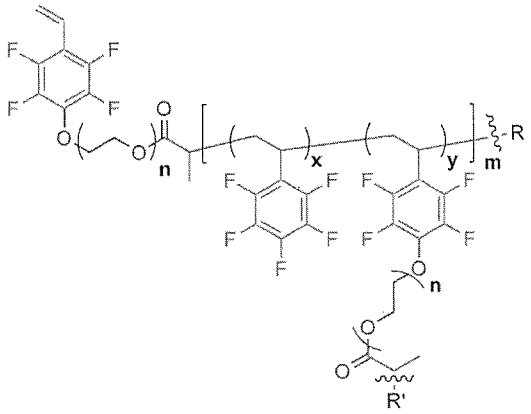
SUMMARY

[0006] The disclosed subject matter provides terpolymers of hyperbranched fluoropolymers, PEG and PDMS to mitigate biofouling in various applications. In accordance with one aspect of the disclosed subject matter, a compound for reducing biofouling, the compound represented by ~~of~~ Formula A as illustrated and below is provided:



(Formula A)

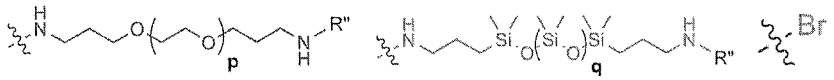
wherein:

n is selected from an integer between 1 and 15 inclusive;

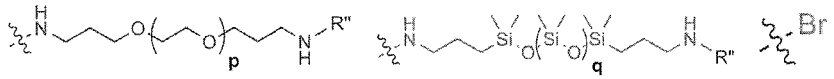
x is selected from a number between 0.01 and 0.99, where y = (1 - x);

m is selected from an integer between 1 and 250 inclusive;

R is selected from the group consisting of



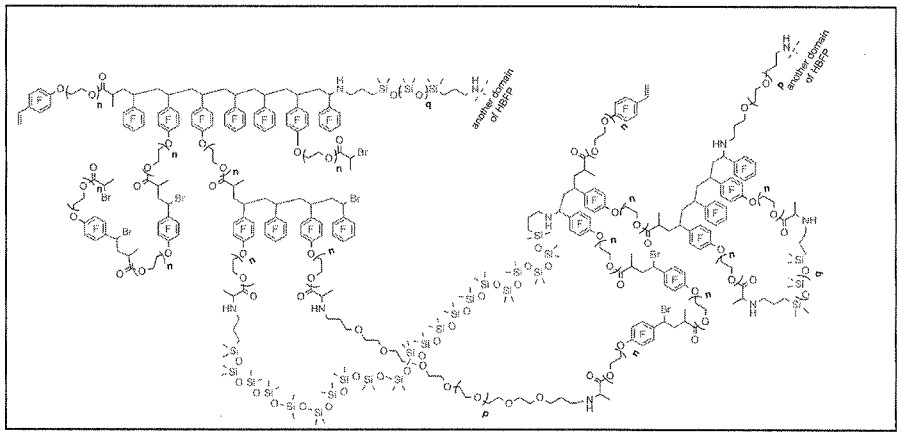
and R' is selected from the group consisting of



wherein p and q are integers independently selected from between 1 and 250

inclusive and R" is another domain of Formula A or Hydrogen.

[0007] According to certain embodiments of the disclosed subject matter, the compound of Formula A is represented by the formula below:



wherein n is selected from an integer between 1 and 15 inclusive, and p and q are independently selected from an integer between 1 and 250 inclusive.

[0008] According to another ~~aspect~~ embodiment of the disclosed subject matter, a method for reducing biofouling of a surface is provided. The method includes providing a terpolymer according to Formula A above to a surface susceptible to biofouling.

[0009] According to another ~~aspect~~ embodiment of the disclosed subject matter, a method for preparing a compound for reducing fouling of a crude hydrocarbon in a hydrocarbon refining process is provided. According to another aspect of the disclosed subject matter, a method for preparing a compound for mitigating biofouling is provided. The method includes:

(a) reacting 2,3,4,5,6-pentafluorostyrene with polyethylene glycol to obtain a product represented by Formula I below:

[0010] wherein n is selected from an integer between 1 and 15 inclusive;

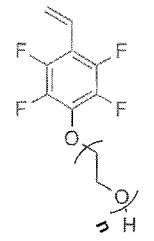
x is selected from a number between 0.01 and 0.99, where y = (1 - x); and

m, q, and p are independently selected from an integer between 1 and 250 inclusive; and

(d) reacting the branched fluoropolymer obtained in (c) with chain bisaminopropyl-polyethylene glycol having between 1 and 250 monomer units and bisaminopropyl-polydimethylsiloxane having between 1 and 250 monomer units to obtain a terpolymer of the branched fluoropolymer, polyethylene glycol and polydimethylsiloxane.

