CLAIMS

1. A method of treating an algae containing aqueous medium comprising adding an effective amount of a treatment composition to said aqueous medium, said treatment composition comprising 1) a water soluble or dispersible cationic polymer and 2) a metal containing inorganic coagulant.

2. A method as recited in claim 1 wherein water soluble or dispersible cationic polymer 1) comprises a member or members selected from the group consisting of a) water soluble cationic quaternary ammonium starch, b) a water soluble quaternary ammonium starch/gum blend, and c) a water soluble modified tannin.

3. A method as recited in claim 2 further comprising the step of filtering said aqueous medium.

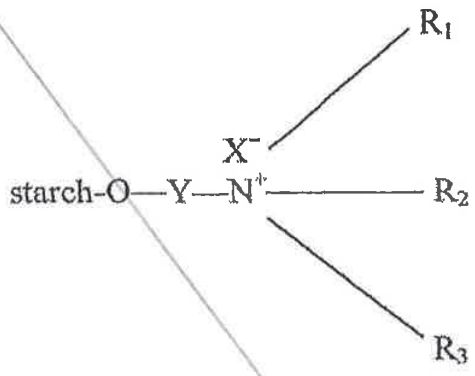
4. A method as recited in claim 2 wherein said algae containing aqueous medium is an agglomerated mass of algae with water dispersed throughout said mass.

5. A method as recited in claim 4 further comprising the step of separating said algae from said water thereby harvesting said algae.

6. A method as recited in claim 1 wherein between about 1-1,000 ppm of 1) is added to said aqueous medium and from about 1-1,000 ppm of 2) is added to said aqueous medium based upon one million parts of said aqueous medium.

7. A method as recited in claim 3 wherein said aqueous medium is part of a municipal water plant treatment system.

8. The method of claim 2 wherein said water soluble cationic starch a) is present and has the formula:



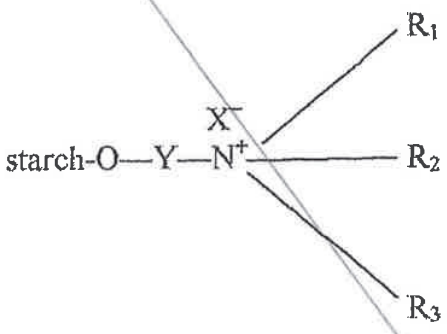
wherein X is any monovalent anion including, chloride, bromide, iodide, methyl sulfate; Y is selected from the group consisting of 2, 3 epoxy propyl, 3-halo-2-hydroxy propyl, 2 haloethyl, o, p or m (αhydroxy-β halo ethyl) benzyl; R_1, R_2, and R_3 are independently selected from the group consisting of hydrogen, hydroxyl, alkyl, substituted alkyl, aryl and alkaryl, and in which two of the Rs (R_1, R_2, R_3) may be joined to form a heterocyclic ring compound or a homocyclic ring compound, further in which the total number of carbons in all three of R_1, R_2, and R_3 should not exceed about 14 carbons, with the proviso that if all three of R_1, R_2, and R_3 are different and R_3 contains more than 3 carbon atoms but not more than 12, then R_1 and R_2 are from the group consisting of methyl and ethyl; and if R_1 and R_2 are joined to form a ring compound, R_3 is an alkyl group not greater than ethyl wherein the concentration of starch in the composition is in the range of 7 to 30 percent by weight.

9. A method according to claim 8 wherein the starch is selected from the group consisting of corn, potato tapioca, sago, wheat, waxy maize, grain sorghum, grain starches, and dextrin.

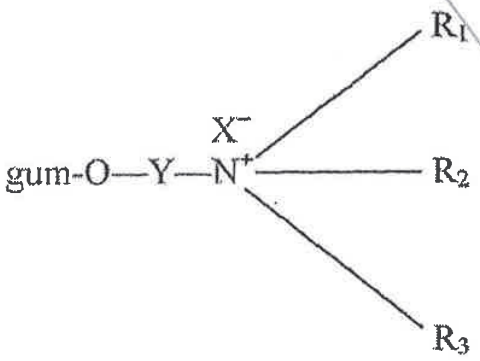
10. A method according to claim 8 wherein the degree of substitution of the composition is in the range of 0.2 to 1.2.

