Claims:

1. An additive composition for a marine fuel or a heating oil comprising:
a. a colloidal dispersion of catalytic metal particles, the particles comprising:
i. a metal compound core, the metal compound comprising at least one of iron, ruthenium, osmium, and cerium; and
ii. a polyalkenyl-substituted carboxylic acid or anhydride,;
b. a neutral or overbased alkaline earth metal detergent comprising calcium and/or strontium; and
c. a carrier fluid miscible with a marine fuel oil, a heavy fuel oil, a marine distillate fuel and/or a residual fuel oil.

2. An additive composition according to Claim 1 wherein the metal compound is a compound of iron, a compound of cerium or mixtures thereof, alternatively wherein the metal compound is iron oxide, cerium oxide or mixtures thereof and further alternatively iron (III) oxide and/or iron (II,III) oxide.

3. An additive composition according to any preceding claim, wherein the catalytic metal particles have a particle size of from 1nm to 1µm, from 2nm to 500nm, from 3nm to 100nm, from 3nm to 50nm or from 5nm to 15nm.

4. An additive composition according to any preceding claim, wherein the overbased alkaline earth metal detergent forms a second colloidal dispersion in the additive composition having a particle size of from 1nm to 1µm, from 2nm to 500nm, from 3nm to 100nm, from 3nm to 50nm or from 5nm to 15nm.

5. An additive composition according to any preceding claim, wherein the polyalkenyl-substituted carboxylic acid or anhydrideis a di-, tri-, or polycarboxylic acid, alternatively wherein the polyalkenyl-substituted carboxylic acid or anhydride is a di- or tricarboxylic acid, further alternatively wherein the polyalkenyl-substituted carboxylic acid or anhydride is a di-carboxylic acid.

6. An additive composition according to Claim 5 wherein each carboxylic acid group is separated from another carboxylic acid group by no more than three or by no more than two carbon atoms within the polyalkenyl-substituted carboxylic acid.

7. An additive composition according to any preceding claim, wherein the polyalkenyl moiety has a number average molecular weight of from 100 to 4000, from 200 to 2250, from 250 to 2000, from 500 to 1500, from 750 to 1250 or from 850 to 1100.

8. An additive composition according to any preceding claim wherein the polyalkenyl-substituted carboxylic acid or anhydride is poly(isobutenyl) succinic acid or poly(isobutenyl) succinic anhydride.

9. An additive composition according to any of Claims 1 to 4 wherein the polyalkenyl-substituted carboxylic acid or anhydride is a fatty acid, optionally wherein the fatty acid is monounsaturated or saturated, further optionally wherein the fatty acid is selected from capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, arachidic acid, behenic acid, lignoceric acid, caproleic acid, lauroleic acid, myristoleic acid, palmitoleic acid, oleic acid, elaidic acid, vaccenic acid, gadoleic acid, erucic acid, brassidic acid, nervonic acid and again further optionally wherein the fatty acid is oleic acid.

10. An additive composition according to any preceding claim wherein the alkaline earth metal detergent:

a. is overbased;
b. comprises calcium; and/or
c. comprises hydroxybenzoate, salicylate or sulphonate.

11. An additive composition according to any preceding claim wherein the alkaline earth metal detergent comprises calcium salicylate, alternatively wherein the alkaline earth metal detergent is an overbased calcium salicylate detergent, and also alternatively wherein the alkaline earth metal detergent is calcium salicylate overbased with calcium hydroxide / calcium carbonate.

12. An additive composition according to any preceding claim wherein the alkaline earth metal detergent has a degree of carbonation of from 50% to 95%, typically from 60% to 90%, also typically from 65% to 90% or from 65% to 85% and further typically from 70% to 80%.

13. An additive composition according to any preceding claim wherein the alkaline earth metal detergent has a basicity index of from 0.1 to 10, from 0.5 to 9, from 1 to 8.5, from 1.5 to 7, from 2 to 5, from 2.5 to 3.5 or of about 3.