[0011] According to a further ~~aspect~~ embodiment of the disclosed subject matter, a compound prepared by the above method is provided. According to a further aspect of the disclosed subject matter, a compound for mitigating biofouling is provided, the compound prepared by a method comprising:

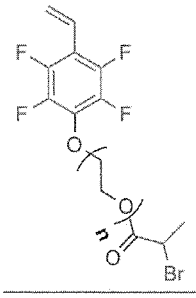
(a) reacting 2,3,4,5,6-pentafluorostyrene with polyethylene glycol to obtain a product represented by Formula I below:



(I)

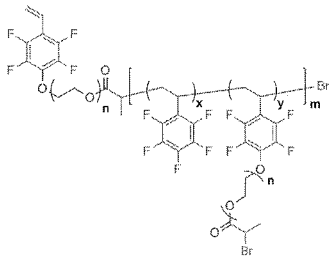
wherein n is selected from an integer between 1 and 15 inclusive;

(b) reacting the product obtained in (a) with 2-bromopropionyl bromide to obtain a product represented by Formula II below:



(II)

(c) reacting the product obtained in (b) with 2,3,4,5,6-pentafluorostyrene to obtain a branched fluoropolymer represented by Formula III below:



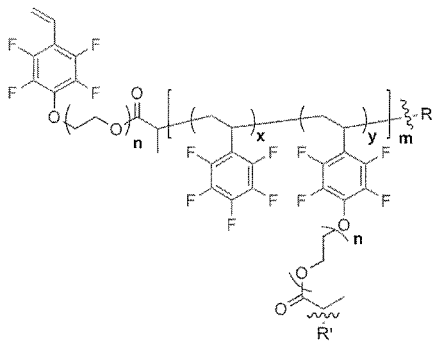
(III)

wherein n is selected from an integer between 1 and 15 inclusive; x is selected from a number between 0.01 and 0.99, where y = (1 - x); and m is selected from an integer between 1 and 250 inclusive; and

(d) reacting the branched fluoropolymer obtained in (c) with chain bisaminopropyl-polyethylene glycol having between 1 and 250 monomer units and bisaminopropyl-polydimethylsiloxane having between 1 and 250 monomer units to obtain a terpolymer of the branched fluoropolymer, polyethylene glycol and polydimethylsiloxane.

[0012] According to another ~~aspect~~ embodiment of the disclosed subject matter, a method for mitigating biofouling of a surface is provided. The method includes providing a surface susceptible to biofouling and contacting the surface with a compound represented by Formula A.

According to another aspect of the disclosed subject matter, a method of mitigating biofouling is provided, comprising contacting a surface susceptible to biofouling with a compound represented by Formula A:

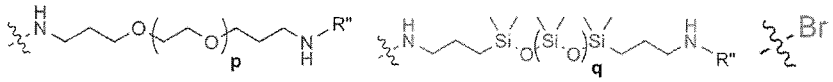


(Formula A)

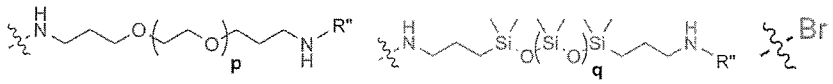
wherein n is selected from an integer between 1 and 15 inclusive;

x is selected from a number between 0.01 and 0.99, where y = (1 - x); m is selected from an integer between 1 and 250 inclusive; and

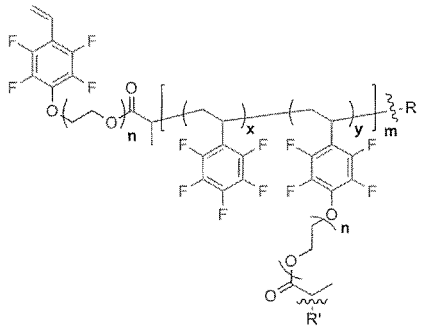
wherein R is selected from the group consisting of



