concentration of tagged treatment polymer currently present in the industrial water system from that information.

It is known that tagging of polymers is difficult to accomplish because of the difficulty in chemically combining fluorescent moieties with non-fluorescent polymers. Therefore, in order to synthesize tagged treatment polymers it is also desirable to produce fluorescent monomers that are readily polymerized to form tagged treatment polymers.

Thus it is clear that there is definite utility in novel methods and compositions for making and using tagged treatment polymers. 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~~

At least one embodiment of the ~~invention~~ present disclosure is directed towards novel monomers, novel polymers made from those monomers, and novel methods of their use as tagged polymers.

~~At least one embodiment~~ An aspect of the ~~invention~~ present disclosure is directed towards a method of maintaining a desired amount of tagged treatment polymer in an industrial water system comprising the steps of: a) adding an inert tracer and a tagged treatment polymer to the water of an industrial water system, such that a desired concentration of said tagged treatment polymer is present in said water, b)

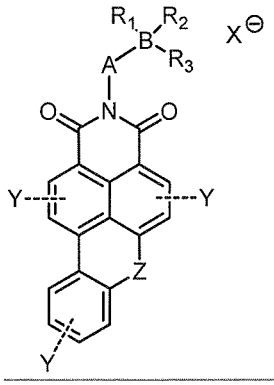
using a fluorometer to detect the fluorescent signals of said inert tracer and said tagged treatment polymer, c) converting the fluorescent signals of said inert tracer and said tagged treatment polymer to the concentration of said inert tracer and said tagged treatment polymer, and d) adjusting the concentration of said tagged treatment polymer according to what the desired concentration is for said tagged treatment polymer in said industrial water system; said tagged treatment polymer is selected from the group consisting of: $G_aQ_jW_t$, $G_aQ_vW_fS_c$, and any combination thereof; wherein:

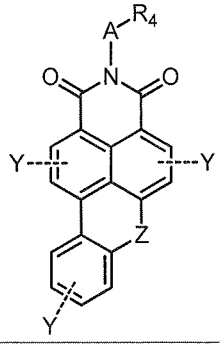
G, Q, W and S are all monomer moieties making up a backbone of a polymer chain, the distribution of G, Q, W and S along the polymer chain are in random order and in relative amounts of a, j, t, v, f, and c;

for polymer $G_aQ_vW_fS_c$ a is from about 0.001 to about 10.00 mole percent; v is from about 0 to about 97.999 mole percent; f is from about 1 to about 97.999 mole percent; c is from about 1 to about 40 mole percent; and a + v + f + c = 100;

for polymer $G_aQ_jW_t$ a is from about 0.001 to about 10.0 mole percent; j is from about 0 to about 99.999 mole percent; t is from about 0 to about 99.999 mole percent; and a + j + t = 100,

G is selected from the group consisting of: Formula I, Formula II,





Formula I Formula II

in Formula I: Y is one or more of the following: H, F, Cl, Br, NO_2, CO_2H and its salts, PO_3H_2 and it salts, SO_3H and its salts, SO_2NH_2 or SO_2NR_2; Z is one of the following: CH_2, C=O, CR_2, NH, NR, NH_2^+, NR_2^+, NOH, O, S, SO, or SO_2; R_1 and R_2 are alkyl; R_3 is selected from the group consisting of allyl, 2-hydroxy-3-allyloxy-propyl, vinyl benzyl, 3-methacrylamidopropyl, 3-acrylamidopropyl, 2-acryloxyethyl and 2-methacryloxyethyl. A is selected from the group consisting of alkyl, alkyloxyalkyl, alkylamidoalkyl, aryl or nonexistent; with the proviso that when A is nonexistent, B is nitrogen (N) and B is bonded directly to the imide nitrogen. B is sulfur or nitrogen with the proviso that when B is sulfur only one of R_1 or R_2 is present; X is an anionic counter ion; and

in Formula II: Y is one or more of the following: H, F, Cl, Br, NO_2, CO_2H and its salts, PO_3H_2 and it salts, SO_3H and its salts, SO_2NH_2 or SO_2NR_2; Z is one of the following: CH_2, C=O, CR_2, NH, NR, NH_2^+, NR_2^+, NOH, O, S, SO, or SO_2; A is selected from the group consisting of alkyl, alkyloxyalkyl, alkoxy, alkylamidoalkyl, alkylamino, NH, aryl or nonexistent; R_4 is selected from the group consisting of allyl, acryl, methacryl, 2-hydroxy-3-allyloxy-propyl, vinyl benzyl, 2-acryloxyethyl and 2-methacryloxyethyl;

