate; acrylic acid, methacrylic acid, and esters and salts thereof; maleic acid, fumaric acid, and esters and anhydrides thereof; styrene; acrylonitrile; vinylidene chloride; vinyl ether; and the like. Of these vinyl compounds, halogenated vinyls are preferred, and vinyl chloride is more preferred. The polymerization procedure is particularly suitable as a method for suspension polymerization of vinyl chloride alone, or a method for suspension polymerization of vinyl chloride and a monomer copolymerizable with vinyl chloride together. Examples of the monomer copolymerizable with vinyl chloride include: vinyl esters such as vinyl acetate and

vinyl propionate; (meth)acrylic acid esters such as methyl (meth)acrylate and ethyl (meth)acrylate; α-olefins such as ethylene and propylene; unsaturated dicarboxylic acids such as maleic anhydride and itaconic acid; acrylonitrile; styrene; vinylidene chloride; vinyl ether; and the like.

[0074]

When the suspension polymerization of the vinyl compound is carried out in the polymerization procedure, a charging proportion of each component, a polymerization temperature, a polymerization time period, and the like may be similar to conditions that have been conventionally adopted in suspension polymerization of a vinyl compound. Furthermore, there is no limitation on a charging order and a ratio of the vinyl compound, the polymerization initiator, the dispersant, the aqueous medium, and the other additives.

[0075]

In accordance with the polymerization procedure in which the dispersant according to an embodiment of the present invention is used, vinyl polymer particles having a small average particle diameter can be efficiently obtained. Furthermore, the vinyl polymer particles obtained by the polymerization procedure are favorable also in plasticizer absorptivity.

EXAMPLES

[0076]

Hereinafter, the present invention is explained in more detail by way of Examples, but the present invention is not in any way limited to these Examples. Physical property values of the polymer (A) were measured in accordance with the following method.

[0077]

Viscosity-Average Degree of Polymerization

In the case in which the polymer (A) is PVA, a solution in methanol of polyvinyl acetate (PVAc) before subjecting to the saponification reaction, which had been obtained previously, from which unreacted vinyl acetate was eliminated, was charged into n-hexane to allow for precipitation of the PVAc. In the case in which the polymer (A) was PVAc, the resultant PVAc was used. Purification by reprecipitation in which the PVAc was dissolved in acetone was conducted three times, followed by drying under reduced pressure at 60 °C, whereby a purified product of the PVAc was obtained. After a solution in methanol of the purified product of the PVAc was subjected to saponification at the alkali molar ratio of 0.2, Soxhlet extraction with methanol was performed for 3 days, and then drying gave the purified product of the PVA. The degree of polymerization (viscosity-average degree of polymerization) of the PVA thus obtained was measured in accordance with JIS K6726: 1994.

[0078]

Content of Structural Units Derived from Monomer (M) (Conversion)

The content of the structural unit derived from the monomer (M) in the polymer (A) (conversion: degree of modification (mol%)) was calculated from the spectrum of modified species by a ^{1}H-NMR spectrum analysis.

[0079]

Degree of Saponification

The degree of saponification of the polymer (A) was measured in accordance with JIS K6726: 1994.

[0080]

Production Example 1: Production of PVA-1

Into a 3-L reaction chamber equipped with a stirrer, a reflux condenser, a nitrogen feed port, an additive addition port, and an initiator addition port were charged 330.0 parts by mass of vinyl acetate, 100.0 parts by mass of acryloylmorpholine as the monomer (M), and 1,170.0 parts by mass of methanol, and after the temperature was raised to 60 °C, replacement with nitrogen gas in the system was carried out by nitrogen bubbling for 30 min. Polymerization was started by adding 2.0 parts by mass of 2,2'-azobis(4-methoxy-2,4-dimethylvaleronitrile) (AIBN). During the polymerization, the polymerization temperature of 60 °C was maintained, and after 4 hours when the degree of polymerization reached 50%, the polymerization was stopped by cooling. Next, unreacted vinyl acetate was eliminated under reduced pressure to give a solution of polyvinyl acetate in methanol. Saponification was performed by adding a solution of NaOH in methanol (10% by mass concentration) to the PVAc solution adjusted to 30% by mass, such that an NaOH molar ratio (the number of moles of NaOH/ the number of moles of the vinyl ester unit in PVAc) became 0.0005. The moisture content of the saponification solution was adjusted to 1% by mass. After the saponification, washing and drying were carried out to give the powder of the vinyl alcohol polymer (PVA-1). Physical properties of PVA-1 are shown in Table 2.

[0081]

Production Examples 2 to 7, Comparative Production Examples 1, 2: Production of PVA-2 to PVA-9

PVA-2 to PVA-9 were each produced by a similar procedure to that of Production Example 1, except that the type of the monomer (M), using amount used of each monomer, methanol, and AIBN used in the polymerization, as well as the NaOH molar ratio in the saponification were as presented in Table 1. Physical properties of PVA-2 to PVA-9 are shown in Table 2.

