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(54) Title: PAINT DETACKIFIER COMPOSITION AND USES THEREOF

(57) Abrégé/Abstract:
The invention provides methods and compositions which may be added into a liquid medium of an aqueous liquid system. It may be used to effectively treat water-based and/or solvent-based paints. The composition comprises: 1) an organic component, and 2) a metal salt. The organic component being one item selected from the list consisting of: an aldehyde-functionalized polyacrylamide, a dialdehyde, a polyacrylamide, and any combination thereof.

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(54) Title: PAINT DETACKIFIER COMPOSITION AND USES THEREOF

(57) Abstract: The invention provides methods and compositions which may be added into a liquid medium of an aqueous liquid system. It may be used to effectively treat water-based and/or solvent-based paints. The composition comprises: 1) an organic component, and 2) a metal salt. The organic component being one item selected from the list consisting of: an aldehyde-functionalized polyacrylamide, a dialdehyde, a polyacrylamide, and any combination thereof.

PAINT DETACKIFIER COMPOSITION AND USES THEREOF

Cross-Reference to Related Applications

This application claims priority to Chinese Patent Application Serial No. 2015101954685 filed on April 23, 2015, and U.S. Patent Application No. 62/169,380 filed on June 1, 2015 .

Background of the Invention

The invention relates to compositions, methods, and apparatuses for improving paint detackification. In particular one or more embodiments of the invention relate to a paint detackifier composition, and a paint detackifier composition for treatment of the aqueous liquid, and particularly for treatment of paint spray booth recirculating water.

The spray painting of automobile bodies, automobile parts and a variety of products for industrial use and consumer products is generally conducted in completely or partially enclosed working areas with good mechanical ventilation, i.e. paint spray booths. In spray painting, the paints are atomized to form particles via tools such as air spray gun and electrostatic rotary-bell spray gun. Due to low transfer efficiency (transfer efficiency means the ratio of paints adhered to the sprayed objects to overall paints sprayed) of spraying paint, there is a very serious overspray problem. About only 50% to 80% of paint mists adhere to the surface of the sprayed workpiece to form a paint film, and the remaining 20% to 50% paint particles become oversprayed paint mists escaping into the surrounding environment. Oversprayed paint mists contain highly-pelletized solvents and solid particles, such as aromatic hydrocarbon, alcohol, ketone and resin. These pollutants may diffuse into the air to pollute the equipment or the surrounding environment, or adhere to a paint film to form particles to influence spraying quality, and meanwhile do harm to health of the workers. In terms of safety and cost, most commonly, water is recirculated in paint spray booths to absorb and capture oversprayed paint mists. However, water containing oversprayed paints may have negative influence on the equipment and working environment and result in poor spraying qualities (such as orange peel and paint drops phenomena), and thus needs to be treated. Currently, it is common practice to add

Date Reçue/Date Received 2022-09-23

paint detackifiers into recirculating water in paint spray booths to capture and reduce the stickiness of oversprayed paint mists.

The existing paint detackifiers have many defects, such as high cost, poor detackification effect for water-based or solvent-based paints and overgrown microorganism in paint spray booth recirculating water.

Accordingly, there is a need for a low cost, high performance and environment-friendly paint detackifier with excellent detackification effect for both water-based and solvent-based paints.

The art described in this section is not intended to constitute an admission that any patent, publication or other information referred to herein is "prior art" with respect to this invention, unless specifically designated as such. In addition, this section should not be construed to mean that a search has been made or that no other pertinent information as defined in 37 CFR § 1.56(a) exists.

Brief Summary of the Invention

To satisfy the long-felt but unsolved needs identified above, at least one embodiment of the invention is directed towards a composition. The composition comprises: 1) an organic component; and 2) a metal salt. The organic component may be one item selected from the list consisting of: an aldehyde-functionalized polyacrylamide, a dialdehyde, a polyacrylamide, and any combination thereof.

The organic component may be 0.01 to 70 by weight % of the composition. The metal salt may be 0.05 to 90 by weight % of the of the composition. Preferably the organic component is 0.35 to 50 by weight % of the composition and the metal salt is 0.5 to 80 by weight % of the composition. The organic component may be an aldehyde-functionalized polyacrylamide obtained by the reaction of a dialdehyde with a polyacrylamide or a structurally similar material produced by other reaction mechanism. The organic component may be an aldehyde-functionalized polyacrylamide which has a mole ratio of dialdehyde groups to acrylamide monomers is in a range of 0.001 to 100:1, preferably 0.01 to 10:1, and more preferably 0.01 to 5:1. The average molecular weight of the organic component may range between 5,000 and 10,000,000 g/mole, preferably between 6,000 and 2,000,000 g/mole. The organic component may comprise a dialdehyde and/or may comprise an aldehyde-functionalized polyacrylamide obtained by the reaction of a dialdehyde with a polyacrylamide. The dialdehyde may be selected from the group

consisting of: glyoxal, Malondialdehyde, succindialdehyde, glutaric dialdehyde and any combination thereof. The organic component may comprise a polyacrylamide formed by copolymerization of acrylamides monomers, cationic monomers, and/or anionic monomers. The organic component may comprise a polyacrylamide which is cationic, anionic, or zwitterionic. The polyacrylamide may comprise monomers selected from acrylamide or methacrylamide.