Q is selected from the group consisting of acrylic acid and salts thereof, methacrylic acid and salts thereof, maleic acid and salts thereof, maleic anhydride, acrylamide, crotonic acid, acrylamidomethylpropane sulfonic acid and salts thereof; and Q cannot be the same as W;

W is selected from the group consisting of: acrylic acid and salts thereof, methacrylic acid and salts thereof, itaconic acid and salts thereof, maleic acid and salts thereof, maleic anhydride, crotonic acid and salts thereof, acrylamide,

methacrylamide, vinyl sulfonic acid, styrene sulfonate, N-tertbutylacrylamide, N-isopropylacrylamide, butoxymethylacrylamide, N,N-dimethylacrylamide, N,N-diethylacrylamide, dimethylaminoethyl acrylate methyl chloride quaternary salts, dimethylaminoethyl acrylate benzyl chloride quaternary salts, dimethylaminoethyl acrylate methyl sulfate quaternary salt, dimethylaminoethyl methacrylate methyl sulfate quaternary salt, dimethylaminoethyl acrylamide methyl sulfate quaternary salts, dimethylaminopropyl acrylamide methyl sulfate quaternary salts, dimethylaminopropyl methacrylamide methyl sulfate quaternary salts, diallyldimethyl ammonium chloride, N-vinyl formamide, dimethylamino ethyl methacrylate acid salts (including, but not limited to, sulfuric acid and hydrochloride acid salts), dimethylaminoethyl methacrylate methyl chloride quaternary salt, dimethylaminoethyl methacrylate benzyl chloride quaternary salt, methacrylamidopropyl trimethyl ammonium chloride, acrylamidopropyl trimethyl ammonium chloride, methylene bis acrylamide, diallylamine, acid salts of diallylamine, triallylamine, acid salts of triallylamine, ethylene glycol dimethacrylate, hydroxymethylacrylate, hydroxyethylacrylate, hydroxypropylacrylate, hydroxypropylmethacrylate, diethylene glycol dimethacrylate, triethylene glycol dimethylacrylate, polyethylene glycol dimethacrylate, glycidyl methacrylate, acrylamidomethylpropane sulfonic acid and the sodium salt thereof, vinyl alcohol, vinyl acetate, and N-vinylpyrrolidone; and

S is selected from the group consisting of sulfomethylacrylamide and sulfoethylacrylamide.

Another aspect of the present disclosure is directed towards a tagged treatment polymer, the polymer made up of a chain of chemically bonded

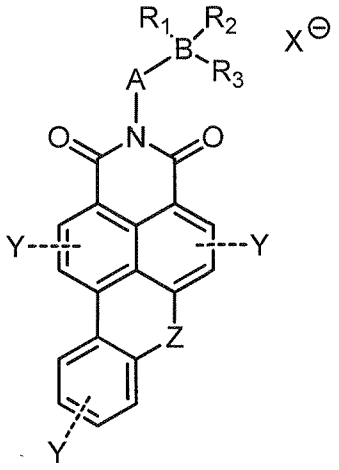
monomeric units, at least some of the monomeric units selected from the group consisting of: $G_aQ_jW_t$, $G_aQ_vW_fS_c$, and any combination thereof; wherein:

the distribution of G, Q, W and S along the polymer chain are in random order and in relative amounts of a, j, t, v, f, and c;

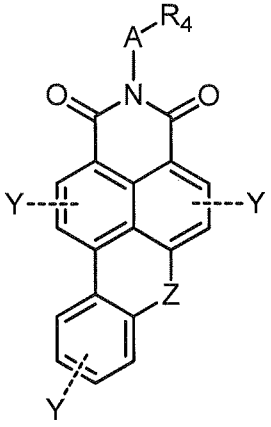
for polymer $G_aQ_vW_fS_c$ a is from about 0.001 to about 10.00 mole percent; v is from about 0 to about 97.999 mole percent; f is from about 1 to about 97.999 mole percent; c is from about 1 to about 40 mole percent; and a + v + f + c = 100;

for polymer $G_aQ_jW_t$ a is from about 0.001 to about 10.0 mole percent; j is from about 0 to about 99.999 mole percent; t is from about 0 to about 99.999 mole percent; and a + j + t = 100,