[0082]

Comparative Production Example 1: Production of PVAc-1

Into a 3-L reaction chamber equipped with a stirrer, a reflux condenser, a nitrogen feed port, an additive addition port, and an initiator addition port were charged 270.0 parts by mass of vinyl acetate, 34.8 parts by mass of methyl acrylate as the monomer (M), and 1,230.0 parts by mass of methanol, and after the temperature was raised to 60 °C, replacement with nitrogen gas in the system was carried out by nitrogen bubbling for 30 min. Polymerization was started by adding 1.0 parts by mass of 2,2'-azobis(4-methoxy-2,4-dimethylvaleronitrile) (AIBN). During the polymerization, the polymerization temperature of 60 °C was maintained, and after 4 hours when the degree of polymerization reached 50%, the polymerization was stopped by cooling. Next, unreacted vinyl acetate was eliminated under reduced pressure to give a solution of polyvinyl acetate in methanol. The solution of polyvinyl acetate in methanol was charged into n-hexane to allow for precipitation of polyvinyl acetate. Washing and drying of the precipitated matter gave powder of polyvinyl acetate (PVAc-1). Physical properties of the PVAc-1 are shown in Table 2.

[0083]

Example 1

PVA-1 as the polymer (A) was dissolved in water to give an aqueous solution of Example 1 having a content of the polymer (A) of 39.2% by mass.

[0084]

Examples 2 to 7, Comparative Example 1

Each aqueous solution of Examples 2 to 7 and Comparative Example 1 was obtained by a similar procedure to that of Example 1 except that the type and the

content of the polymer (A) were changed as shown in Table 2.

[0085]

Comparative Example 2, 3

Preparation of aqueous solutions each having a content of the polymer (A) being 40% by mass was attempted with changes of the type of the polymer (A) as shown in Table 2. However, a large amount of the polymer (A) was undissolved, thereby leading to a failure in obtaining the aqueous solution having a content of dissolved polymer (A) being at least 35% by mass.

[0086]

Evaluations

Viscosity of Aqueous Solution

The viscosity was measured on each aqueous solution obtained in Examples 1 to 7 and Comparative Example 1. The measurement of the viscosity of the aqueous solution was conducted under conditions involving a rotor speed of 60 rpm and a temperature of 20 °C, by using a B-type viscometer BLII (spindle: LV-04) manufactured by Toki Sangyo Co., Ltd. Upon this evaluation, in the case in which the viscosity was 2,500 mPa·s or less, the viscosity was assessed as being sufficiently low. The results are shown in Table 2.

[0087]

Suspension Polymerization of Vinyl Chloride

Suspension polymerization of vinyl chloride was carried out according to the following method by using, as a dispersant, each aqueous solution of Examples 1 to 7 and Comparative Example 1. It is to be noted that suspension polymerization was not conducted as for Comparative Examples 2 and 3, since preparation of the aqueous solution at a content of at least 35% by mass failed. Next, particles of each vinyl chloride polymer obtained were evaluated on the average particle diameter and the plasticizer absorption as described below. The results of the evaluations are shown in Table 2.

[0088]

From each aqueous solution of Examples and Comparative Examples, an aliquot in an amount of 400 ppm in terms of the solid content of the solution with respect to vinyl chloride described later was taken. Each aqueous solution thus provided was diluted by adding deionized water thereto, whereby a first aqueous dispersant solution was obtained. 100 parts by mass of the first aqueous dispersant solution were charged into an autoclave having a volume of 5 L. Similarly, from an aqueous PVA solution in which commercially available PVA (“Kuraray Poval 48-80” manufactured by Kuraray Co., Ltd.,) was dissolved, an aliquot in an amount of 800 ppm in terms of the solid content of the aqueous PVA solution with respect to vinyl chloride was taken. The aqueous PVA solution thus provided was diluted by adding deionized water thereto, whereby a second aqueous dispersant solution was obtained. 100 parts by mass of the second aqueous dispersant solution were charged into the above-described autoclave. Next, deionized water was added to the autoclave such that a total of deionized water was 1,300 parts by mass.

Subsequently, 0.65 parts by mass of a 70% by mass toluene solution of cumyl peroxyneodecanoate, and 1.05 parts by mass of a 70% by mass toluene solution of t-butyl peroxyneodecanoate were charged into the autoclave. Degassing was performed to remove oxygen such that pressure inside the autoclave was 0.0067 MPa. Thereafter, 800 parts by mass of vinyl chloride were charged into the autoclave, and a temperature of the contents inside the autoclave was raised to 57 °C to start polymerization with stirring. At the time of starting the polymerization, the pressure

inside the autoclave was 0.83 MPa. The polymerization was terminated when 3.5 hrs had passed from the start of the polymerization and the pressure inside the autoclave had reached 0.70 MPa, and unreacted vinyl chloride was removed. Subsequently, a polymerization slurry was taken out and drying was performed at 65 °C for 17 hrs to give vinyl chloride polymer particles.

