CLAIMS

We claim:

1. An aqueous film- firefighting composition concentrate comprising:

(a) an effective amount of a monomeric C_6 perfluoroalkyl surfactant having a molecule weight less than 800 daltons, wherein said surfactant is zwitterionic or anionic;

(b) an effective amount of a foam stabilizing agent, and

(c) an effective amount of at least one non-fluorinated surfactant,

wherein said composition has less than 0.8 % F, and is substantially free of any surfactant containing a perfluoroalkyl group containing more than 6 carbon atoms and wherein said composition meets Military Specification MIL-F- 24385F.

2. The composition according to claim 1 wherein said non-fluorinated surfactant is an anionic surfactant.

3. The composition according to claim 1 or claim 2, wherein said foam stabilizing agent is a glycol ether.

4. The composition according to any of claims 1-3, further comprising a corrosion inhibitor.

5. The composition according to any of claims 1-4 wherein said monomeric C_6 perfluoroalkyl surfactant is zwitterionic.

6. The composition according to any of claims 1-5 wherein said monomeric perfluoroalkyl surfactant has a structure represented by the formula I:

I: R_f-X-Y-L-Z

wherein R_f is C_6 straight or branched chain perfluoroalkyl;

X is C_2-C_{12} straight or branched chain alkylene, or C_2-C_{12} straight or branched chain alkenylene containing 1 or 2 alkene moieties;

Y is selected from the group consisting of:

-S-$CH_2CH(R^1)CON(R^2)$-, -O-CH_2CH_2-$N(R^3)(R^4)$-;

-O-$CH_2CH(OR^5)CH_2$-$N(R^3)(R^4)$-; -O-$CH_2CH(OR^5)CH_2$-S-;

-S-$CH_2CH(OR^5)CH_2$-$N(R^3)(R^4)$-; and -S-$CH_2CH(OR^5)CH_2$-S-;

L is C_2-C_{12} straight or branched chain alkylene, where one carbon atom in the chain optionally is replaced by $-N(R^6)(R^7)$-; and

Z is $-OSO_3^-$, $-SO_3^-$, or $-CO_2^-$,

wherein R^1, R^2, R^3, R^4, R^6 and R^7, independently are H or straight or branched chain C_1-C_6 alkyl, and R^5 is H or straight or branched chain C_1-C_6 alkyl or trialkylsilyl.

7. An aqueous film- firefighting composition concentrate comprising:

(a) an effective amount of a perfluoroalkyl surfactant having a structure represented by the formula I:

I: R_f-X-Y-L-Z

wherein R_f is C_6 straight or branched chain perfluoroalkyl;

X is C_2-C_{12} straight or branched chain alkylene, or C_2-C_{12} straight or branched chain alkenylene containing 1 or 2 alkene moieties;

Y is selected from the group consisting of:

$-S-CH_2CH(R^1)CON(R^2)-$, $-O-CH_2CH_2-N(R^3)(R^4)-$;

$-O-CH_2CH(OR^5)CH_2-N(R^3)(R^4)-$; $-O-CH_2CH(OR^5)CH_2-S-$;

$-S-CH_2CH(OR^5)CH_2-N(R^3)(R^4)-$; and $-S-CH_2CH(OR^5)CH_2-S-$;

L is C_2-C_{12} straight or branched chain alkylene, where one carbon atom in the chain optionally is replaced by $-N(R^6)(R^7)-$; and

Z is $-OSO_3^-$, $-SO_3^-$, or $-CO_2^-$,

wherein R^1, R^2, R^3, R^4, R^6 and R^7, independently are H or straight or branched chain C_1-C_6 alkyl, and R^5 is H or straight or branched chain C_1-C_6 alkyl or trialkylsilyl;

(b) an effective amount of a foam stabilizing agent, and

(c) an effective amount of at least one non-fluorinated surfactant,

wherein said composition does not contain an effective amount of a perfluorinated surfactant that does not conform to formula I.