R' is selected from the group consisting of



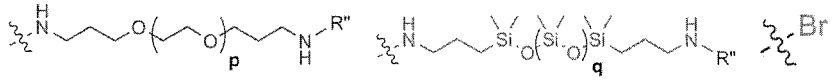
wherein R" is another domain of Formula A or Hydrogen. According to a further aspect of the disclosed subject matter, a composition comprising the compound represented by Formula A for mitigating biofouling of a surface is provided:



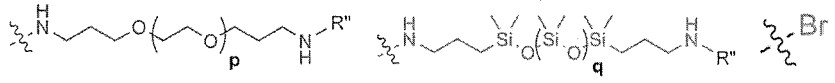
(Formula A)

wherein n is selected from an integer between 1 and 15 inclusive; x is selected from a number between 0.01 and 0.99, where y = (1 - x); and m is selected from an integer between 1 and 250 inclusive; and

wherein R is selected from the group consisting of



and R' is selected from the group consisting of



wherein R" is another domain of Formula A or Hydrogen.

[0013] In addition, the disclosed subject matter provides compositions comprising the compound identified above, and products incorporating compositions comprising the compound identified above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The disclosed subject matter will now be described in conjunction with the accompanying drawings in which:

[0015] FIG. 1 is a schematic illustration of a synthesis protocol for a terpolymer of HBFP-PEG-PDMS.

FIG. 2 illustrates gel permeation chromatography curves for the HBFPs as synthesized in

glycol is between about 0.5% and about 99% of the weight of the compound.

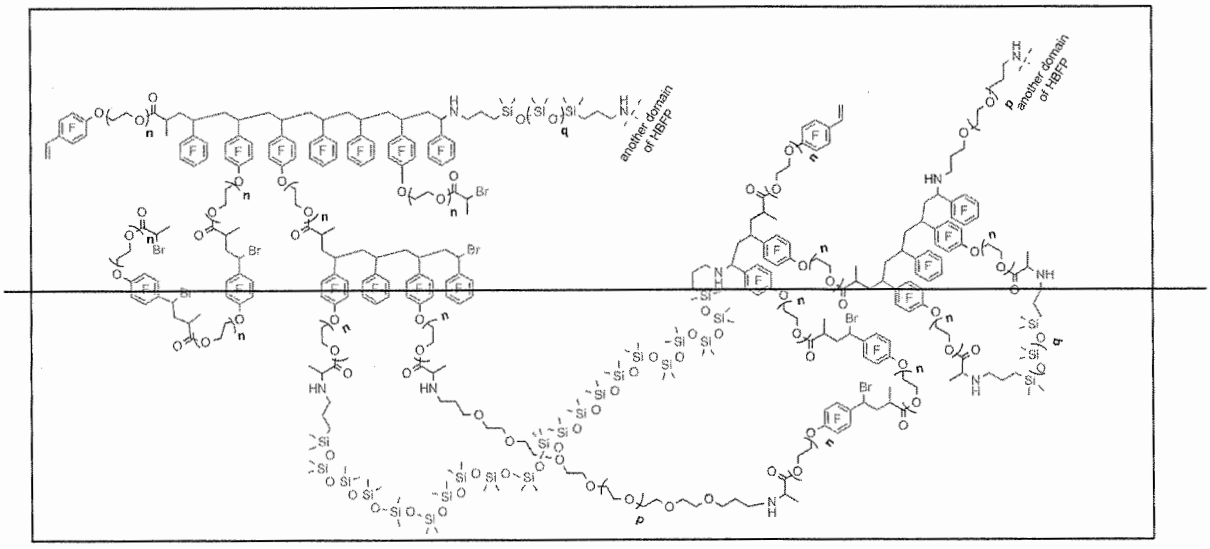
3. The compound of claim 1, wherein the weight percentage of diamino-polydimethylsiloxane is between about 0.5% and about 99% of the weight of the compound.

4. The compound of claim 1, wherein the weight percentage of diaminopolyethylene glycol is between about 17.5% and about 30% of the weight of the compound.

5. The compound of claim 1, wherein the weight percentage of diamino-polydimethylsiloxane is between about 17.5% and about 30% of the weight of the compound.