[0089]

(1) Average particle diameter of vinyl chloride polymer particles

A particle diameter distribution of the vinyl chloride polymer particles obtained was measured by a dry sieve analysis using a wire mesh with a Tyler mesh standard. Results thereof were plotted in accordance with the Rosin-Rammler distribution equation, and an average particle diameter (d_{p50}; median diameter) was calculated. In this evaluation, the case of the average particle diameter being 220 μm or less was determined as the average particle diameter not being large. In regard to Comparative Examples 3 and 5, the resultant vinyl chloride polymer particles formed blocks, and although the average particle diameter was not measured by the method described above, the average particle diameter was small.

[0090]

(2) Plasticizer absorptivity of vinyl chloride polymer particles

A mass of a syringe having a volume of 5 mL, packed with 0.02 g of absorbent cotton, was weighed (defined as X (g)), and then a mass after charging thereinto 0.5 g of the vinyl chloride polymer particles was weighed (defined as Y (g)). Thereinto was charged 1 g of dioctyl phthalate (DOP), and the syringe was left to stand for 15 min. Subsequently, centrifugal separation was performed under conditions involving 3,000 rpm and 40 min to remove unabsorbed DOP, and a mass after removal was weighed (defined as Z (g)). Then, the plasticizer absorptivity (%) of the vinyl chloride polymer particles was determined by the following calculation formula. The plasticizer absorptivity being higher indicates that processing is easier, suggesting mainly that defects generated in the appearance, such as aggregates, are unlikely to appear during processing into a sheet. In this evaluation, the plasticizer absorptivity was assessed as being favorable in a case in which the plasticizer absorptivity was 20% or more.

$$\text{Plasticizer absorptivity (\%)} = 100 \times [\{Z - X) / (Y - X)\} - 1]$$

[0091]

Table 1

	Polymer (A)	Polymerization condition						Saponification condition
		vinyl acetate (parts by mass)	methanol (parts by mass)	monomer (M)		AIBN (parts by mass)	Conversion (%)	NaOH molar ratio
				type	(parts by mass)			
Production Example 1	PVA-1	330.0	1,170.0	acryloylmorpholine	100.0	2.0	50	0.0005
Production Example 2	PVA-2	330.0	1,170.0	N-vinyl-2-pyrrolidone	186.6	3.0	50	0.0010
Production Example 3	PVA-3	300.0	1,200.0	PEO acrylate (n = 3)	81.2	1.5	50	0.0075
Production Example 4	PVA-4	300.0	1,200.0	PEO acrylate (n = 3)	81.2	1.5	50	0.0040
Production Example 5	PVA-5	300.0	1,200.0	PEO acrylate (n = 9)	83.8	1.5	50	0.0050
Production Example 6	PVA-6	300.0	1,200.0	PEO acrylate (n = 9)	83.8	1.5	50	0.0010
Production Example 7	PVA-7	270.0	1,230.0	methyl acrylate	34.8	1.0	50	0.0070
Comparative Production Example 1	PVA-8	300.0	1,200.0	PEO acrylate (n = 9)	83.8	1.5	50	0.0085
Comparative Production Example 2	PVA-9	270.0	1,230.0	-	-	1.0	50	0.0010

	Polymer (A)	Polymerization condition						Saponification condition
		vinyl acetate (parts by mass)	methanol (parts by mass)	monomer (M)		AIBN (parts by mass)	Conversion (%)	NaOH molar ratio
				type	(parts by mass)			
Comparative Production Example 3	PVAc-1	270.0	1,230.0	methyl acrylate	34.8	1.0	50	-

[0092]

It is to be noted that “n” in Table 1 is a value of n, when X in the formula (1) represents a polyethylene glycol group (-O-(CH_2CH_2O)$_n$-H).

[0093]

Table 2

	Polymer (A)	Physical properties			Aqueous solution evaluation		dispersant evaluation	
		viscosity-average degree of polymerization	degree of modification (mol%)	degree of saponification (mol%)	content (mass%)	viscosity (mPa·s)	average particle diameter (μm)	plasticizer absorptivity (%)
Example 1	PVA-1	170	21.9	45.7	39.2	1,330	159.9	24.7
Example 2	PVA-2	180	16.5	44.8	40.0	1,490	182.3	29.2
Example 3	PVA-3	205	11.6	57.8	40.1	1,150	169.5	23.1
Example 4	PVA-4	205	11.6	40.2	40.5	1,920	188.6	28.2
Example 5	PVA-5	227	4.5	67.2	40.3	1,890	172.4	24.5
Example 6	PVA-6	227	4.5	42.4	39.1	2,000	176.0	25.7
Example 7	PVA-7	210	21.1	48.4	40.7	1,810	184.1	22.9
Comparative Example 1	PVA-8	227	4.5	88.0	40.2	1,770	170.4	18.7
Comparative Example 2	PVA-9	205	-	55.5	insoluble		-	-
Comparative Example 3	PVAc-1	210	21.1	0.0	insoluble		-	-