The cationic monomers may be selected from the group consisting of: diallyl-N,N-disubstituted ammonium chloride, diallydimethylammonium chloride, N-(3-dimethylaminopropyl)methacrylamide, N-(3-dimethylaminopropyl) acrylamide, methacryloyloxyethyltrimethylammonium chloride, acryloyloxyethyltrimethylammonium chloride, methacryloyloxyethyldimethylbenzylammonium chloride, acryloyloxyethyldimethylbenzylammonium chloride, (3-acrylamidopropyl)trimethylammonium chloride, methacrylamidopropyltrimethylammonium chloride, 3-acrylamido-3-methylbutyltrimethylammonium chloride, 2-vinylpyridine, methacrylic-2-(dimethylamino) ethyl ester, acrylic-2-(dimethylamino) ethyl ester, ethyleneglycol acrylate and combinations thereof; the anionic monomers are selected from the group consisting of acrylic acid, methacrylic acid, itaconic acid, maleic acid, maleic anhydride and salts of these acids and any combination thereof.

The metal salt may be selected from the group consisting of: aluminum salt, iron salt, zirconium salt, aluminum sulfate, aluminum chloride, polyaluminum chloride, polyaluminum nitrate, polyaluminum sulfate, aluminum chlorohydrate, polyaluminum silicate sulfate, polyaluminum nitrate sulfate, polyaluminum sulfate chloride, zirconium, iron sulfate, iron chloride, polyiron chloride, polyiron sulfate, polyiron silicate sulfate, polyiron sulfate chloride and any combination thereof.

The composition may further comprise one or more natural polymer or synthetic polymer in 0.001 to 10 by weight % of the composition. The natural polymer or synthetic polymer may be selected from the group consisting of acrylamides copolymer or tripolymer, chitosan, guar gum, cellulose, starch, modified cellulose and any combination thereof.

The composition may be within a liquid medium of an aqueous liquid system. The aqueous liquid system may be selected from the group consisting of: a recirculating water system, a wastewater processing system, a paint spray booth, a paint

spray booth recirculating water system, and any combination thereof. The composition may detackify paint. The composition may detackify paint which was sprayed during an automobile painting operation. The organic component and the metal salt may contact each other: before they have been introduced into an aqueous liquid system, after they have been introduced into an aqueous liquid system, while they are being introduced into an aqueous liquid system, and any combination thereof. The composition of method of its use may further comprise a flocculant. The composition may be used in a method which further comprises the step of altering the pH of the liquid medium.

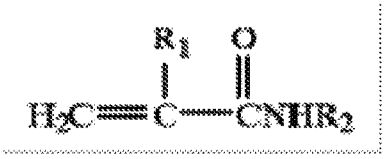
Additional features and advantages are described herein, and will be apparent from, the following Detailed Description.

Detailed Description of the Invention

DEFINITIONS

The following definitions are provided to determine how terms used in this application, and in particular how the claims, are to be construed. The organization of the definitions is for convenience only and is not intended to limit any of the definitions to any particular category.

"***Acrylamide Monomer***" means a monomer of formula



wherein R1 is H or C1-C4 alkyl and R2 is H, C1-C4 alkyl, aryl or arylalkyl. Representative acrylamide monomers are acrylamide and methacrylamide.

"***Alkyl***" as used herein means a monovalent group derived from a straight or branched chain saturated hydrocarbon by the removal of a single hydrogen atom. Representative alkyl groups include methyl, ethyl, n- and iso-propyl, cetyl and the like. C1-C4 alkyl means alkyls having 1 to 4 carbon atoms, for example methyl, ethyl, n-propyl, isopropyl and the like.

"***Alkylene***" as used herein means a divalent group derived from a straight or branched chain saturated hydrocarbon by the removal of two hydrogen atoms. Representative alkylene groups include methylene, ethylene, propylene, and the like.

"***Alkyloxy***" as used herein means "***Alkyl-O***" groups wherein alkyl is defined hereinabove.

"***Amino Group***" as used herein means the groups of molecule formula -NHY2, wherein Y2 is selected from H, alkyl, aryl and arylalkyl.

"***Anionic Monomer***" as used herein includes α,β-unsaturated carboxylic acids having 3 to 7 carbon atoms or their salts.

"***Aqueous Liquid***" means any aqueous solutions including but not limited to liquid media present in waste water treatment systems and liquid media containing paint.

"***Aqueous Liquid System***" means any process system or equipment making use of stored or flowing water, it includes but is not limited to, a recirculating water system, a wastewater processing system, a paint spray booth, and/or a paint spray booth recirculating water system.

"***Aryl***" as used herein means an aromatic monocyclic or multicyclic ring system having about 6 to about 10 carbon atoms. The aryl is optionally substituted with one or more C1-C20 alkyl, alkoxy or haloalkyl groups. Representative aryl groups include phenyl or naphthyl, or substituted phenyl or substituted naphthyl. Wherein, the substitution of the substituted phenyl or substituted naphthyl is methyl.

"***Arylalkyl***" as used herein means an aryl-alkylene-group wherein aryl and alkylene are defined hereinabove. Representative arylalkyl groups include benzyl, phenylethyl, phenylpropyl, 1-naphthylmethyl, and the like, for example benzyl.

"***Cationic Monomer***" as used herein includes unsaturated monomers containing amino groups and/or quaternary ammonium groups.