8. The composition according to claim 7 wherein said non-fluorinated surfactant is an anionic surfactant.

9. The composition according to claim 7 or claim 8, wherein said foam stabilizing agent is a glycol ether.

10. The composition according to any of claims 7-9, further comprising a corrosion inhibitor.

11. The composition according to any of claims 7-10, wherein Yis $-S-CH_2C(R^1)CON(R^2)-$.

12. The composition according to claim 11, wherein R^1 is H or straight chain alkyl and R^2 is H.

13. The composition according to any of claims 7-10, wherein Yis $-O-CH_2CH_2-N(R^3)(R^4)-$.

14. The composition according to claim 13, wherein R^3 and R^4 are H or methyl.

15. The composition according to any of claims 7-10, wherein Y is -O-$CH_2CH(OR^5)CH_2$-$N(R^3)(R^4)$-.

16. The composition according to claim 15, wherein R^3 and R^4 are H or methyl, and R^5 is H or trialkylsilyl.

17. The composition according to any of claims 7-10, wherein Y is -O-$CH_2CH(OR^5)CH_2$-S-.

18. The composition according to claim 17, wherein R^5 is H or trialkylsilyl.

19. The composition according to any of claims 7-10, wherein Y is -S-$CH_2CH(OR^5)CH_2$-$N(R^3)(R^4)$-.

20. The composition according to claim 19, wherein R^3 and R^4 are H or methyl, and R^5 is H or trialkylsilyl.

21. The composition according to any of claims 7-10, wherein Y is -S-$CH_2CH(OR^5)CH_2$-S-.

22. The composition according to claim 21, wherein R^5 is H or trialkylsilyl.

23. The composition according to any preceding claim, further comprising an alkylpolyglycoside in the amount of 0.3 to 7%.

24. The composition according to any preceding claim, further comprising a polysaccharide gum in an amount of 0.1 to 5%.

25. The composition according to any of claims 7-24, comprising a plurality of perfluoroalkyl surfactants of the formula I.

26. The composition according to any preceding claim, wherein said foam stabilizing agent is present in an amount of 1-50%, said non-fluorinated surfactant is present in an amount of 0.1 to 30% and said perfluoroalkyl surfactant or mixture of surfactants of formula I is present in an amount of 0.5 to 20%.

27. A fire-fighting foam, comprising a composition according to any of claims 1-26, and an aqueous liquid.

28. The foam according to claim 27, wherein said aqueous liquid is brackish water or seawater.

29. A method of making a fire-fighting foam, comprising foaming a composition according to any of claims 1-26 with an aqueous liquid.

30. The method according to claim 29, wherein said aqueous liquid is brackish water or seawater.

31. An aqueous film- firefighting composition concentrate comprising:

(a) an effective amount of a perfluoroalkyl surfactant having a structure represented by the formula I:

I: R_f-X-Y-L-Z

wherein R_f is C_6 straight or branched chain perfluoroalkyl;

X is C_2-C_{12} straight or branched chain alkylene, or C_2-C_{12} straight or branched chain alkenylene containing 1 or 2 alkene moieties;

Y is selected from the group consisting of:

$-S-CH_2CH(R^1)CON(R^2)-$, $-O-CH_2CH_2-N(R^3)(R^4)-$;

$-O-CH_2CH(OR^5)CH_2-N(R^3)(R^4)-$; $-O-CH_2CH(OR^5)CH_2-S-$;

$-S-CH_2CH(OR^5)CH_2-N(R^3)(R^4)-$; and $-S-CH_2CH(OR^5)CH_2-S-$;

L is C_2-C_{12} straight or branched chain alkylene, where one carbon atom in the chain optionally is replaced by $-N(R^6)(R^7)-$; and

Z is $-OSO_3^-$, $-SO_3^-$, or $-CO_2^-$,

wherein R^1, R^2, R^3, R^4, R^6 and R^7, independently are H or straight or branched chain C_1-C_6 alkyl, and R^5 is H or straight or branched chain C_1-C_6 alkyl or trialkylsilyl;

(b) an effective amount of a fluorinated foam stabilizing agent containing 3 to 7 perfluorinated carbon atoms, and

(c) an effective amount of at least one non-fluorinated surfactant, and

wherein said composition does not contain an effective amount of a perfluorinated surfactant that does not conform to formula I.

