formaldehyde sulfoxylate into 15 % saline at 80 °C to coagulate thereby obtaining a crumb; washing the crumb with water; and drying the washed one.

[0005] However, in the conventional acrylic rubber such as the acrylic rubber described in Patent Document 1, mutual adhesion between hydrous crumbs after coagulation may occur. When such mutual adhesion between the hydrous crumbs occurs, there has been a problem that the efficiency of washing after the coagulation is lowered, a drying time when drying the hydrous crumbs is required to be prolonged, a polymer recovery ratio is deteriorated, and the like, and thus productivity is lowered. In addition, there has been a problem that sticking to a roll when various compounding agents are blended using a roll tends to occur, and thus processability when performing a processing with a roll is not sufficient, and also a problem that water resistance is greatly decreased.

RELATED ART DOCUMENTS

PATENT DOCUMENTS

[0006] Patent Document 1: Japanese Unexamined Patent Application Publication No. 2011-88956

SUMMARY ~~OF THE INVENTION~~

PROBLEM TO BE SOLVED ~~BY THE INVENTION~~

[0007] The present ~~invention~~ disclosure has been accomplished in view of such circumstances. The present ~~invention~~ disclosure aims to provide a method for producing an acrylic rubber, the method being able to effectively prevent generation of the mutual adhesion between hydrous crumbs and providing a high polymer recovery ratio, and the acrylic rubber being excellent in drying property and roll processability and being capable of providing a cross-linked rubber that has excellent water resistance.

MEANS FOR SOLVING THE PROBLEM

[0008] As a result of extensive studies to achieve the above object, the present inventors have found that the above object can be achieved by coagulating a polymerized emulsion liquid in the presence of two or more types of compounds having a polyoxyalkylene skeleton when the polymerized emulsion liquid obtained by emulsion polymerizing a monomer for forming an acrylic rubber is coagulated.

[0009] In addition, the present inventors have further found that the effectiveness of the present ~~invention~~disclosure is greatly improved by using a particular catalyst or a particular coagulant, and a particular coagulation temperature, as well as by performing acid washing in the washing step.

The present inventors have completed the present ~~invention~~ disclosure based on these findings.

[0010] Accordingly, in an aspect, the present ~~invention~~ disclosure provides a method for producing an acrylic rubber, comprising: an emulsion polymerization step of emulsion polymerizing a monomer for forming the acrylic rubber so as to obtain a polymerized emulsion liquid; and a coagulation step of coagulating the polymerized emulsion liquid in the presence of two or more types of compounds having a polyoxyalkylene skeleton so as to obtain a hydrous crumb.

According to the method for producing the acrylic rubber of the present ~~invention~~disclosure, it is preferable that the coagulation step is a step of obtaining the hydrous crumb by coagulating the polymerized emulsion liquid in the presence of two or more types of compounds having the polyoxyalkylene skeleton, the compounds having different molecular weights.

According to the method for producing the acrylic rubber of the present ~~invention~~disclosure, it is preferable that the coagulating step is a

step of obtaining the hydrous crumb by coagulating the polymerized emulsion liquid in the presence of a polyalkylene glycol (A) and an ester compound of a polyalkylene glycol (B1) and/or an ether compound of a polyalkylene glycol (B2).

[0011] According to the method for producing the acrylic rubber of the present ~~invention~~disclosure, it is preferable that emulsion polymerization in the emulsion polymerization step is performed with using a material containing a peroxide, ferrous sulfate, and an ascorbic acid or a salt of an ascorbic acid as a polymerization catalyst.

According to the method for producing the acrylic rubber of the present ~~invention~~disclosure, it is preferable that coagulation in the coagulation step is performed by contacting the polymerized emulsion liquid with a sulfate compound.

According to the method for producing the acrylic rubber of the present ~~invention~~disclosure, it is preferable that a coagulation temperature in the coagulation step is 60 °C or more.

According to the method for producing the acrylic rubber of the present ~~invention~~disclosure, it is preferable that the method comprises: a washing step of performing washing on the hydrous crumb; and a drying step of drying the washed hydrous crumb, and it is preferable that the washing step comprises an acid washing.

[0012] Further, the present ~~invention~~ disclosure provides an acrylic rubber obtained by the above-mentioned methods.

In addition, the present ~~invention~~ disclosure provides a rubber composition comprising a rubber ingredient and a cross-linking agent, the rubber ingredient comprising the above-mentioned acrylic rubber; and a cross-linked rubber prepared by cross-linking such a rubber composition.

[0012a] In a further aspect, there is provided a method for producing a rubber composition comprising

a step for producing an acrylic rubber by the method as defined above, and

a step for adding a cross-linking agent to a rubber ingredient comprising the produced acrylic rubber.

[0012b] In another aspect, there is provided a method for producing a cross-linked rubber comprising

a step for producing a rubber composition by the method as defined above, and

a step for cross-linking the produced rubber composition.