"***Dialdehyde-Functionalized Polyacrylamides***" and "***Aldehyde-Functionalized Polyacrylamide***" are used interchangeably and as used herein mean a polyacrylamide structurally substantially identical to those prepared by the reaction of multifunctional (such as dibasic or di-functional) aldehyde and polyacrylamides. A person skilled in the art may prepare such dialdehyde-functionalized polyacrylamides according to the known technique, such as preparation process as shown in US Published Patent Application 2009/0165978, and US Patents: 8,709,207 B2, 7,641,766 B2, and 7,901,543

B2. A person skilled in the art may adjust suitable reaction conditions such as pH value, temperature, reaction medium and selection of other suitable additives such as catalyst, depending on raw material used. Representative examples of such dialdehyde-functionalized polyacrylamides include commercially available products such as Nalco64280, Nalco64170, Nalco64180, and Nalco64110.

"***Halogen***" or "***Halo-***" as used herein may include fluorine, chlorine, bromine and iodine.

"***Mixture of Dialdehyde and Polyacrylamides***" as used herein means the physical mixture of dibasic aldehyde and polyacrylamides.

"***Paint***" as used herein is a generic term which includes liquids comprised of resin, pigment, dispersing medium and other functional additives, which are used to be painted to the surface of an object to form a solid film having protection, decoration or other special properties, paint(s) may include water-based paints and solvent-based paints depending on the dispersing medium used, Water-based paints includes paints dispersed in water as a dispersing medium, Solvent-based paints includes paints dispersed in organic solvents such as aromatic hydrocarbon as a dispersing medium.

"***Paint Detackifier Composition***", "***Paint Detackifying Composition***" and "***Paint Killer Composition***" are interchangeably used.

"***Polyacrylamide***" as used herein includes polymers formed by copolymerization of acrylamide monomers, cationic monomers and/or anionic monomers and polymers whose structures are substantially identical to them as well but were formed through other methods. A copolymerization method may be conducted according to the known copolymerization methods of polyacrylamides, for example, the methods disclosed in US Patent 7,901,543 B2 (and in particular according to the methods shown in its example 1). Such copolymerization methods may be as follows: to an aqueous phase containing monomers is added dropwise an initiator at suitable temperature condition, which gradually leads to polymerization of the monomers. A person skilled in the art can select suitable reaction temperature, reaction medium and other useful additives such as catalyst depending on monomers involved.

In the event that the above definitions or a description stated elsewhere in this application is inconsistent with a meaning (explicit or implicit) which is commonly used or in a dictionary,
the application and the claim terms in particular are understood to be construed according

Date Reçue/Date Received 2022-09-23

to the definition or description in this application, and not according to the common definition or dictionary definition. In light of the above, in the event that a term can only be understood if it is construed by a dictionary, if the term is defined by the Kirk-Othmer Encyclopedia of Chemical Technology, 5th Edition, (2005), (Published by Wiley, John & Sons, Inc.) this definition shall control how the term is to be defined in the claims. All illustrated chemical structures also include all possible stereoisomer alternatives.

EMBODIMENTS

At least one embodiment of the invention is directed towards a composition. The composition may be used as a paint detackifier composition. The composition may be used in a liquid medium of an aqueous liquid system. The composition may be used in for detackifying paint in aqueous liquid. The composition may be used in for detackifying paint in paint spray booth recirculating water. At least one embodiment of the invention is a method for treating paint spray booth recirculating water.

The composition may comprise: 1) an organic component; and 2) a metal salt. The organic component may be one item selected from the list consisting of: an aldehyde-functionalized polyacrylamide, a dialdehyde, a polyacrylamide, and any combination thereof. The organic component may be an aldehyde-functionalized polyacrylamide obtained by the reaction of a dialdehyde with a polyacrylamide. The organic component may comprise a dialdehyde or comprises an aldehyde-functionalized polyacrylamide obtained by the reaction of a dialdehyde with a polyacrylamide.

In at least one embodiment, the composition may be a paint detackifier composition. The paint detackifier composition of the present invention may comprise 1) a dialdehyde-functionalized polyacrylamides or a mixture of dialdehyde and polyacrylamides, and 2) aluminum salt and/or iron salt.

In at least one embodiment, the organic component may be an dialdehyde-functionalized polyacrylamide. The weight average molecular weight of the dialdehyde-functionalized polyacrylamides may range between 5,000 and 10,000,000 g/mole, preferably between 6,000 and 2,000,000 g/mole. The determination method of the weight average molecular weight is well-known in the art.

Date Reçue/Date Received 2022-09-23

The mole ratio of dialdehyde groups to acrylamides monomers (G/A ratio) in the dialdehyde-functionalized polyacrylamides and the mixture of the dialdehyde and the polyacrylamides may be in a range of 0.001 to 100:1, preferably 0.01 to 10:1, and more preferably 0.01 to 5:1.

The dibasic aldehyde applicable for the present invention may include, without limitation, glyoxal, Malondialdehyde, succindialdehyde, and glutaric dialdehyde, and any combination thereof. Often, glyoxal is used as the dibasic aldehyde.

In at least one embodiment, the weight average molecular weight of the polyacrylamides may range between 4,000 and 200,000 g/mole.

In at least one embodiment, the polyacrylamides may be cationic or anionic or zwitterionic. Accordingly, the dialdehyde-functionalized polyacrylamides may also be cationic or anionic or zwitterionic.

Cationic polyacrylamides may be copolymers of one or more acrylamide monomers and one or more cationic monomers (as described for example at least in US Patents 7,641,766 B2 and 7,901,543 B2); anionic polyacrylamides may be copolymers of one or more acrylamide monomers and one or more anionic monomers (see for example International Patent Document WO0011046A1); zwitterionic polyacrylamides may be copolymers of one or more acrylamide monomers, one or more cationic monomers and one or more anionic monomers (see for example International Patent Document WO0011046A1).

