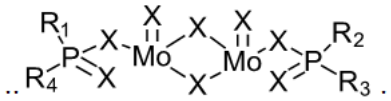
What is claimed is:

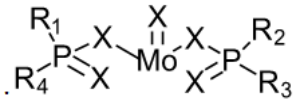
1. A method of inhibiting deposition of a foulant comprising:

introducing into a process equipment subject to fouling or a fluid in contact with the process equipment subject to fouling a foulant inhibiting composition effective to inhibit deposition of a foulant onto the process equipment, said foulant inhibiting composition comprising a molybdenum-containing complex comprising:

at least one molybdenum-containing complex having the formula selected from Formula I, II, III, or IV,

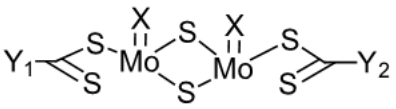


Formula I

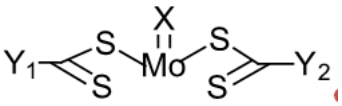


Formula II

wherein R_1, R_2, R_3, and R_4, are each a hydrocarbon group and wherein R_1, R_2, R_3, and R_4 can be the same or different; and X is oxygen or sulfur and X can be the same or different,



Formula III



Formula IV

wherein Y_1 and Y_2 are each oxygen, nitrogen or carbon-containing ligands and Y^1 and Y^2 can be the same or different, and X is each oxygen or sulfur, and X can be the same of different from each other.

2. The method as in claim 1, wherein the introducing is carried out after or during a decoking or cleaning or during a warm up process in the process equipment.

3. The method as in any one of claims 1-2, wherein the introducing is carried out during a hydrocarbon processing in the process equipment.

4. The method as in any one of claims 1-3, wherein the introducing is carried out intermittently.

5. The method as in any one of claims 1-3, wherein the introducing is carried out continuously.

6. The method as in any one of claims 1-5, wherein the process equipment comprises a coil, a heat exchanger, a transfer line exchanger, a quench cooler, a furnace, a separation column or a fractionator.

7. The method as in any one of claims 1-6, wherein the process equipment comprises iron or an iron alloy.

8. The method as in any one of claims 1-7, wherein the iron alloy comprises carbon steel, stainless steel, or a nickel-chromium-iron alloy.

9. The method as in any one of claims 1-8, wherein the foulant comprises one or more of coke, sludge, a corrosion product, a polymer, and catalyst fines.

10. The method as in one of claims 1-9, wherein the fluid comprises at least a liquid hydrocarbon material.

11. The method as in one of claims 1-10, wherein the molybdenum-containing complex is added to the fluid in an amount from 1 ppm to 3000 ppm of the fluid volume.

12. The method as in one of claims 1-11, wherein the fluid further comprises one or more asphaltene inhibitors, paraffin inhibitors, scale inhibitors, emulsifiers, water clarifiers, dispersants, emulsion breakers, or any combination thereof.

13. The method as in one of claims 1-12, wherein the R_1, R_2, R_3, and R_4 of formulae I and II comprise thiophosphates, phosphates and polymers thereof.

14. The method as in one of claims 1-12, wherein the Y^1 and Y^2 of formulae III and IV comprise thiocarbamates and polymers thereof.

15. The method as in one of claims 1-14, wherein the at least one molybdenum-containing complex comprises a molybdenum dithiocarbamate, dithiophosphate, polymers thereof and combinations thereof.

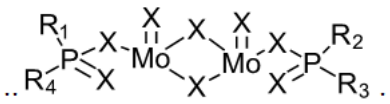
16. The method of claim 1, wherein the at least one molybdenum-containing complex comprises a molybdenum dithiocarbamate and wherein the molybdenum dithiocarbamate comprises an alkyldithiocarbamate.

17. The method of claim 16, wherein the alkyldithiocarbamate comprises an ethyl hexyl dithiocarbamate.

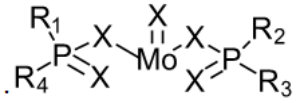
18. The method of claim 1, wherein the at least one molybdenum-containing complex comprises a molybdenum dithiophosphate and wherein the molybdenum dithiophosphate comprises an alkyldithiophosphate.

19. The method as in one of claims 1-18, wherein the introducing the molybdenum-containing complex inhibits foulant deposition onto the process equipment compared to operating the process equipment under the same conditions without the introduction of the molybdenum-containing complex.

20. A composition comprising at least one molybdenum-containing complex to inhibit deposition of a foulant in contact with process equipment subject to fouling, the at least one molybdenum-containing complex comprising the formula selected from Formula I, II, II or IV:

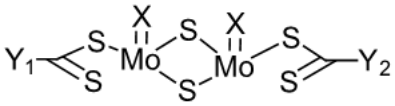


Formula I

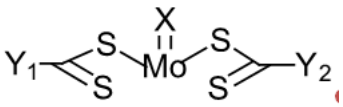


Formula II

wherein R_1, R_2, R_3, and R_4, are each a hydrocarbon group and wherein R_1, R_2, R_3, and R_4 can be the same or different; and X is oxygen or sulfur and X can be the same or different.



Formula III



Formula IV

wherein Y_1 and Y_2 are each oxygen, nitrogen or carbon-containing ligands and Y^1 and Y^2 can be the same or different, and X is each oxygen or sulfur, and X can be the same of different from each other.

21. The composition of claim 20, wherein the composition further comprises one or more asphaltene inhibitors, paraffin inhibitors, scale inhibitors, emulsifiers, water clarifiers, dispersants, emulsion breakers, or any combination thereof.

22. The composition as in one of claims 20-21, wherein the R_1, R_2, R_3, and R_4 of formulae I and II comprise thiophosphates, phosphates and polymers thereof.

23. The composition as in one of claims 20-22, wherein the Y^1 and Y^2 of formulae III and IV comprise thiocarbamates and polymers thereof.

24. The composition as in one of claims 20-23, wherein the at least one molybdenum-containing complex comprises a molybdenum dithiocarbamate, dithiophosphate, polymers thereof and combinations thereof.

25. The composition of claim 20, wherein the at least one molybdenum-containing complex comprises a molybdenum dithiocarbamate and wherein the molybdenum dithiocarbamate comprises an alkyldithiocarbamate.

26. The composition of claim 25, wherein the alkyldithiocarbamate comprises an ethyl hexyl dithiocarbamate.

27. The composition of claim 20, wherein the at least one molybdenum-containing complex comprises a molybdenum dithiophosphate and wherein the molybdenum dithiophosphate comprises an alkyldithiophosphate.

28. The composition as in one of claims 20-27, wherein the molybdenum-containing complex is 1 ppm to 3000 ppm of the composition.