

What is claimed is:

Claim 1. A microencapsulated biocide comprising:

a core material comprising an isothiazolone biocide or antifouling agent; and

one or more layers of wall material encapsulating the core material to form a capsule;

wherein the capsule releases about 10% or less of the isothiazolone biocide or antifouling agent in xylene at room temperature over 90 days and provides sustained release of the core material upon immersion in water;

wherein the one or more layers of wall material is selected from the group consisting of a reaction product of polyvinyl alcohol and a phenolic resin, a reaction product of an amino formaldehyde resin, an acrylic polymer, a reaction product of polyvinyl alcohol and an isocyanate, and a gelatin-gum.

Claim 2. The microencapsulated biocide of claim 1 wherein the isothiazolone includes 4,5-dichloro-2-n-octyl-3(2H)-isothiazolone.

Claim 3. The microencapsulated biocide of claim 1 wherein the water leaches the core material from the capsule.

Claim 4. The microencapsulated biocide of claim 3 wherein at least one layer of wall material incorporates a dopant into the structure of the wall material during the encapsulation process.

Claim 5. The microencapsulated biocide of claim 4 wherein the dopant is selected from the group consisting of polyvinyl alcohol, hydroxyethylcellulose, hydroxypropylcellulose, methylcellulose, hydroxyethylmethylcellulose, hydroxypropylmethylcellulose, hydroxybutylmethylcellulose, ethylhydroxyethylcellulose, and polyethylene glycols.

Claim 6. The microencapsulated biocide of claim 5 wherein the dopant is polyvinyl alcohol.

Claim 7. The microencapsulated biocide of claim 1 wherein the core material further comprises a partially water soluble solvent that dissolves the isothiazolone biocide or antifouling agent.

Claim 8. The microencapsulated biocide of claim 7 wherein the partially water soluble solvent is an ester or an ether or mixtures thereof.

Claim 9. The microencapsulated biocide of claim 1 wherein the capsule includes an inner layer of wall material of an acrylic polymer or a melamine-formaldehyde and an outer layer of wall material of a PVA-urea-resorcinol-gluteraldehyde.

Claim 10. The microencapsulated biocide of claim 1 wherein the capsule includes an inner layer of wall material of a gelatin-gum and an outer layer of wall material of a melamine-formaldehyde or a urea-resorcinol-formaldehyde.

Claim 11. The microencapsulated biocide of claim 1 wherein the capsule includes an inner layer of wall material, an intermediate layer of wall material, and an outer layer of wall material.

Claim 12. The microencapsulated biocide of claim 1 wherein the capsule includes an inner layer of wall material of a reaction product of polyvinyl alcohol and an isocyanate and an outer layer of wall material of a reaction product of an amino formaldehyde resin.

Claim 13. The microencapsulated biocide of claim 12 wherein the capsule further comprises an intermediate layer of wall material between the inner and outer layers of wall material, the intermediate layer of wall material comprising a gelatin-gum.

Claim 14. The microencapsulated biocide of claim 1 included in a coating composition comprising a film former or binder.

Claim 15. The microencapsulated biocide of claim 1 wherein the coating composition is a marine paint.

Claim 16. The microencapsulated biocide of claim 1 included in a roofing material.

Claim 17. (A microencapsulated biocide comprising:

a core material comprising an isothiazolone biocide or antifouling agent and a partially water soluble solvent having a partial water solubility of about 0.5 % to about 5 % in water; and

one or more layers of wall material encapsulating the core material to form a capsule;

wherein the capsule is stable in xylene and is permeable to water for water to leach the

core material from the capsule as a sustained release;

wherein the capsule releases about 10% or less of the isothiazolone biocide or antifouling agent in xylene at room temperature over 90 days.

Claim 18. (The microencapsulated biocide of claim 17 wherein the partially water soluble solvent is incorporated into the core in an amount of about 5% to about 25%.

Claim 19. The microencapsulated biocide of claim 17 wherein the solvent is an ester or an ether or mixtures thereof.

Claim 20. The microencapsulated biocide of claim 17 wherein the isothiazolone includes 4,5-dichloro-2-n-octyl-3(2H)-isothiazolone.