14. An additive composition according to any preceding claim, wherein the ratio of the colloidal dispersion of catalytic metal particles by mass of catalytic metal to neutral or overbased alkaline earth metal detergent by mass of alkaline earth metal, is in the range of from 1000:1 to 1:1000, from 100:1 to 1:100, from 10:1 to 1:10, from 5:1 to 1:5, from 3:1 to 1:3, from 2:1 to 1:2, from 1:1 to 1:2, from less than 1:1 to 1:2, from 1:1.1 to 1:2, from 1:1.4 to 1:1.6 or is about 1:1.5, or wherein the molar ratio of catalytic metal to alkaline earth metal is in a range of from 1000:1 to 1:1000, from 100:1 to 1:100, from 10:1 to 1:15, from 5:1 to 1:10, from 3:1 to 1:5, from 2:1 to 1:4, from 1:1 to 1:3, from less than 1:1 to 1:3, from 1:1.5 to 1:2.5, from 1:1.8 to 1:2.2 or is about 1:2.

15. A marine fuel composition or heating oil composition comprising an additive composition according to any preceding claim and a marine fuel oil, a heavy fuel oil, a marine distillate fuel and/or a residual fuel oil.

16. The marine fuel composition or heating oil composition of Claim 15 wherein the marine fuel composition, the marine fuel oil, the heavy fuel oil, the marine distillate fuel and/or the residual fuel oil:

i. is defined according to, or meets, at least one of the marine fuel specifications for petroleum products of ISO 8217:2017, ISO 8217:2012, ISO 8217:2010 and/or ISO 8217:2005;
ii. has a sulfur content of no greater than 5 mass %, 2 mass %, 1 mass %, 0.5, mass % or 0.1 mass % of atoms of sulfur;

iii. is at least in part, or optionally in the case of the marine fuel oil entirely, produced from crude oil by means of fractional distillation;
iv. contains one or more further additives, optionally selected from detergents, dispersants, stabilisers, demulsifiers, emulsion preventatives, corrosion inhibitors, cold flow improvers, pour point depressants and CFPP modifiers, viscosity improvers, lubricity improvers and/or combustion improvers; or
v. any combination of i. to iv.

17. A marine fuel composition or heating oil composition according to any of Claims 15 to 16 comprising the additive composition in an amount of:
a. from 1 ppm to 1000 ppm, such as 5 ppm to 500 ppm, 10 ppm to 100 ppm, 25 ppm to 70 ppm or 40 ppm to 60ppm by mass of metal;
b. from 1 ppm to 1000 ppm, such as 2 ppm to 500 ppm, 5 ppm to 200 ppm, 10 ppm to 100 ppm, 12 ppm to 50 ppm or 15 ppm to 30 ppm by mass of catalytic metal, preferably iron; or
c. from 1 ppm to 1000 ppm, such as 2 ppm to 500 ppm, 5 ppm to 200 ppm, 10 ppm to 100 ppm, 15 ppm to 60 ppm or 20 ppm to 40 ppm by mass of alkaline earth metal, preferably calcium.

18. A method of improving the fuel economy, combustion characteristics and/or emissions performance of a marine fuel or heating oil comprising the step of combining the marine fuel or heating oil with an additive composition according to any of Claims 1 to 14.

19. A method of producing a marine fuel or heating oil composition comprising the step of combining a marine fuel oil, a heavy fuel oil, a marine distillate fuel and/or a residual fuel oil with an additive composition according to any of Claims 1 to 14.

20. Use of an additive composition according to any of Claims 1 to 14 or a combination of additives comprising (A) a colloidal dispersion of catalytic metal particles, as defined in any one of claims 1 to 14, the particles comprising: (i) a metal compound core, the metal compound comprising at least one of iron, ruthenium, osmium, and cerium; and (ii) a polyalkenyl-substituted carboxylic acid or anhydride as defined in any of claims 1 to 14; and, (B) a neutral or overbased alkaline earth metal detergent comprising

calcium and/or strontium, as defined in any of claims 1 to 14; to improve the fuel economy, combustion characteristics and/or emissions performance of a marine fuel or heating oil.