CLAIMS

1. An aqueous film- firefighting composition concentrate comprising:

(a) an effective amount of a perfluoroalkyl surfactant having a structure represented by the formula I:

I: R_f-X-Y-L-Z

wherein R_f is C_6 straight or branched chain perfluoroalkyl;

X is C_2-C_{12} straight or branched chain alkylene, or C_2-C_{12} straight or branched chain alkenylene containing 1 or 2 alkene moieties;

Y is selected from the group consisting of:

$-S-CH_2CH(R^1)CON(R^2)-$, $-O-CH_2CH_2-N(R^3)(R^4)-$;

$-O-CH_2CH(OR^5)CH_2-N(R^3)(R^4)-$; $-O-CH_2CH(OR^5)CH_2-S-$;

$-S-CH_2CH(OR^5)CH_2-N(R^3)(R^4)-$; and $-S-CH_2CH(OR^5)CH_2-S-$;

L is C_2-C_{12} straight or branched chain alkylene, where one carbon atom in the chain optionally is replaced by $-N(R^6)(R^7)-$; and

Z is $-OSO_3^-$, $-SO_3^-$, or $-CO_2^-$,

wherein R^1, R^2, R^3, R^4, R^6 and R^7, independently are H or straight or branched chain C_1-C_6 alkyl, and R^5 is H or straight or branched chain C_1-C_6 alkyl or trialkylsilyl;

(b) an effective amount of a foam stabilizing agent, and

(c) an effective amount of at least one non-fluorinated surfactant,

wherein said composition has less than 0.8 % F, and is substantially free of any surfactant containing a perfluoroalkyl group containing more than 6 carbon atoms.

2. The composition according to claim 1 wherein said non-fluorinated surfactant is an anionic surfactant.

3. The composition according to claim 1 or claim 2, wherein said foam stabilizing agent is a glycol ether.

4. The composition according to any one of claims 1-3, further comprising a corrosion inhibitor.

5. The composition according to any one of claims 1-4, wherein said composition does not contain an effective amount of a perfluorinated surfactant that does not conform to formula I.

6. The composition according to any one of claims 1-5, wherein Y is $-S-CH_2C(R^1)CON(R^2)-$.

7. The composition according to claim 6, wherein R^1 is H or straight chain alkyl and R^2 is H.

8. The composition according to any one of claims 1-5, wherein Y is $-O-CH_2CH_2-N(R^3)(R^4)-$.

9. The composition according to claim 8, wherein R^3 and R^4 are H or methyl.

10. The composition according to any one of claims 1-5, wherein Y is $-O-CH_2CH(OR^5)CH_2-N(R^3)(R^4)-$.

11. The composition according to claim 10, wherein R^3 and R^4 are H or methyl, and R^5 is H or trialkylsilyl.

12. The composition according to any one of claims 1-5, wherein Y is $-O-CH_2CH(OR^5)CH_2-S-$.

13. The composition according to claim 12, wherein R^5 is H or trialkylsilyl.

14. The composition according to any one of claims 1-5, wherein Y is $-S-CH_2CH(OR^5)CH_2-N(R^3)(R^4)-$.

15. The composition according to claim 14, wherein R^3 and R^4 are H or methyl, and R^5 is H or trialkylsilyl.

16. The composition according to any one of claims 1-5, wherein Y is $-S-CH_2CH(OR^5)CH_2-S-$.

17. The composition according to claim 16, wherein R^5 is H or trialkylsilyl.

18. The composition according to any preceding claim, further comprising an alkylpolyglycoside in the amount of 0.3 to 7%.

19. The composition according to any preceding claim, further comprising a polysaccharide gum in an amount of 0.1 to 5%.

20. The composition according to any preceding claim, comprising a plurality of perfluoroalkyl surfactants of the formula I.

21. The composition according to any preceding claim, wherein said foam stabilizing agent is present in an amount of 1-50%, said non-fluorinated surfactant is present in an amount of 0.1 to 30% and said perfluoroalkyl surfactant or mixture of surfactants of formula I is present in an amount of 0.5 to 20%.

22. A fire-fighting foam, comprising a composition according to any preceding claim, and an aqueous liquid.

23. The foam according to claim 22, wherein said aqueous liquid is brackish water or seawater.

24. A method of making a fire-fighting foam, comprising foaming a composition according to any one of claims 1-21 with an aqueous liquid.

25. The method according to claim 24, wherein said aqueous liquid is brackish water or seawater.