G is selected from the group consisting of: Formula I, Formula II,



Formula I



Formula II

in Formula I: Y is one or more of the following: H, F, Cl, Br, NO_2, CO_2H and its salts, PO_3H_2 and it salts, SO_3H and its salts, SO_2NH_2 or SO_2NR_2; Z is one of the following: CH_2, C=O, CR_2, NH, NR, NH_2^+, NR_2^+, NOH, O, S, SO, or SO_2; R_1 and R_2 are alkyl; R_3 is selected from the group consisting of allyl, 2-hydroxy-3-allyloxy-propyl, vinyl benzyl, 3-methacrylamidopropyl, 3-acrylamidopropyl, 2-

acryloxyethyl and 2-methacryloxyethyl. A is selected from the group consisting of alkyl, alkyloxyalkyl, alkylamidoalkyl, aryl or nonexistent; with the proviso that when A is nonexistent, B is nitrogen (N) and B is bonded directly to the imide nitrogen. B is sulfur or nitrogen with the proviso that when B is sulfur only one of R_1 or R_2 is present; X is an anionic counter ion; and

in Formula II: Y is one or more of the following: H, F, Cl, Br, NO_2, CO_2H and its salts, PO_3H_2 and it salts, SO_3H and its salts, SO_2NH_2 or SO_2NR_2; Z is one of the following: CH_2, C=O, CR_2, NH, NR, NH_2^+, NR_2^+, NOH, O, S, SO, or SO_2; A is selected from the group consisting of alkyl, alkyloxyalkyl, alkoxy, alkylamidoalkyl, alkylamino, NH, aryl or nonexistent; R_4 is selected from the group consisting of allyl, acryl, methacryl, 2-hydroxy-3-allyloxy-propyl, vinyl benzyl, 2-acryloxyethyl and 2-methacryloxyethyl;

Q is selected from the group consisting of acrylic acid and salts thereof, methacrylic acid and salts thereof, maleic acid and salts thereof, maleic anhydride, acrylamide, crotonic acid, acrylamidomethylpropane sulfonic acid and salts thereof; and Q cannot be the same as W;

W is selected from the group consisting of: acrylic acid and salts thereof, methacrylic acid and salts thereof, itaconic acid and salts thereof, maleic acid and salts thereof, maleic anhydride, crotonic acid and salts thereof, acrylamide, methacrylamide, vinyl sulfonic acid, styrene sulfonate, N-tertbutylacrylamide, N-isopropylacrylamide, butoxymethylacrylamide, N,N-dimethylacrylamide, N,N-diethylacrylamide, dimethylaminoethyl acrylate methyl chloride quaternary salts, dimethylaminoethyl acrylate benzyl chloride quaternary salts, dimethylaminoethyl acrylate methyl sulfate quaternary salt, dimethylaminoethyl

methacrylate methyl sulfate quaternary salt, dimethylaminoethyl acrylamide methyl sulfate quaternary salts, dimethylaminopropyl acrylamide methyl sulfate quaternary salts, dimethylaminopropyl methacrylamide methyl sulfate quaternary salts, diallyldimethyl ammonium chloride, N-vinyl formamide, dimethylamino ethyl methacrylate acid salts (including, but not limited to, sulfuric acid and hydrochloride acid salts), dimethylaminoethyl methacrylate methyl chloride quaternary salt, dimethylaminoethyl methacrylate benzyl chloride quaternary salt, methacrylamidopropyl trimethyl ammonium chloride, acrylamidopropyl trimethyl ammonium chloride, methylene bis acrylamide, diallylamine, acid salts of diallylamine, triallylamine, acid salts of triallylamine, ethylene glycol dimethacrylate, hydroxymethylacrylate, hydroxyethylacrylate, hydroxypropylacrylate, hydroxypropylmethacrylate, diethylene glycol dimethacrylate, triethylene glycol dimethylacrylate, polyethylene glycol dimethacrylate, glycidyl methacrylate, acrylamidomethylpropane sulfonic acid and the sodium salt thereof, vinyl alcohol, vinyl acetate, and N-vinylpyrrolidone; and

S is selected from the group consisting of sulfomethylacrylamide and sulfoethylacrylamide.

The tagged treatment polymer may be selected from the group consisting of: $G_aQ_jW_t$, $G_aQ_vW_fS_c$, and any combination thereof. G, Q, W and S may all be monomeric units (a polymer is a chain of chemically bonded monomeric units) making up a backbone of a polymer chain. G is the tag and Q, W, and S are other monomeric units. The distribution of G, Q, W and S along the polymer chain are in random order and in relative amounts of a, j, t, v, f, and c. For polymer $G_aQ_vW_fS_c$ a may be from about 0.001 to about 10.00 mole percent; v may be from about

0 to about 97.999 mole percent; f may be from about 1 to about 97.999 mole percent; c may be from about 1 to about 40 mole percent; and a + v + f + c = 100.

