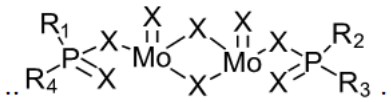
What is claimed is:

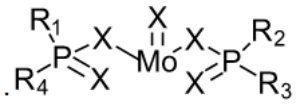
1. A method of inhibiting deposition of a foulant comprising:

a) prior to introducing a hydrocarbon feedstock comprising one or more foulants into process equipment comprising a surface, pre-passivating the process equipment to provide treated, pre-passivated process equipment, said pre-passivating comprising contacting the surface with a passivating composition to pre-passivate the surface, said composition 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~~ a formula selected from the group consisting of Formula I, II, III, or IV,

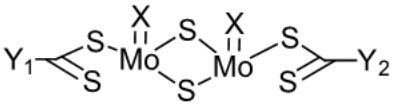


Formula I

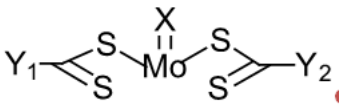


Formula II

~~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~~wherein each of R_1, R_2, R_3, and R_4, is a hydrocarbon group and wherein R_1, R_2, R_3, and R_4 can be the same or different; each X is oxygen or sulfur and each X can be the same or different; and wherein each of Y_1 and Y_2 is oxygen, nitrogen or carbon-containing ligands and Y_1 and Y_2 can be the same or different

b) using the treated, pre-passivated process equipment to process a hydrocarbon feedstock comprising a foulant such that the hydrocarbon feedstock contacts the pre-passivated surface; and

c) introducing a fouling inhibiting composition into the hydrocarbon feedstock, wherein the fouling inhibiting composition comprises at least one molybdenum-containing complex having the formula selected from the group consisting of Formula I, II, III, and IV as defined above.

~~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.~~2. The method as in ~~any one of~~ claim~~s~~ 1~~-7~~, wherein the process equipment ~~iron alloy~~ comprises carbon steel, stainless steel, or a nickel-chromium-iron alloy.

~~9.~~3. The method as in any one of the preceding claims~~ 1-8~~, wherein the foulant comprises ~~one or more of~~ coke~~, sludge, a corrosion product, a polymer, and catalyst fines~~.

4. The method as in any one of the preceding claims, wherein the foulant comprises a corrosion product.

5. The method as in any one of the preceding claims, wherein the foulant comprises catalyst fines.

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

~~11.~~6. The method as in any one of the preceding claims ~~1-10~~, wherein the molybdenum-containing complex is ~~added~~ introduced to the hydrocarbon feedstock in step c) in an amount in the range ~~fluid in an amount~~ from 1 ppm to 3000 ppm of the hydrocarbon feedstock~~fluid~~ volume.

~~12.~~7. The method as in any one of the preceding claims ~~1-11~~, wherein the ~~fluid~~ fouling inhibiting composition further comprises one or more asphaltene inhibitors, paraffin inhibitors, scale inhibitors, emulsifiers, water clarifiers, dispersants, emulsion breakers, or any combination thereof.

~~13.~~8. The method as in any one of the preceding claims ~~1-12~~, wherein the at least one molybdenum-containing complex has formula I and/or II~~R_1, R_2, R_3, and R_4 of formulae I and II comprise thiophosphates, phosphates and polymers thereof~~.

~~14.~~9. The method as in any one of the preceding claims ~~1-12~~, wherein the at least one molybdenum-containing complex has formula III and/or IV~~Y~~ Y^1 ~~and~~ Y^2 ~~of formulae III and IV comprise thiocarbamates and polymers thereof~~.

~~15.~~10. The method as in any one of the preceding claims ~~1-14~~, wherein the at least one molybdenum-containing complex comprises a molybdenum dithiocarbamate, a molybdenum dithiophosphate, or ~~polymers thereof and~~ combinations thereof.

~~16.~~11. 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.~~12. The method of claim ~~16~~11, wherein the molybdenum alkyldithiocarbamate comprises an ethyl hexyl dithiocarbamate.

~~18.~~13. 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.~~14. The method as in any one of the preceding claims ~~1-18~~, wherein the introducing the molybdenum-containing complex to the hydrocarbon feedstock in step c) 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.

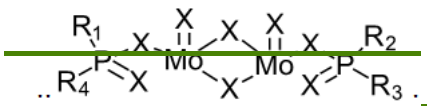
15. A method of inhibiting fouling in a process containment, comprising:

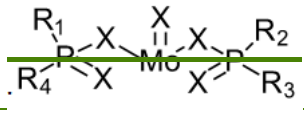
a) prior to introducing a hydrocarbon fluid source comprising one or more foulants into the process containment, pre-passivating a metal surface of the process containment to provide a treated, pre-passivated process containment surface, said pre-passivating comprising contacting the metal surface with a fouling inhibiting, passivating composition comprising at least one molybdenum-containing complex;

b) contacting the pre-passivated process containment surface with the hydrocarbon fluid source comprising the one or more foulants; and

c) providing a fouling inhibiting composition in the hydrocarbon fluid source, wherein the corrosion inhibiting composition comprises at least one molybdenum-containing complex.

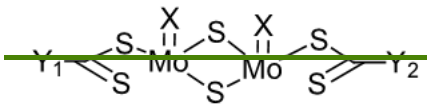
~~20. A composition comprising at least one molybdenum-containing complex to inhibit deposition of a foulant in contact with process equipment subject to fouling, the at least one molybdenum-containing complex comprising the formula selected from Formula I, II, II or IV:~~

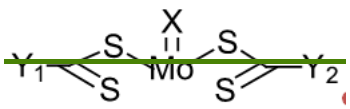




~~Formula I~~ ~~Formula II~~

~~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.