6. The compound of claim 1, wherein the weight percentage of diaminopolyethylene glycol is between about 17.5% and about 30% of the weight of the compound the weight percentage of diamino-polydimethylsiloxane is between about 17.5% and about 30% of the weight of the compound.

~~7. The compound of claim 1, wherein the compound is represented by:~~



~~8~~7. The compound of claim 1, wherein the compound comprises a heterogeneous distribution of chemical domains.

~~9~~8. The compound of claim ~~8~~7, wherein the compound comprises a heterogeneous distribution of hydrophobic and hydrophilic domains.

~~10~~9. The compound of claim 1, wherein the compound has exhibits topographical heterogeneity at the microscale and at the nanoscale.

~~11~~10. The compound of claim 1, wherein the compound comprises a raised region, a lattice region, and a deeper interstitial region.

~~12~~11. The compound of claim ~~11~~10, wherein

the raised region is characterized by a high modulus, a low deformation, a low surface energy, and low dissipation;

the lattice region is characterized by a moderate modulus, a moderate deformation, a low surface energy, and a moderate dissipation; and

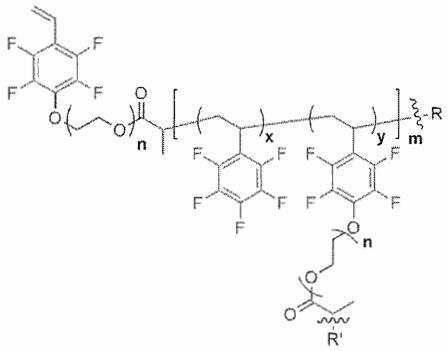
the deeper interstitial region is characterized by a low modulus, a high deformation, a high surface energy, and a high dissipation.

~~13~~12. A method for preparing a compound for mitigating biofouling comprising:

(a) reacting 2,3,4,5,6-pentafluorostyrene with polyethylene glycol to obtain a product represented by Formula I below:

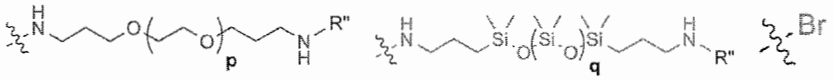
polyethylene glycol having between 1 and 250 monomer units and bisaminopropyl-polydimethylsiloxane having between 1 and 250 monomer units to obtain a terpolymer of the branched fluoropolymer, polyethylene glycol and polydimethylsiloxane.

~~14~~13. The method of claim ~~13~~12, wherein the terpolymer of the branched fluoropolymer, polyethylene glycol and polydimethylsiloxane obtained is represented by the compound of Formula A below

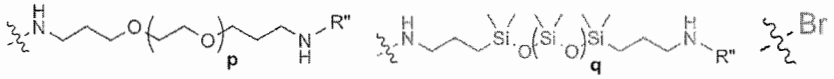


(Formula A)

wherein R is selected from the group consisting of

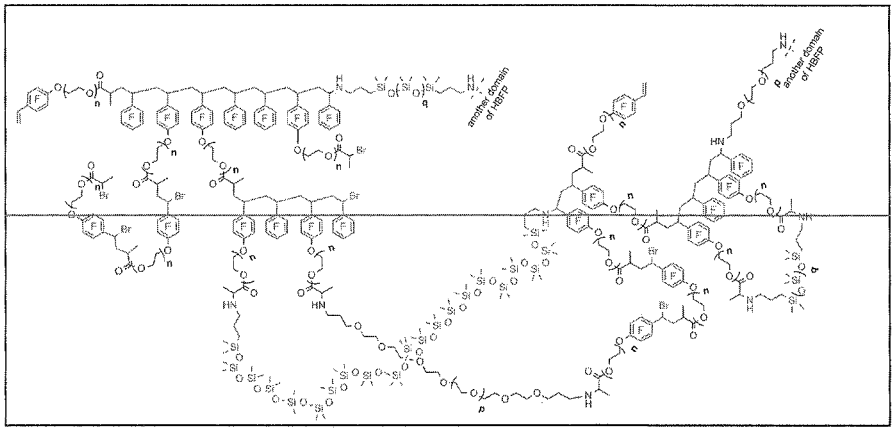


and R' is selected from the group consisting of



wherein R" is another domain of Formula A or Hydrogen.