11. A method according to claim 8 wherein the degree of substitution of the composition is in the range of 0.1 to 1.8.

12. A method according to claim 2 wherein said water soluble quaternary ammonium starch/gum blend b) is present, said cationic ammonium modified starch having the formula:



and said cationic quaternary ammonium modified gum has the formula:



wherein X is any monovalent anion including chloride, bromide, iodide, methyl sulfate; Y is selected from the group consisting of 2, 3 epoxy propyl, 3-halo-2-hydroxy propyl, 2 haloethyl, o, p or m (αhydroxy-β halo ethyl) benzyl; R_1, R_2, and R_3 are independently selected from the group consisting of hydrogen, hydroxyl, alkyl, substituted alkyl, aryl, and alkaryl, and in which two of the Rs may be joined to form a heterocyclic ring compound or a homocyclic ring compound further in which the total number of carbons in all three of R_1, R_2, and R_3 should not exceed about 14.

13. A method according to claim 12 wherein the gum is selected from the group consisting of guar, carboxylmethyl cellulose, propylene glycol alginate, locust bean karaya, sodium alginate and xanthum.

14. A method according to claim 12 wherein the starch is selected from the group consisting of corn, potato, tapioca, sago, rice wheat, waxy maize, grain sorghum, grain starches, and dextrin.

15. A method according to claim 12 wherein the degree of substitution of the composition is in the range of 0.2 to 1.2.

16. A method according to claim 12 wherein the degree of substitution of the composition is in the range of 0.1 to 1.8.

17. A method according to claim 12 wherein the concentration of gum in the composition is in the range of 5-15 starch : 1 gum (by weight).

18. A method as recited in claim 2 wherein said water soluble tannin c) is present and comprises a tannin/cationic copolymer.

19. A method as recited in claim 18 wherein said tannin/cationic copolymer has a cationic repeat unit moiety comprising MADAME, METAC, or AETAC.

20. A method as recited in claim 18 wherein said water soluble tannin is present and comprises a reaction product of tannin, aldehyde, and amine.

21. A method as recited in claim 1 wherein said metal containing inorganic coagulant comprises a salt of a bivalent or trivalent metal.

22. A method as recited in claim 21 wherein said metal containing inorganic coagulant contains alum.

23. A method as recited in claim 21 wherein said metal containing inorganic coagulant contains bivalent (ferrous) or trivalent (ferric) irons.

CLAIMS

What is claimed is:

1. A method of treating an algae containing aqueous medium comprising adding an effective amount of a treatment composition to said aqueous medium, said treatment composition comprising 1) a water soluble or dispersible cationic polymer comprising a member or members selected from the group consisting of a) water soluble cationic quaternary ammonium starch, b) a water soluble quaternary ammonium starch/gum blend, and c) a water soluble modified tannin; and 2) a metal containing inorganic coagulant.

2. A method as recited in claim 1 further comprising the step of filtering said aqueous medium.

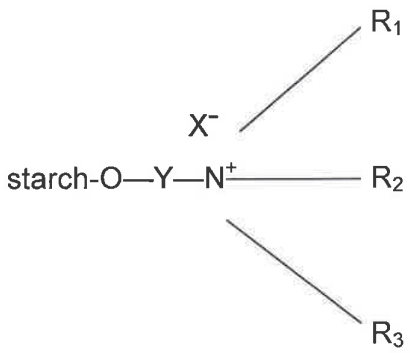
3. A method as recited in claim 1 wherein said algae containing aqueous medium is an agglomerated mass of algae with water dispersed throughout said mass.

4. A method as recited in claim 3 further comprising the step of separating said algae from said water thereby harvesting said algae.

5. A method as recited in claim 1 wherein between about 1-1,000 ppm of 1) is added to said aqueous medium and from about 1-1,000 ppm of 2) is added to said aqueous medium.