Claim 21. The microencapsulated biocide of claim 17 wherein the at least one layer of wall material is selected from the group consisting of a reaction product of polyvinyl alcohol and a phenolic resin, a reaction product of an amino formaldehyde resin, an acrylic polymer, a reaction product of polyvinyl alcohol and an isocyanate, and a gelatin-gum.

Claim 22. The microencapsulated biocide of claim 17 wherein the capsule includes an inner layer of wall material of an acrylic polymer or a melamine-formaldehyde and an outer layer of wall material of a PVA-urea-resorcinol-glutaraldehyde or a PVA-urea-resorcinol-formaldehyde.

Claim 23. The microencapsulated biocide of claim 17 wherein the capsule includes an inner layer of wall material of a gelatin-gum and an outer layer of wall material of an amino formaldehyde resin or a urea-resorcinol-formaldehyde.

Claim 24. The microencapsulated biocide of claim 23 wherein the capsule further includes an innermost layer of wall material of a reaction product of polyvinyl alcohol and an isocyanate separating the core material from the inner layer of wall material.

Claim 25. The microencapsulated biocide of claim 17 wherein the capsule includes an inner layer of wall material, an intermediate layer of wall material, and an outer layer of wall material.

Claim 26. The microencapsulated biocide of claim 17 wherein the capsule includes an inner layer of wall material of an interfacial reaction product of an aromatic polyisocyanate and an outer layer of wall material of a PVA-urea-resorcinol-formaldehyde.

Claim 27. (A coating composition comprising:

a film former or binder; and

a microencapsulated biocide comprising:

a core material comprising an isothiazolone biocide or antifouling agent; and

one or more layers of wall material encapsulating the core material to form a capsule;

wherein the capsule is stable in xylene and is permeable to water for water to leach the core material from the capsule as a sustained release;

wherein the capsule releases about 10% or less of the isothiazolone biocide or antifouling agent in xylene at room temperature over 90 days and provides sustained release of the core material upon immersion in water.

wherein the one or more layers of wall material is selected from the group consisting of a reaction product of polyvinyl alcohol and a phenolic resin, a reaction product of an amino formaldehyde resin, an acrylic polymer, a reaction product of polyvinyl alcohol and an isocyanate, and a gelatin-gum.

Claim 28. A roofing material including a microencapsulated biocide comprising:

a core material comprising an isothiazolone biocide or antifouling agent dissolved in a partially water soluble solvent having a partial water solubility of about 0.5 % to about 5 % in water; and

one or more layers of wall material encapsulating the core material to form a capsule;

wherein the capsule is stable in xylene and is permeable to water for water to leach the core material from the capsule as a sustained release;

wherein the capsule releases about 10% or less of the isothiazolone biocide or antifouling

agent in xylene at room temperature over 90 days.

Claim 29. A microencapsulated biocide comprising:

- an isothiazolone biocide or antifouling agent as a core material encapsulated in a wall material comprising one or more layers of material;

- wherein the wall material releases about 10% or less of the isothiazolone biocide or antifouling agent in xylene at room temperature over 90 days and from which water or saltwater can leach the biocide from the capsule;

- wherein the wall material contains a dopant to enhance the ability of water to leach the isothiazolone from the capsule and is;

- a reaction product of polyvinyl alcohol, urea, resorcinol, and gluteraldehyde; or

- a melamine-formaldehyde wall encapsulated in a polyvinyl alcohol wall;

- wherein the dopant is the polyvinyl alcohol.

Claim 30. The microencapsulated biocide of claim 1 wherein the core material further comprises a partially water soluble solvent that dissolves the isothiazolone biocide or antifouling agent.

Claim 31. The microencapsulated biocide of claim 7 wherein the partially water soluble solvent is an ester or an ether or mixtures thereof.

Claim 32. The microencapsulated biocide of claim 17 wherein the isothiazolone includes 4,5-dichloro-2-n-octyl-3(2H)-isothiazolone.