~~15. The method of claim 13, wherein the terpolymer of terpolymer of the branched fluoropolymer, polyethylene glycol and polydimethylsiloxane is represented by:~~



~~16~~14. The method of claim ~~13~~12, wherein the weight percentage of diamino-polyethylene glycol is between about 0.5% and about 99% of the weight of the compound.

~~17~~15. The method of claim ~~13~~12, wherein the weight percentage of diamino-polydimethylsiloxane is between about 0.5% and about 99% of the weight of the compound.

~~18~~16. The method of claim ~~13~~12, wherein the weight percentage of diaminopolyethylene glycol is between about 17.5% and about 30% of the weight of the compound.

~~19~~17. The method of claim ~~13~~12, wherein the weight percentage of diamino-polydimethylsiloxane is between about 17.5% and about 30% of the weight of the compound.

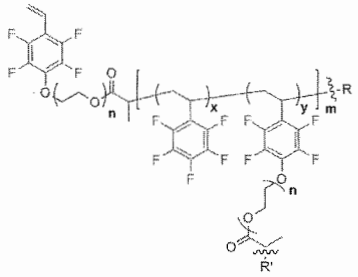
~~20~~18. The method of claim ~~13~~12, wherein the weight percentage of diaminopolyethylene glycol is between about 17.5% and about 30% of the weight of the compound the weight percentage of diamino-polydimethylsiloxane is between about 17.5% and about 30% of the weight of the compound.

~~21~~19. A compound for mitigating biofouling, the compound prepared by a method

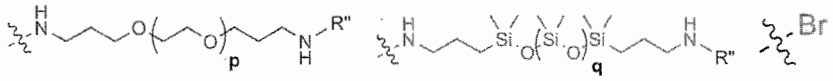
between 0.01 and 0.99, where y = (1 - x); and m is selected from an integer between 1 and 250 inclusive; and

(d) reacting the branched fluoropolymer obtained in (c) with chain bisaminopropyl-polyethylene glycol having between 1 and 250 monomer units and bisaminopropyl-polydimethylsiloxane having between 1 and 250 monomer units to obtain a terpolymer of the branched fluoropolymer, polyethylene glycol and polydimethylsiloxane.

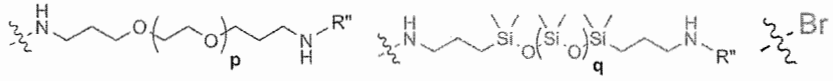
~~22~~20. The compound prepared by the method of claim ~~21~~19, wherein the compound is represented by



wherein R is selected from the group consisting of

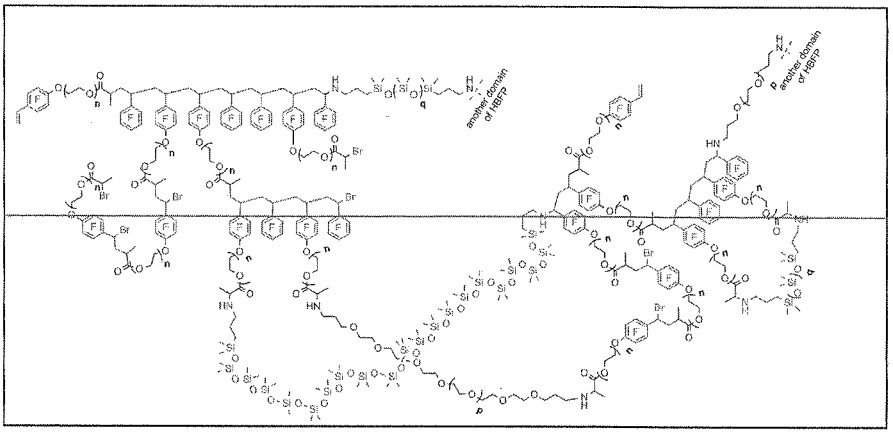


and R' is selected from the group consisting of



wherein R" is another domain of Formula A or Hydrogen.

~~23. The compound prepared by the method of claim 21, wherein the compound is represented by~~



~~24~~21. The compound prepared by the method of claim ~~21~~19, wherein the weight percentage of diamino-polyethylene glycol is between about 0.5% and about 99% of the weight of the compound.

~~25~~22. The compound prepared by the method of claim ~~21~~19, wherein the weight percentage of diamino-polydimethylsiloxane is between about 0.5% and about 99% of the weight of the compound.