In at least one embodiment, the organic component comprises a polyacrylamide formed by copolymerization of acrylamides monomers, cationic monomers, and/or anionic monomers.

In at least one embodiment, the organic component comprises a polyacrylamide which is cationic, anionic, or zwitterionic.

In at least one embodiment, the polyacrylamide comprises monomers selected from acrylamide or methacrylamide.

Examples of acrylamide monomers suitable useful for use with the invention may include, but are not limited to one or more of: acrylamide, methacrylamide, N-substituted acrylamide, N,N-disubstituted acrylamide. Substitution in N-substituted acrylamide and N,N-disubstituted acrylamide may be alkyl wherein alkyl is defined hereinabove. Their examples may include, but are not limited to one or more of: N-isopropyl acrylamide, N,N-dimethyl acrylamide, N,N-diethyl acrylamide and the like.

There may be more than one (for example two, three or more) kind of acrylamide monomers in polyacrylamides. For example, acrylamide monomers involved in copolymerization may be both acrylamide and methacrylamide.

In at least one embodiment, acrylamide or methacrylamide is used as acrylamide monomers.

In at least one embodiment, acrylamide is used as acrylamide monomers.

In at least one embodiment, at least one monomer is ethyleneglycol acrylate.

Examples of cationic monomers suitable for the present invention may include, but are not limited to: diallyl-N,N-disubstituted ammonium chloride (where the substitution is methyl, ethyl or propyl), diallydimethylammonium chloride (DADMAC), N-(3-dimethylaminopropyl)methacrylamide, N-(3-dimethylaminopropyl) acrylamide, methacryloyloxyethyltrimethylammonium chloride (DMAEM·MCQ), acryloyloxyethyltrimethylammonium chloride (DMAEA·MCQ), methacryloyloxyethyldimethylbenzylammonium chloride, acryloyloxyethyldimethylbenzylammonium chloride, (3-acrylamidopropyl)trimethylammonium chloride, methacrylamidopropyltrimethylammonium chloride, 3-acrylamido-3-methylbutyltrimethylammonium chloride, 2-vinylpyridine, methacrylic-2-(dimethylamino) ethyl ester, acrylic-2-(dimethylamino) ethyl ester, and any combination thereof. In other words, if there is cationic monomer, there may be more than one (for example two, three or more) kind of cationic monomer or monomers in polyacrylamides as needed.

In at least one embodiment, the cationic monomers include one or more of: dialkylaminoalkyl acrylates and methacrylates and their quaternary or acid salts, including, but not limited to, dimethylaminoethyl acrylate methyl chloride quaternary salt, dimethylaminoethyl acrylate methyl sulfate quaternary salt, dimethylaminoethyl acrylate benzyl chloride quaternary salt, dimethylaminoethyl acrylate sulfuric acid salt, dimethylaminoethyl acrylate hydrochloric acid salt, dimethylaminoethyl methacrylate methyl chloride quaternary salt, dimethylaminoethyl methacrylate methyl sulfate quaternary salt, dimethylaminoethyl methacrylate benzyl chloride quaternary salt, dimethylaminoethyl methacrylate sulfuric acid salt, dimethylaminoethyl methacrylate hydrochloric acid salt, dialkylaminoalkylacrylamides or methacrylamides and their quaternary or acid salts such as acrylamidopropyltrimethylammonium chloride,

dimethylaminoethyl acrylate methyl chloride quaternary salt, dimethylaminoethyl acrylate benzyl chloride quaternary salt, dimethylaminoethyl methacrylate methyl chloride quaternary salt, dimethylaminoethyl methacrylate benzyl chloride quaternary salt, methacrylamidopropyl trimethylammonium chloride, dimethylaminopropyl acrylamide methyl sulfate quaternary salt, dimethylaminopropyl acrylamide sulfuric acid salt, dimethylaminopropyl acrylamide hydrochloric acid salt, methacrylamidopropyltrimethylammonium chloride, dimethylaminopropyl methacrylamide methyl sulfate quaternary salt, dimethylaminopropyl methacrylamide sulfuric acid salt, dimethylaminopropyl methacrylamide hydrochloric acid salt, diethylaminoethylacrylate, diethylaminoethylmethacrylate, diallyldiethylammonium chloride, diallyldimethylammonium chloride, and the like, and any combinations thereof.

In at least one embodiment, the polyacrylamides are amine-bearing copolymers such as copolymers of acrylamide and diallylamine or acrylamide and a diallylammonium salt. Representative example of such amine-bearing copolymers are described in US Patent 8,852,400. In at least one embodiment diallydimethylammonium chloride (DADMAC), methacryloyloxyethyltrimethylammonium chloride (DMAEM·MCQ) or acryloyloxyethyltrimethylammonium chloride (DMAEA·MCQ) may be used as cationic monomer.

In at least one embodiment, diallydimethylammonium chloride (DADMAC) is used as cationic monomer.

In at least one embodiment, at least one monomer is Methacrylamidopropyltrimethylammonium Chloride or Methylenebis-Acrylamide-Methacrylamido-Propyl Trimethyl-Ammonium Chloride Co-Polymer (MAPTAC). Generally, if there is cationic monomer, namely under the circumstance of zwitterionic or cationic polyacrylamides, the amount of the cationic monomer is at least 10 mole percent, for example at least 8 mole percent of the polyacrylamides.