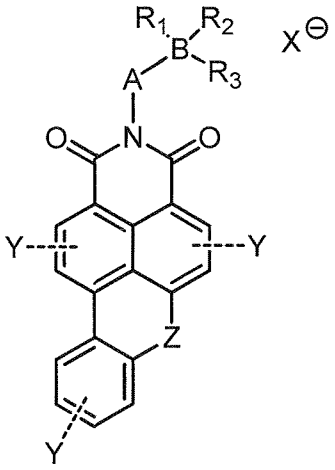
For polymer $G_aQ_jW_t$ a may be from about 0.001 to about 10.0 mole percent; j may be from about 0 to about 99.999 mole percent; t may be from about 0 to about 99.999 mole percent; and a + j + t = 100.

The polymer may be a tripolymer, a terpolymer, or any other sort of copolymer made up of multiple kinds of monomeric units.

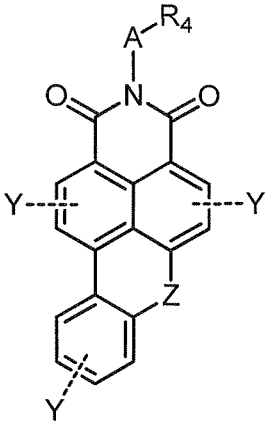
G may be selected from the group consisting of: Formula I, Formula II,

methacrylamidopropyl trimethyl ammonium chloride, acrylamidopropyl trimethyl ammonium chloride, methylene bis acrylamide, diallylamine, acid salts of diallylamine, triallylamine, acid salts of triallylamine, ethylene glycol dimethacrylate, hydroxymethylacrylate, hydroxyethylacrylate, hydroxypropylacrylate, hydroxypropylmethacrylate, diethylene glycol dimethacrylate, triethylene glycol dimethylacrylate, polyethylene glycol dimethacrylate, glycidyl methacrylate, acrylamidomethylpropane sulfonic acid and the sodium salt thereof, vinyl alcohol, vinyl acetate, and N-vinylpyrrolidone.

Another aspect of the present disclosure is directed towards a fluorescent monomer selected from the group consisting of compounds Formula I and Formula II, wherein:



Formula I



Formula II

in Formula I: Y is one or more of the following: H, F, Cl, Br, NO_2, CO_2H and its salts, PO_3H_2 and it salts, SO_3H and its salts, SO_2NH_2 or SO_2NR_2; Z is one of the following: CH_2, C=O, CR_2, NH, NR, NH_2^+, NR_2^+, NOH, O, S, SO, or SO_2; R_1 and R_2 are alkyl; R_3 is selected from the group consisting of allyl, 2-

hydroxy-3-allyloxy-propyl, vinyl benzyl, 3-methacrylamidopropyl, 3-acrylamidopropyl, 2-acryloxyethyl and 2-methacryloxyethyl. A is selected from the group consisting of alkyl, alkyloxyalkyl, alkylamidoalkyl, aryl or nonexistent; with the proviso that when A is nonexistent, B is nitrogen (N) and B is bonded directly to the imide nitrogen. B is sulfur or nitrogen with the proviso that when B is sulfur only one of R_1 or R_2 is present; X is an anionic counter ion;

in Formula II: Y is one or more of the following: H, F, Cl, Br, NO_2, CO_2H and its salts, PO_3H_2 and it salts, SO_3H and its salts, SO_2NH_2 or SO_2NR_2; Z is one of the following: CH_2, C=O, CR_2, NH, NR, NH_2^+, NR_2^+, NOH, O, S, SO, or SO_2; A is selected from the group consisting of alkyl, alkyloxyalkyl, alkoxy, alkylamidoalkyl, alkylamino, NH, aryl or nonexistent; R_4 is selected from the group consisting of allyl, acryl, methacryl, 2-hydroxy-3-allyloxy-propyl, vinyl benzyl, 2-acryloxyethyl and 2-methacryloxyethyl.

Detailed Description of the Invention

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.

"***Aldrich***" means Aldrich Chemical Company, P.O. Box 2060, Milwaukee, WI 53201 USA, Telephone Numbers (414) 273-3850 and (800) 558-9160;

"***Aliphatic Amine***" refers to amines in which the amine group is attached to a saturated carbon atom;

"***Alkoxy***" means a moiety of the formula RO-, where R is alkyl;

"***Alkoxylalkyl***" means a moiety of the formula R-O-R_1, where R and R_1 are alkyl;

"***Alkylamidoalkyl***" means a moiety of the formula R-C(O)NH-R_1-, where R and R_1 are alkyl;