What is claimed is:

1. A microencapsulated biocide comprising:
a core material comprising an isothiazolone biocide or antifouling agent encapsulated in a wall material; and
wherein the wall material is a dual wall, and the dual wall has an inner wall containing an acrylic polymer or a melamine-formaldehyde resin encapsulated by the outer wall, which contains a reaction product of polyvinyl alcohol, urea, resorcinol, and glutaraldehyde, or the dual wall has an inner wall containing gelatin-gum arabic and an outer wall containing melamine formaldehyde, or the wall material is a multi-wall and the multi-wall includes a reaction product of an aromatic polyisocyanate as the first wall, a gelatin-gum arabic as the second wall, and a melamine-formaldehyde as the overcoat wall;
wherein the capsule releases 10% or less of the isothiazolone biocide or antifouling agent in xylene at room temperature over 90 days and provides sustained release of the core material upon immersion in water.
2. The microencapsulated biocide of claim 1 wherein the isothiazolone includes 4,5-dichloro-2-n-octyl-3(2H)-isothiazolone.
3. The microencapsulated biocide of claim 1 wherein the water leaches the core material from the capsule.
4. The microencapsulated biocide of claim 1 wherein the core material further comprises a partially water soluble solvent that dissolves the isothiazolone biocide or antifouling agent.
5. The microencapsulated biocide of claim 4 wherein the partially water soluble solvent has a boiling point above 175°C.

6. The microencapsulated biocide of claim 1 included in a coating composition comprising a film former or binder.
7. The microencapsulated biocide of claim 6 wherein the coating composition is a marine paint.
8. The microencapsulated biocide of claim 1 included in a roofing material.
9. The microencapsulated biocide of claim 1 wherein the core material further comprises a partially water soluble solvent having a partial water solubility of 0.5 % to 5 % in water.
10. The microencapsulated biocide of claim 9 wherein the partially water soluble solvent dissolves in water in an amount of 0.5% to 5% and is incorporated into the core in an amount of 5% to 25%.
11. The microencapsulated biocide of claim 9 wherein the solvent is selected from the group consisting of dimethyl adipate, diisobutyl adipate, diisobutyl glutarate, diisobutyl succinate, polyglycol, glycol ether EB acetate, and mixtures thereof.
12. The microencapsulated biocide of claim 9 wherein the isothiazolone includes 4,5-dichloro-2-n-octyl-3(2H)-isothiazolone.
13. A coating composition comprising:
 - a film former or binder; and
 - a microencapsulated biocide comprising:
 - a core material comprising an isothiazolone biocide or antifouling agent;
 - and

one or more layers of wall material encapsulating the core material to form a capsule;

wherein the capsule is stable in xylene and is permeable to water for water to leach the core material from the capsule as a sustained release;

wherein the capsule releases ~~about~~ 10% or less of the isothiazolone biocide or antifouling agent in xylene at room temperature over 90 days and provides sustained release of the core material upon immersion in water;

wherein the wall material is a dual wall, and the dual wall has an inner wall containing an acrylic polymer or a melamine-formaldehyde resin encapsulated by the outer wall, which contains a reaction product of polyvinyl alcohol, urea, resorcinol, and glutaraldehyde, or the dual wall has an inner wall containing gelatin-gum arabic and an outer wall containing melamine formaldehyde, or the wall material is a multi-wall and the multi-wall includes a reaction product of an aromatic polyisocyanate as the first wall, a gelatin-gum arabic as the second wall, and a melamine-formaldehyde as the overcoat wall.

14. A roofing material including a microencapsulated biocide comprising:

a core material comprising an isothiazolone biocide or antifouling agent; and

wherein the wall material is a dual wall, and the dual wall has an inner wall containing an acrylic polymer or a melamine-formaldehyde resin encapsulated by the outer wall, which contains a reaction product of polyvinyl alcohol, urea, resorcinol, and glutaraldehyde, or the dual wall has an inner wall containing gelatin-gum arabic and an outer wall containing melamine formaldehyde, or the wall material is a multi-wall and the multi-wall includes a reaction product of an aromatic polyisocyanate as the first wall, a gelatin-gum arabic as the second wall, and a melamine-formaldehyde as the overcoat wall;

wherein the capsule is stable in xylene and is permeable to water for water to leach the core material from the capsule as a sustained release;

wherein the capsule releases 10% or less of the isothiazolone biocide or antifouling agent in xylene at room temperature over 90 days.