Examples of anionic monomers suitable for the present invention may include, but are not limited to, acrylic acid, methacrylic acid, itaconic acid, maleic acid, maleic anhydride and salts of these acids and any combination thereof. In other words, if there is anionic monomer, there may be more than one (for example two, three or more) kind of anionic monomer or monomers in polyacrylamides as needed.

Examples of anionic monomers suitable for the present invention may include, but are not limited to one or more of: acrylic acid, and its salts, including, but not

limited to sodium acrylate, and ammonium acrylate, methacrylic acid, and its salts, including, but not limited to sodium methacrylate, and ammonium methacrylate, 2-acrylamido-2-methylpropanesulfonic acid (AMPS), the sodium salt of AMPS, sodium vinyl sulfonate, styrene sulfonate, maleic acid, and its salts, including, but not limited to the sodium salt, and ammonium salt, sulfonate, itaconate, sulfopropyl acrylate or methacrylate or other water-soluble forms of these or other polymerizable carboxylic or sulphonic acids. Sulfomethylated acrylamide, allyl sulfonate, sodium vinyl sulfonate, itaconic acid, acrylamidomethylbutanoic acid, fumaric acid, vinylphosphonic acid, vinylsulfonic acid, allylphosphonic acid, sulfomethylated acrylamide, phosphonomethylated acrylamide, and the like, and any combination thereof.

In at least one embodiment, acrylic acid or methacrylic acid is used as anionic monomer.

Generally, if there is anionic monomer, namely under the circumstance of zwitterionic or anionic polyacrylamides, the amount of the anionic monomer is not more than 30 mole percent, for example 1 to 10 mole percent of the polyacrylamides.

There are both cationic monomers and anionic monomers in the zwitterionic polyacrylamides. In the present invention, there is no limitation to the ratio of cationic monomers and anionic monomers as long as a stable polymer can be obtained. It may be advantageous to have mole amounts of anionic monomers which are larger than mole amounts of cationic monomers, or the reverse.

It may be advantageous for the total amounts of the anionic monomers and the cationic monomers to account for at least 9 mole percent of the zwitterionic polyacrylamides, for example, at least 10 mole percent, but the amount of the cationic monomers is generally not more than 50 mole percent of the zwitterionic polyacrylamides, for example, not more than 25 mole percent.

In at least one embodiment, in the composition the organic component is 0.01 to 70 by weight % of the composition and/or the metal salt is 0.05 to 90 by weight % of the of the composition. Preferably the organic component is 0.35 to 50 by weight % of the composition and the metal salt is 0.5 to 80 by weight % of the of the composition.

In at least one embodiment, the paint detackifier composition of the present invention may include 0.01 to 15 by weight % of the dialdehyde-functionalized polyacrylamides or the mixture of the dialdehyde and the polyacrylamides, and 0.05 to 40

by weight % of the aluminum salt and/or iron salt, based on total amount of the composition.

In at least one embodiment, the paint detackifier composition of the present invention may include 0.35 to 10 by weight % of the dialdehyde-functionalized polyacrylamides or the mixture of the dialdehyde and the polyacrylamides, and 0.5 to 35 by weight % of the aluminum salt and/or iron salt, based on total amount of the composition.

In at least one embodiment, the paint detackifier composition of the present invention may include 1 to 5 by weight % of the dialdehyde-functionalized polyacrylamides or the mixture of the dialdehyde and the polyacrylamides, and 15 to 35 by weight % of the aluminum salt and/or iron salt, based on total amount of the composition.

In at least one embodiment, the metal salt is selected from the group consisting of: aluminum salt, iron salt, zirconium salt, aluminum sulfate, aluminum chloride, polyaluminum chloride, polyaluminum nitrate, polyaluminum sulfate, aluminum chlorohydrate, polyaluminum silicate sulfate, polyaluminum nitrate sulfate, polyaluminum sulfate chloride, zirconium, iron sulfate, iron chloride, polyiron chloride, polyiron sulfate, polyiron silicate sulfate, polyiron sulfate chloride and combinations thereof.

In at least one embodiment, the aluminum salt is selected from the group consisting of aluminum sulfate, aluminum chloride, polyaluminum chloride, polyaluminum nitrate, polyaluminum sulfate, aluminum chlorohydrate, polyaluminum silicate sulfate, polyaluminum nitrate sulfate, polyaluminum sulfate chloride and combinations thereof. Typically, the aluminum salt is polybasic aluminum salt, for example, polyaluminum chloride, polyaluminum silicate sulfate and the like.

In at least one embodiment, the iron salt is selected from the group consisting of iron sulfate, iron chloride, polyiron chloride, polyiron sulfate, polyiron silicate sulfate, polyiron sulfate chloride and combinations thereof. Typically, the iron salt is polybasic iron salt, for example, polyiron chloride, polyiron silicate sulfate and the like.

It would be appreciated by a person skilled in the art that the salts used in the present invention may include, but not limited to, salts listed above, and other salts or equivalent commonly used in the art may be applicable for the paint detackifier composition of the present invention. And, as understood by a person skilled in the art, the aluminum salts and iron salts are not limited to those salts listed above.

In at least one embodiment, the paint detackifier composition of the present invention may further include natural polymer or synthetic polymer in 0.001 to 10 by weight %, preferably 0.001 to 2 by weight % of the composition.