[0094]

As shown in Table 2, irrespective of being a high-concentration aqueous solution of a vinyl alcohol polymer having a comparatively low degree of saponification, each aqueous solution of Examples 1 to 7 had a sufficiently low viscosity of 2,500 mPa·s or less. Furthermore, in the case in which suspension polymerization was carried out using each aqueous solution of Examples 1 to 7 as a dispersant, obtaining vinyl chloride polymer particles having a small average particle diameter and being favorable in plasticizer absorptivity was enabled. Each aqueous solution of Examples 1 to 7 was successfully verified to be useful as a dispersant for suspension polymerization. On the other hand, the aqueous solution of Comparative Example 1 was prepared by using a vinyl alcohol polymer having a high degree of saponification, whereby performance as a dispersant for suspension polymerization was inferior. In addition, obtaining high-concentration aqueous solutions failed in Comparative Examples 2 and 3.

[INDUSTRIAL APPLICABILITY]

[0095]

The polymer and the aqueous solution of the present invention can be suitably used as a dispersant for suspension polymerization.

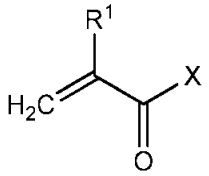
CLAIMS:

[Claim 1] A polymer comprising a vinyl ester unit, a vinyl alcohol unit, and a structural unit derived from a monomer (M), wherein

the monomer (M) is a monomer represented by the following formula (1),

a content of the structural unit derived from the monomer (M) is 2 mol% or more and 70 mol% or less, with respect to total structural units, and

a degree of saponification is more than 0 mol% and less than 70 mol%,



(1)

wherein, in the formula (1): R^1 represents a hydrogen atom or a methyl group; X represents a hydroxy group, an amino group, a morpholino group, a polyethylene glycol group, or a group represented by $-OR^A$; wherein R^A represents an alkyl group having 1 to 12 carbon atoms or an aryl group having 6 to 12 carbon atoms.

[Claim 2] The polymer according to claim 1, wherein a viscosity-average degree of polymerization of the polymer (A) is 30 to 2,000.

[Claim 3] The polymer according to claim 1 or 2, wherein a total content of the vinyl ester unit, the vinyl alcohol unit, and the structural unit derived from the monomer (M) is 90 mol% or more with respect to the total structural units.

[Claim 4] The polymer according to claim 1 or 2, wherein a solution obtained by dissolving 40 parts by mass of the polymer in 60 parts by mass of water has a viscosity at 20 °C of 2,000 mPa·s or less.

[Claim 5] An aqueous solution comprising the polymer according to claim 1 or 2.

[Claim 6] The aqueous solution according to claim 5, wherein a content of the polymer is 10% by mass or more.

[Claim 7] The aqueous solution according to claim 5, having a viscosity at 20 °C of 2,000 mPa·s or less.

[Claim 8] The aqueous solution according to claim 5, wherein a content of the polymer with respect to a total amount of solid matter is 90% by mass or more.

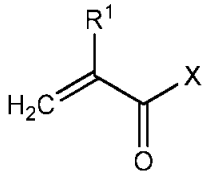
[Claim 9] A dispersant for suspension polymerization comprising the polymer according to claim 1 or 2.

[Claim 10] A dispersant for suspension polymerization comprising a polymer comprising: a vinyl ester unit; a vinyl alcohol unit; and a structural unit derived from a monomer (M), wherein

the monomer (M) is at least one selected from the group consisting of a monomer represented by the following formula (1) and a monomer represented by the following formula (2),

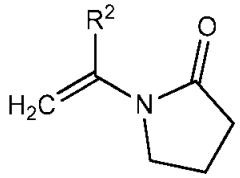
a content of the structural unit derived from the monomer (M) in the polymer is 2 mol% or more and 70 mol% or less with respect to total structural units, and

a degree of saponification of the polymer is more than 0 mol% and less than 70 mol%,



(1)

wherein, in the formula (1), R^1 represents a hydrogen atom or a methyl group; X represents a hydroxy group, an amino group, a morpholino group, a polyethylene glycol group, or a group represented by $-OR^A$; wherein R^A represents an alkyl group having 1 to 12 carbon atoms or an aryl group having 6 to 12 carbon atoms, and



(2)

in the formula (2), R^2 represents a hydrogen atom or a methyl group.