EFFECTS ~~OF INVENTION~~

[0013] According to the present ~~invention~~disclosure, there is provided a method for producing an acrylic rubber, the method being able to effectively prevent generation of the mutual adhesion between hydrous crumbs and providing a high polymer recovery ratio, and the acrylic rubber being excellent in drying property and roll processability and being capable of providing a cross-linked rubber that has excellent water resistance.

DESCRIPTION OF EMBODIMENTS

[0014] [Production method]

A method for producing an acrylic rubber of the present invention comprises: an emulsion polymerization step of emulsion polymerizing a monomer for forming an acrylic rubber so as to obtain a polymerized emulsion liquid; and

a coagulation step of coagulating the polymerized emulsion liquid in the presence of two or more types of compounds having a polyoxyalkylene skeleton so as to obtain a hydrous crumb.

[0015] <Monomer>

The monomer used in the present invention is characterized in that a (meth)acrylic ester is a main component. Note that, the (meth)acrylic ester indicates an acrylic ester and/or a methacrylic ester, and hereinafter, the same is true of (meth)acrylic acid methyl and the like. Further, the main component means a component having preferably 30 wt% or more in the total rubber monomer units. As the (meth)acrylic ester which is a main component, there is no particular limitation, and examples thereof include (meth)acrylic acid alkyl esters and (meth)acrylic acid alkoxyalkyl esters.

[0016] As the (meth)acrylic acid alkyl ester, for example, an ester of an alkanol having 1 to 12 carbon atoms and a (meth)acrylic acid is used, and an ester of an alkanol having 1 to 8 carbon atoms and a

CLAIMS

1. A method for producing an acrylic rubber, comprising:

an emulsion polymerization step of emulsion polymerizing a monomer for forming the acrylic rubber so as to obtain a polymerized emulsion liquid; and

a coagulation step of coagulating the polymerized emulsion liquid in the presence of two or more types of compounds having a polyoxyalkylene skeleton so as to obtain a hydrous crumb.

2. The method for producing the acrylic rubber according to claim 1, further comprising an emulsion preparation step of obtaining a monomer emulsion by mixing the monomer for forming the acrylic rubber with an emulsifier and water prior to the emulsion polymerization step, and

wherein the compounds having the polyoxyalkylene skeleton are added in a manner of mixing the compounds with the monomer emulsion obtained in the emulsion preparation step and/or mixing the compounds with the polymerized emulsion liquid obtained in the emulsion polymerization step.

3. The method for producing the acrylic rubber according to claim 1 or 2, wherein at least one type of compound selected from the group consisting of a homopolymer of oxyalkylene, a copolymer of two or more oxyalkylenes, a polyoxyalkylene alkyl ether, a polyoxyalkylene aryl ether, a polyoxyalkylene alkyl ester, and a polyoxyalkylene alkyl ether ester is used as the compounds having the polyoxyalkylene skeleton.

4. The method for producing the acrylic rubber according to any one of claims 1 to 3, wherein at least two types of compounds, which are

different from each other, selected from the group consisting of a homopolymer of oxyalkylene, a copolymer of two or more oxyalkylenes, a polyoxyalkylene alkyl ether, a polyoxyalkylene aryl ether, a polyoxyalkylene alkyl ester, and a polyoxyalkylene alkyl ether ester are used as the compounds having the polyoxyalkylene skeleton.

5. The method for producing the acrylic rubber according to any one of claims 1 to 4, wherein the coagulation step is a step of obtaining the hydrous crumb by coagulating the polymerized emulsion liquid in the presence of two or more types of compounds having the polyoxyalkylene skeleton, the compounds having different molecular weights.

6. The method for producing the acrylic rubber according to claim 5, wherein a low molecular weight compound (α1) having a polyoxyalkylene skeleton and a weight average molecular weight (Mw) of less than 10,000; and a high molecular weight compound (α2) having a polyoxyalkylene skeleton and a weight average molecular weight (Mw) of 10,000 or more are used as the compounds having the polyoxyalkylene skeleton.

7. The method for producing the acrylic rubber according to claim 6, wherein the weight average molecular weight (Mw) of the low molecular weight compound (α1) is in the range of 100 to 8,000, and the weight average molecular weight (Mw) of the high molecular weight compound (α2) is in the range of 20,000 to 6,000,000.

8. The method for producing the acrylic rubber according to any one of claims 1 to 7, wherein the coagulating step is a step of obtaining the hydrous crumb by coagulating the polymerized emulsion

liquid in the presence of polyalkylene glycol (A) and an ester compound of a polyalkylene glycol (B1) and/or an ether compound of a polyalkylene glycol (B2).

9. The method for producing the acrylic rubber according to claim 8, wherein the polyalkylene glycol (A) is added to the polymerized emulsion liquid after emulsion polymerization.

10. The method for producing the acrylic rubber according to claim 8 or 9, further comprising an emulsion preparation step of obtaining a monomer emulsion by mixing the monomer for forming the acrylic rubber with an emulsifier and water prior to the emulsion polymerization step, and

wherein the ester compound of the polyalkylene glycol (B1) and/or the ether compound of the polyalkylene glycol (B2) are added to the monomer emulsion before emulsion polymerization and/or the polymerized emulsion liquid after emulsion polymerization.