The natural polymer or synthetic polymer may be selected from the group consisting of acrylamides copolymer or tripolymer, chitosan, guar gum, modified cellulose and combinations thereof. Typically, the acrylamides copolymer or tripolymer may be for example acrylamide-diallylamine copolymer, acrylic acid-quaternary ammonium copolymer.

In at least one embodiment, the composition of the present invention may further comprise a flocculant.

In preparation of the paint detackifier composition of the present invention, the dialdehyde-functionalized polyacrylamides or the mixture of the dialdehyde and the polyacrylamides, aluminum salt and/or iron salt, optional polymer may be added into water and may be mixed thoroughly. The ways and sequences for adding components may be adjusted accordingly, for example adding successively, adding simultaneously, pre-mixing or combinations thereof.

At least one embodiment is the use of the composition in a liquid medium of an aqueous liquid system.

In at least one embodiment, the composition detackifies paint.

In at least one embodiment, the composition detackifies paint which was sprayed during an automobile painting operation.

In at least one embodiment, the organic component and the metal salt contact each other: before they have been introduced into an aqueous liquid system, after they have been introduced into an aqueous liquid system, while they are being introduced into an aqueous liquid system, and any combination thereof.

In at least one embodiment, paint detackifier composition is used for detackifying paint in aqueous liquid and/or is used for detackifying paint in paint spray booth recirculating water.

At least one embodiment provides a method for treating paint spray booth recirculating water. The method may comprise adding the paint detackifier composition into paint spray booth recirculating water. This may be for automobile paint as well as for any other sort of paint. In addition, an organic polymer flocculant may be added to

facilitate oversprayed paint mists existing in the water to rapidly flocculate and to be separated from the water.

The added organic polymer flocculant may be one of cationic polyacrylamide solution and anionic polyacrylamide solution, or both cationic polyacrylamide solution and anionic polyacrylamide solution.

The added amounts of the paint detackifier composition and the flocculant may be dependent on the amount of the oversprayed paint mists and the type of paints.

As would be understood by a person skilled in the art, in application, the pre-prepared the paint detackifier composition may be added into water system to be treated, or the components of the paint detackifier composition may be successively or simultaneously added into water system to be treated.

In at least one embodiment, the pH of the liquid medium is altered. In some applications, the pH of the recirculating water system is suitably maintained between 6.0 and 11.0 and preferably between 7.5 and 10 or 7.5 to 9. During the application, the pH may be periodically adjusted using methods and products commonly used in similar applications, such as sodium hydroxide and sodium carbonate.

The paint detackifier composition may improve the purifying treatment efficiency of oversprayed paint waste water, decrease turbidity and chemical oxygen demand, and/or extend service life of recirculating water and reduce replacement times of recirculating water.

The composition may treat oversprayed paint waste water with simple operation and/or in a small amount, and has good detackification effect for various water-based or solvent-based paints and thus has wide application.

EXAMPLES

The foregoing may be better understood by reference to the following examples, which are presented for purposes of illustration and are not intended to limit the scope of the invention. In particular the examples demonstrate representative examples of principles innate to the invention and these principles are not strictly limited to the specific condition recited in these examples. As a result it should be understood that the invention encompasses various changes and modifications to the examples described herein and such changes and modifications can be made without departing from the spirit and scope

of the invention and without diminishing its intended advantages. It is therefore intended that such changes and modifications be covered by the appended claims.

In the following examples, unless otherwise specifically stated, all of the used chemical agents were purchased commercially available chemical agents.

I. Preparation of the paint detackifier compositions:

1. Components were weighted based on the following amounts, and to a beaker were added a certain amounts of water.

2. The weighted dialdehyde-functionalized polyacrylamides or mixture of dialdehyde and polyacrylamides were added, and then stirred to make them dispersed thoroughly, and obtain a component I.

3. The weighted aluminum salt and/or iron salt were added to component I, and then continued to stir, mixing the aluminum salt and/or iron salt with the component I thoroughly, discharging and obtaining the paint detackifier composition; or

4. Optionally, they continued to add the weighted natural polymer or synthetic polymer to the paint detackifier composition obtained in step 3, and then continued to stir, and obtaining the paint detackifier composition containing the natural polymer or synthetic polymer.

A number of examples were prepared and their performance was tested.

Example 1

The composition of the paint detackifier composition of the Example 1 is shown in table 1.

Table 1

components	amounts(kg)
glyoxal-functionalized polyacrylamide (Nalco 64110, available from Nalco company)	2
aluminum chlorohydrate	25
deionized water	73

Example 2

The composition of the paint detackifier composition of the Example 2 is shown in table 2.

Table 2

components	amounts(kg)
glyoxal-functionalized polyacrylamide (Nalco 64180, available from Nalco company)	3
acrylamide-diallylamine copolymer	0.1
polyaluminum chloride	30
deionized water	66.9

Example 3

The composition of the paint detackifier composition of the Example 3 is shown in table 3.

Table 3

components	amounts(kg)
dimethyldiallylammonium chloride-acrylamide copolymer*	3.9
glyoxal	0.1
acrylic acid - quaternary ammonium copolymer	0.5
aluminum chlorohydrate	20
deionized water	75.5

*Wherein dimethyldiallylammonium chloride-acrylamide copolymer is prepared according to the method disclosed in US 7,901,543 B2.

Example 4

The composition of the paint detackifier composition of the Example 4 is shown in table 4.