6. A method as recited in claim 2 wherein said aqueous medium is part of a municipal water plant treatment system.

7. The method of claim 1 wherein said water soluble cationic starch a) is present and has the formula:



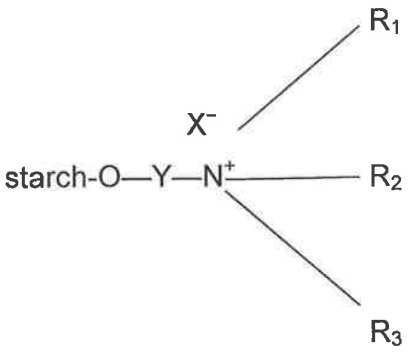
wherein X is any monovalent anion including, chloride, bromide, iodide, methyl sulfate; Y is selected from the group consisting of 2 hydroxyl propyl, ethyl, or o, p or m (αhydroxy-β halo ethyl) benzyl; R_1, R_2, and R_3 are independently selected from the group consisting of hydrogen, hydroxyl, alkyl, substituted alkyl, aryl and alkaryl, and in which two of the Rs (R_1, R_2, R_3) may be joined to form a heterocyclic ring compound or a homocyclic ring compound, further in which the total number of carbons in all three of R_1, R_2, and R_3 should not exceed about 14 carbons, with the proviso that if all three of R_1, R_2, and R_3 are different and R_3 contains more than 3 carbon atoms but not more than 12, then R_1 and R_2 are from the group consisting of methyl and ethyl; and if R_1 and R_2 are joined to form a ring compound, R_3 is an alkyl group not greater than ethyl wherein the concentration of starch in the composition is in the range of 7 to 30 percent by weight.

8. A method according to claim 7 wherein the starch is selected from the group consisting of corn, potato, tapioca, sago, wheat, waxy maize, grain sorghum, grain starches, and dextrin.

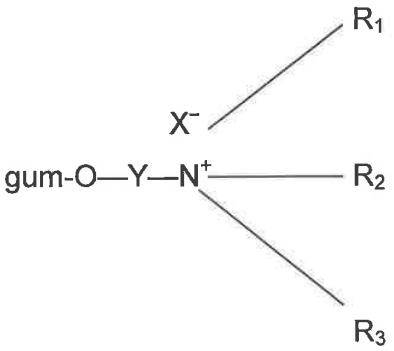
9. A method according to claim 7 wherein the degree of substitution of the composition is in the range of 0.2 to 1.2.

10. A method according to claim 7 wherein the degree of substitution of the composition is in the range of 0.1 to 1.8.

11. A method according to claim 1 wherein said water soluble quaternary ammonium starch/gum blend b) is present, said cationic ammonium modified starch having the formula:



and said cationic quaternary ammonium modified gum has the formula:



wherein X is any monovalent anion including chloride, bromide, iodide, methyl sulfate; Y is selected from the group consisting of 2 hydroxyl propyl, ethyl, or o, p or m (αhydroxy-β halo ethyl) benzyl; R_1, R_2, and R_3 are independently selected from the group consisting of hydrogen, hydroxyl, alkyl, substituted alkyl, aryl, and alkaryl, and in which two of the Rs may be joined to form a heterocyclic ring compound or a homocyclic ring compound further in which the total number of carbons in all three of R_1, R_2, and R_3 should not exceed about 14.

12. A method according to claim 11 wherein the gum is selected from the group consisting of guar, carboxylmethyl cellulose, propylene glycol alginate, locust bean, karaya, sodium alginate and xanthum.

13. A method according to claim 11 wherein the starch is selected from the group consisting of corn, potato, tapioca, sago, rice wheat, waxy maize, grain sorghum, grain starches, and dextrin.

14. A method according to claim 11 wherein the degree of substitution of the composition is in the range of 0.2 to 1.2.

15. A method according to claim 11 wherein the degree of substitution of the composition is in the range of 0.1 to 1.8.

16. A method according to claim 11 wherein the concentration of gum in the composition is in the range of 5-15 starch : 1 gum (by weight).

17. A method as recited in claim 1 wherein said water soluble tannin c) is present and comprises a tannin/cationic copolymer.

18. A method as recited in claim 17 wherein said tannin/cationic copolymer has a cationic repeat unit moiety comprising MADAME, METAC, or AETAC.

19. A method as recited in claim 17 wherein said water soluble tannin is present and comprises a reaction product of tannin, aldehyde, and amine.

20. A method as recited in claim 1 wherein said metal containing inorganic coagulant comprises a salt of a bivalent or trivalent metal.

21. A method as recited in claim 20 wherein said metal containing inorganic coagulant contains alum.

22. A method as recited in claim 20 wherein said metal containing inorganic coagulant contains bivalent (ferrous) or trivalent (ferric) irons.