11. The method for producing the acrylic rubber according to any one of claims 8 to 10, wherein the ester compound of the polyalkylene glycol (B1) and/or the ether compound of the polyalkylene glycol (B2) are at least one of polyoxyalkylene ester compound selected from the group consisting of polyoxyalkylene phosphoric ester, polyoxyalkylene sulfate ester, polyoxyalkylene fatty acid ester, and polyoxyalkylene ether ester and/or at least one polyoxyalkylene ether compound having no ester group selected from the group consisting of polyoxyalkylene alkyl ether and polyoxyalkylene aryl ether.

12. The method for producing the acrylic rubber according to any one of claims 1 to 11, wherein the monomer for forming the acrylic

rubber contains 30 wt% or more of a (meth)acrylic ester monomer.

13. The method for producing the acrylic rubber according to claim 12, wherein the monomer for forming the acrylic rubber contains 30 wt% or more of a (meth)acrylic acid alkyl ester monomer and/or a (meth)acrylic acid alkoxyalkyl ester monomer, both ester monomers having an alkyl group with two or more carbon atoms.

14. The method for producing the acrylic rubber according to any one of claims 1 to 13, wherein the monomer for forming the acrylic rubber contains a cross-linkable monomer.

15. The method for producing the acrylic rubber according to claim 14, wherein the monomer for forming the acrylic rubber contains 0.01 wt% or more of the cross-linkable monomer.

16. The method for producing the acrylic rubber according to claim 14 or 15, wherein the cross-linkable monomer is at least one monomer selected from the group consisting of a carboxyl group-containing monomer, an epoxy group-containing monomer, a halogen group-containing monomer, and a diene monomer.

17. The method for producing the acrylic rubber according to any one of claims 14 to 16, wherein the monomer for forming the acrylic rubber contains 50 to 99.9 wt% of a (meth)acrylic ester monomer and 0.1 to 50 wt% of the cross-linkable monomer.

18. The method for producing the acrylic rubber according to any one of claims 1 to 17, wherein emulsion polymerization in the emulsion polymerization step is performed with using a material containing a

peroxide, ferrous sulfate, and an ascorbic acid or a salt of an ascorbic acid as a polymerization catalyst.

19. The method for producing the acrylic rubber according to any one of claims 1 to 18, wherein coagulation in the coagulation step is performed by contacting the polymerized emulsion liquid with a sulfate compound.

20. The method for producing the acrylic rubber according to claim 19, wherein coagulation in the coagulation step is performed in a manner of adding a metal sulfate to the polymerized emulsion liquid or in a manner of adding the polymerized emulsion liquid to an aqueous solution containing the metal sulfate.

21. The method for producing the acrylic rubber according to claim 20, wherein the metal sulfate is a monovalent metal sulfate.

22. The method for producing the acrylic rubber according to any one of claims 1 to 21, wherein a coagulation temperature in the coagulation step is 60 °C or more.

23. The method for producing the acrylic rubber according to any one of claims 1 to 22, comprising:

a washing step of performing washing on the hydrous crumb; and

a drying step of drying the washed hydrous crumb.

24. The method for producing the acrylic rubber according to claim 23, wherein the washing step comprises an acid washing.

25. A method for producing a rubber composition comprising a step for producing an acrylic rubber by the method according to any one of claims 1 to 24, and a step for adding a cross-linking agent to a rubber ingredient comprising the produced acrylic rubber.

26. A method for producing a cross-linked rubber comprising a step for producing a rubber composition by the method according to claim 25, and a step for cross-linking the produced rubber composition.

~~25. An acrylic rubber obtained by the method according to any one of claims 1 to 24.~~

~~26. The acrylic rubber according to claim 25, wherein a (meth)acrylate unit is from 50 to 99.9 wt%, a cross-linkable monomer unit is from 0.01 to 20 wt%, and a copolymerizable other monomer unit is from 0 to 49.99 wt%.~~

~~27. The acrylic rubber according to claim 26, wherein the cross-linkable monomer unit is a carboxyl group-containing monomer unit.~~

~~28. The acrylic rubber according to any one of claims 25 to 27, wherein a Mooney viscosity is in the range of 10 to 150.~~

~~29. The acrylic rubber according to claim 28, wherein the Mooney viscosity is in the range of 10 to 80.~~

~~30. The acrylic rubber according to any one of claims 25 to 29, wherein a glass transition temperature (Tg) is 25 °C or less.~~

~~31. A rubber composition comprising a rubber ingredient and a cross-linking agent, the rubber ingredient comprising the acrylic rubber according to any one of claims 25 to 30.~~

~~32. The rubber composition according to claim 31, further comprising a cross-linking accelerator, an antioxidant, a filler or a silane coupling agent.~~

~~33. A cross-linked rubber prepared by cross-linking the rubber composition according to claim 31 or 32.~~