Table 4

components	amounts(kg)
glyoxal-functionalized polyacrylamide (Nalco 64110, available from Nalco company)	4.5
acrylic acid - quaternary ammonium copolymer	0.3
polyaluminum silicate sulfate	35
deionized water	60.2

II. Performances tests

Separate tests were run for each paint detackifier composition utilizing water-based basecoats and solvent-based basecoats respectively.

1. Detackifying treatment test for water-based basecoats (manufactured by Nippon Paint Corporation) were conducted using the paint detackifier compositions obtained from examples 1-3 of the present invention. Test procedures were as follows:

- pour 200 ml tap water into a 250 ml glass bottle with cap;
- add 0.5g water-based basecoat, close the cap and vigorously shake for 30s, making the basecoat dispersed thoroughly;
- add 0.1-0.3ml of the paint detackifier composition, close the cap and vigorously shake for 30s, mixing the paint detackifier composition with the basecoat thoroughly;
- adjust the pH to a range of 7 to 9 by pH adjusters (such as aqueous sodium hydroxide solution);
- add 0.2 to 1ml of 1wt% anionic polyacrylamide (manufactured by Nalco company, Nalco 7768), close the cap and vigorously shake for 20s, making it evenly dispersed.
-- leave the sample to stand, and then evaluate the samples for the treatment results; observe and record the turbidity. The results are shown in table 5.

Test results: after being treated by the paint detackifier composition of examples 1-3, the water-based basecoat were completely dispersed and detackified. The floating paint sludge layer was dense and it took less than 10s for the paint sludge layer to completely come up. Treated water was clear and its turbidity was below 10 NTU, completely meeting the requirement of paint spray booths in the art.

Table 5

	added amounts of the paint detackifier composition (ml)	adjusted pH with the aqueous solution of NaOH	added amounts of 1wt% anionic polyacrylamide (ml)	turbidity of water after treatment (NTU)
the paint detackifier composition of examples of the present invention	0.2(example 1)	8	0.35	9.86
	0.2(example 2)	8	0.25	9.12
	0.2(example 3)	8	0.3	9.18
	0.3(example 1)	8	0.4	9.7
	0.3(example 2)	8	0.4	8.36
	0.3(example 3)	8	0.3	6.08

2. Detackifying treatment test for solvent-based basecoats (manufactured by BASF Corporation) was conducted using the paint detackifier compositions obtained from examples 1-3 of the present invention. Test procedures were as follows:

- pour 200 ml tap water in a 250 ml glass bottle with cap;
- add 0.1 to 0.5ml of the paint detackifier composition, close the cap and vigorously shake for 30s, mixing the paint detackifier composition with the basecoat thoroughly;
- adjust the pH to a range of 7 to 9 by pH adjusters (such as the aqueous sodium hydroxide solution);
- add 0.5g solvent-based basecoat, close the cap and vigorously shake for 30s, making the basecoat dispersed thoroughly;

- add 0.2 to 1ml of 1wt% anionic polyacrylamide (manufactured by Nalco company, Nalco 7768), close the cap and vigorously shake for 20s, making it evenly dispersed.

- leave the sample to stand, and then evaluate the samples for the treatment results; observe and record the turbidity. The results are shown in table 6.

Test results: after being treated by the paint detackifier composition of examples 1-3, the solvent-based basecoats were completely dispersed and detackified. The floating paint sludge layer was dense and it took less than 10s for the paint sludge layer to completely come up. Treated water was clear and its turbidity is well below 10 NTU, completely meeting the requirement of paint spray booths in the art.

Table 6

	added amounts of the paint detackifier composition (ml)	adjusted pH with the aqueous solution of NaOH	added amounts of 1wt% anionic polyacrylamide (ml)	turbidity of water after treatment (NTU)
the paint detackifier composition of examples of the present invention	0.1(example 1)	8	0.4	5.69
	0.1(example 2)	8	0.4	7.03
	0.1(example 3)	8	0.3	5.75
	0.3(example 1)	8	0.3	2.6
	0.3(example 2)	8	0.5	6.37
	0.3(example 3)	8	0.5	4.21

While this invention may be embodied in many different forms, there are described in detail herein specific preferred embodiments of the invention. The present disclosure is an exemplification of the principles of the invention and is not intended to limit the invention to the particular embodiments illustrated.

Furthermore, the invention encompasses any possible combination of some or all of the various embodiments mentioned herein or described herein . In addition the invention encompasses any

Date reçue/Date received 2023-05-23

possible combination that also specifically excludes any one or some of the various embodiments mentioned herein or described herein.

The above disclosure is intended to be illustrative and not exhaustive. This description will suggest many variations and alternatives to one of ordinary skill in this art. All these alternatives and variations are intended to be included within the scope of the claims where the term "comprising" means "including, but not limited to". Those familiar with the art may recognize other equivalents to the specific embodiments described herein which equivalents are also intended to be encompassed by the claims.

All ranges and parameters disclosed herein are understood to encompass any and all subranges subsumed therein, and every number between the endpoints. For example, a stated range of "1 to 10" should be considered to include any and all subranges between (and inclusive of) the minimum value of 1 and the maximum value of 10; that is, all subranges beginning with a minimum value of 1 or more, (e.g. 1 to 6.1), and ending with a maximum value of 10 or less, (e.g. 2.3 to 9.4, 3 to 8, 4 to 7), and finally to each number 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 contained within the range. All percentages, ratios and proportions herein are by weight unless otherwise specified.

This completes the description of the preferred and alternate embodiments of the invention. Those skilled in the art may recognize other equivalents to the specific embodiment described herein which equivalents are intended to be encompassed by the claims attached hereto.