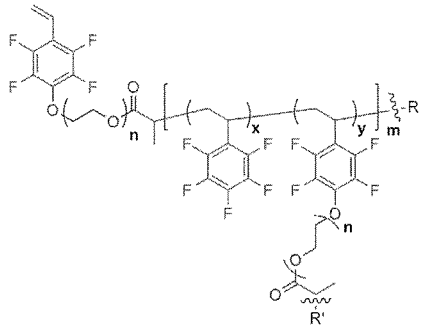
~~26~~23. The compound prepared by the method of claim ~~21~~19, wherein the weight percentage of diaminopolyethylene glycol is between about 17.5% and about 30% of the weight of the compound.

~~27~~24. The compound prepared by the method of claim ~~21~~19, wherein the weight percentage of diamino-polydimethylsiloxane is between about 17.5% and about 30% of the weight of the compound.

~~28~~25. The compound prepared by the method of claim ~~21~~19, wherein the weight percentage of diaminopolyethylene glycol is between about 17.5% and about 30% of the weight of the

compound the weight percentage of diamino-polydimethylsiloxane is between about 17.5% and about 30% of the weight of the compound.

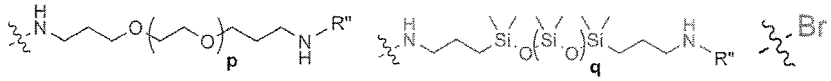
~~29~~26. A composition for mitigating biofouling, wherein the composition comprises the compound represented by Formula A:



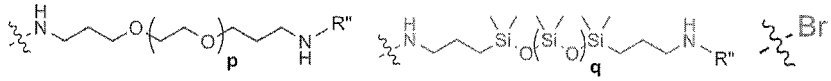
(Formula A)

wherein n is selected from an integer between 1 and 15 inclusive; x is selected from a number between 0.01 and 0.99, where y = (1 - x); and m is selected from an integer between 1 and 250 inclusive; and

wherein R is selected from the group consisting of

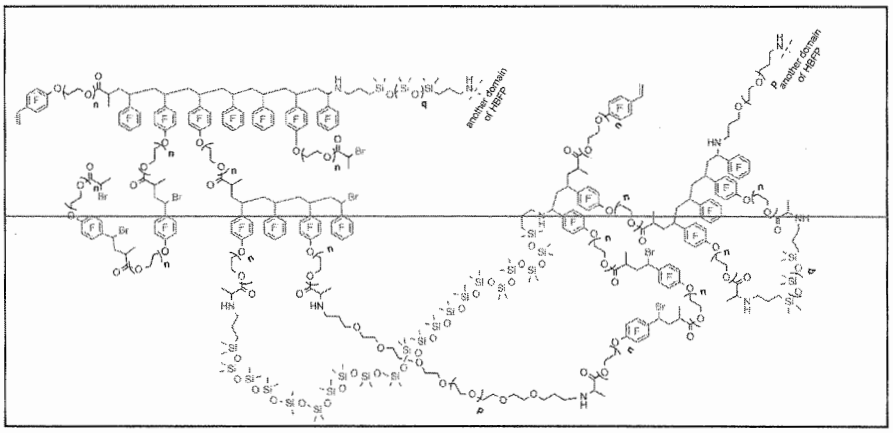


and R' is selected from the group consisting of



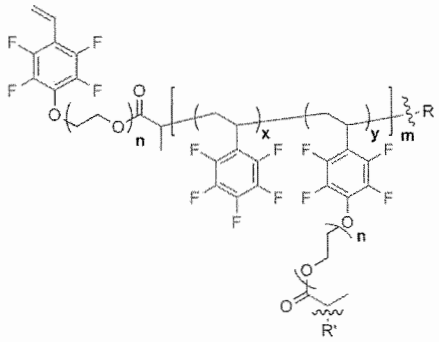
wherein R" is another domain of Formula A or Hydrogen.

~~30. The composition of claim 29, wherein the compound is represented by~~



~~32~~27. The composition of claim ~~29~~26, further comprising one or more of an adhesion agent, a dispersant, a solvent, and a stabilizer.

~~33~~28. A method of mitigating biofouling comprising contacting a surface susceptible to biofouling with a compound represented by Formula A:



(Formula A)

wherein n is selected from an integer between 1 and 15 inclusive;