Date Reçue/Date Received 2022-09-23

Claims

1. A composition comprising an aldehyde-functionalized polyacrylamide and a metal salt, wherein the aldehyde-functionalized polyacrylamide is 0.01 to 70 by weight % of the composition and the metal salt is 0.05 to 90 by weight % of the composition.

2. The composition of claim 1, wherein the aldehyde-functionalized polyacrylamide is 0.35 to 50 by weight % of the composition and the metal salt is 0.5 to 80 by weight % of the composition.

3. The composition of any one of claims 1 to 2, wherein the aldehyde-functionalized polyacrylamide is obtained by the reaction of a dialdehyde with a polyacrylamide.

4. The composition of any one of claims 1 to 3, wherein the aldehyde-functionalized polyacrylamide has a mole ratio of dialdehyde groups to acrylamide monomers in a range of 0.001 to 100:1.

5. The composition of any one of claims 1 to 3, wherein the aldehyde-functionalized polyacrylamide has a mole ratio of dialdehyde groups to acrylamide monomers in a range of 0.01 to 10:1.

6. The composition of any one of claims 1 to 3, wherein the aldehyde-functionalized polyacrylamide has a mole ratio of dialdehyde groups to acrylamide monomers in a range of 0.01 to 5:1.

7. The composition of any one of claims 1 to 6, wherein the average molecular weight of the the aldehyde-functionalized polyacrylamide ranges between 5,000 and 10,000,000 g/mole.

Date reçue/Date received 2023-05-23

8. The composition of any one of claims 1 to 6, wherein the average molecular weight of the the aldehyde-functionalized polyacrylamide ranges between 6,000 and 2,000,000 g/mole.

9. The composition of any one of claims 1 to 8, wherein the aldehyde-functionalized polyacrylamide is obtained by the reaction of a dialdehyde with a polyacrylamide, and the dialdehyde comprises glyoxal, malondialdehyde, succindialdehyde, glutaric dialdehyde, or any combination thereof.

10. The composition of any one of claims 1 to 8, wherein aldehyde-functionalized polyacrylamide comprises a polyacrylamide formed by copolymerization of acrylamides monomers, cationic monomers, and/or anionic monomers.

11. The composition of any one of claims 1 to 8, wherein the aldehyde-functionalized polyacrylamide is cationic, anionic, or zwitterionic.

12. The composition of claim 10, wherein the polyacrylamide comprises monomers selected from acrylamide or methacrylamide.

13. The composition of claim 10, wherein the cationic monomers comprise diallyl-N,N-disubstituted ammonium chloride, diallydimethylammonium chloride, N-(3-dimethylaminopropyl)methacrylamide, N-(3-dimethylaminopropyl) acrylamide, methacryloyloxyethyltrimethylammonium chloride, acryloyloxyethyltrimethylammonium chloride, methacryloyloxyethyldimethylbenzylammonium chloride, acryloyloxyethyldimethylbenzylammonium chloride, (3-acrylamidopropyl)trimethylammonium chloride, methacrylamidopropyltrimethylammonium chloride, 3-acrylamido-3-methylbutyltrimethylammonium chloride, 2-vinylpyridine, methacrylic-2-

Date reçue/Date received 2023-05-23

(dimethylamino) ethyl ester, acrylic-2-(dimethylamino) ethyl ester, ethyleneglycol acrylate, or combinations thereof; and the anionic monomers comprise acrylic acid, methacrylic acid, itaconic acid, maleic acid, maleic anhydride and salts of these acids, or combinations thereof.

14. The composition of any one of claims 1 to 13, wherein the metal salt comprises aluminum salt.

15. The composition of any one of claims 1 to 13, wherein the metal salt comprises iron salt, zirconium salt, aluminum sulfate, aluminum chloride, polyaluminum chloride, polyaluminum nitrate, polyaluminum sulfate, aluminum chlorohydrate, polyaluminum silicate sulfate, polyaluminum nitrate sulfate, polyaluminum sulfate chloride, iron sulfate, iron chloride, polyiron chloride, polyiron sulfate, polyiron silicate sulfate, polyiron sulfate chloride, or a combination thereof.

16. The composition of any one of claims 1 to 15, further comprising natural polymer or synthetic polymer in 0.001 to 10 by weight % of the composition.

17. The composition of claim 16, wherein the natural polymer or synthetic polymer comprises acrylamides copolymer or tripolymer, chitosan, guar gum, cellulose, starch, modified cellulose, or a combination thereof.

18. The composition of any one of claims 1 to 17 further comprising a flocculant.

19. A method comprising the introduction of the composition of any one of claims 1 to 18 into a liquid medium of an aqueous liquid system.

Date reçue/Date received 2023-05-23

20. The method of claim 19, wherein the aqueous liquid system comprises a recirculating water system, a wastewater processing system, a paint spray booth, a paint spray booth recirculating water system, or a combination thereof.

21. The method of any one of claims 19 to 20, wherein the aldehyde-functionalized polyacrylamide and the metal salt contact each other before they have been introduced into the aqueous liquid system, after they have been introduced into the aqueous liquid system, while they are being introduced into the aqueous liquid system, or a combination thereof.

22. The method of any one of claims 19 to 21 further comprising the step of altering the pH of the liquid medium.

23. Use of the composition of any one of claims 1 to 18 to detackify paint.

24. The use of claim 23 to detackify paint sprayed during an automobile painting operation.

Date reçue/Date received 2023-05-23