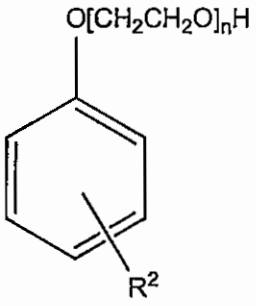
CLAIMS

1. An overbased sulphurised calcium phenate detergent additive made from an alkylphenol and comprising a colloidal system in which a calcium carbonate core is stabilized by a sulphurised phenate surfactant in a liquid medium, where phenolic functional groups in unreacted alkylphenol starting material are oxyalkylated to provide oxyalkyl groups of formula
– $(R^1O)_n$ - , where R^1 is ethylene, propylene or butylene and n is independently from 1 to 10.

2. The detergent additive of claim 1 where phenolic functional groups in the sulphurised phenate surfactant are oxyalkylated to provide oxyalkyl groups of formula – $(R^1O)_n$ - , where R^1 is ethylene, propylene or butylene and n is independently from 1 to 10.

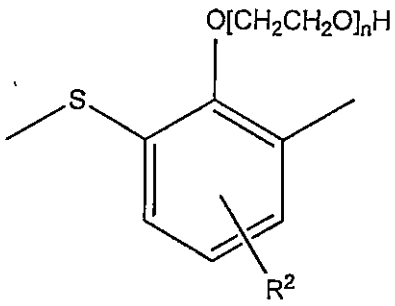
3. The detergent additive of claim 1 or 2 where more than 25 such as more than 50, mole % of the phenolic functional groups are mono-oxyalkylated.

4. The detergent additive of any of claims 1 to 3 where the oxyalkylated unreacted phenol has the formula



where R^2 is a hydrocarbyl group having 9-100, preferably 9-70, most preferably 9-50, carbon atoms, and n is independently from 1 to 10.

5. The detergent additive of any of claims 1 to 4 where the oxyalkylated sulphurised phenate surfactant has repeating units of the formula



where R^2 is a hydrocarbyl group having 9-100, preferably 9-70, most preferably 9-50, carbon atoms, and n is independently from 1 to 10.

6. The detergent of claim 4 or claim 5 where R^2 is a branched chain para-substituent.

7. The detergent of claim 6 where the alkylphenol is tetrapropenylphenol.

8. The detergent of claim 4 or claim 5 where R^2 is a straight-chain meta-substituent.

9. The detergent of claim 8 where the alkylphenol is distilled, hydrogenated cashew nut shell liquid.

10. The detergent of any of claims 1 to 9 where more than 30, such as more than 40, such as more than 50, such as more than 60, such as more than 70, such as more than 80, such as more than 90, such as more than 95, mole % of the phenolic functional groups in unreacted alkylphenol starting material are oxyalkylated.

11. The detergent of any of claims 1 to 10 including less than 5, such as less than 1, such as less than 0.5, such as less than 0.1, mole % of unreacted alkylphenol starting material.

12. The detergent of any claims 1 to 11 in the form of a complex/hybrid detergent prepared from a mixture of more than one metal surfactant where at least one

of the surfactants is a phenate and at least one of the surfactants is not a phenate.

13. A method of making a detergent of any of claims 1 to 12 comprising reacting an overbased sulphurised calcium phenate with ethylene carbonate, propylene carbonate or butylene carbonate; preferably, and if necessary, the reaction taking place after any water present in the overbased sulphurised calcium phenate has been removed.

14. An overbased calcium phenate detergent obtainable by the method of claim 13.

15. A lubricating oil composition comprising or made by mixing:

(A) an oil of lubricating viscosity in a major amount; and

(B) as an additive component, in a minor amount, a detergent as claimed in any of claims 1 to 12 and 14.

16. The composition of claim 15 further comprising one or more additive components, different from (B), selected from one or more ashless dispersants, detergents, corrosion inhibitors, antioxidants, pour point depressants, antiwear agents, friction modifiers, demulsifiers, antifoaming agents and viscosity modifiers.

17. A method of lubricating surfaces of an internal combustion engine during its operation which comprises

(iv) providing a lubricating oil composition of claim 15 or claim 16 to the crankcase of the internal combustion engine;

(v) providing a hydrocarbon fuel in the combustion chamber of the engine; and

(vi) combusting the fuel in the combustion chamber.

CLAIMS

1. An overbased sulphurised calcium phenate detergent additive made from an alkylphenol and comprising a colloidal system in which a calcium carbonate core is stabilized by a sulphurised phenate surfactant in a liquid medium, where phenolic functional groups in unreacted alkylphenol starting material are oxyalkylated to provide oxyalkyl groups of formula

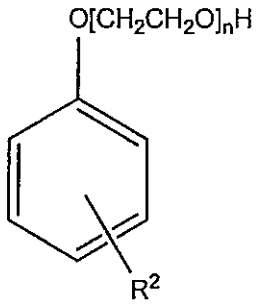
$$-(R^1O)_n-,$$

where R^1 is ethylene, propylene or butylene and n is independently from 1 to 10, by post-treatment of the overbased sulphurised calcium phenate detergent with alkylene carbonate.

2. The detergent additive of claim 1 where phenolic functional groups in the sulphurised phenate surfactant are oxyalkylated to provide oxyalkyl groups of formula $-(R^1O)_n-$, where R^1 is ethylene, propylene or butylene and n is independently from 1 to 10.

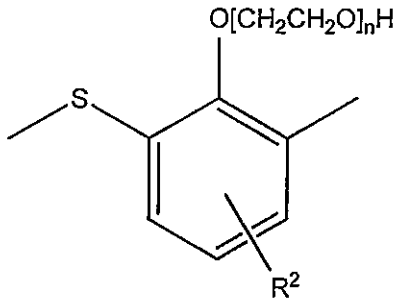
3. The detergent additive of claim 1 or 2 where more than 25 such as more than 50, mole % of the phenolic functional groups are mono-oxyalkylated.

4. The detergent additive of any of claims 1 to 3 where the oxyalkylated unreacted phenol has the formula



where R^2 is a hydrocarbyl group having 9-100, preferably 9-70, most preferably 9-50, carbon atoms, and n is independently from 1 to 10.

5. The detergent additive of any of claims 1 to 4 where the oxyalkylated sulphurised phenate surfactant has repeating units of the formula



where R^2 is a hydrocarbyl group having 9-100, preferably 9-70, most preferably 9-50, carbon atoms, and n is independently from 1 to 10.

6. The detergent of claim 4 or claim 5 where R^2 is a branched chain para-substituent.

7. The detergent of claim 6 where the alkylphenol is tetrapropenylphenol.

8. The detergent of claim 4 or claim 5 where R^2 is a straight-chain meta-substituent.

9. The detergent of claim 8 where the alkylphenol is distilled, hydrogenated cashew nut shell liquid.

10. The detergent of any of claims 1 to 9 where more than 30, such as more than 40, such as more than 50, such as more than 60, such as more than 70, such as more than 80, such as more than 90, such as more than 95, mole % of the phenolic functional groups in unreacted alkylphenol starting material are oxyalkylated.

11. The detergent of any of claims 1 to 10 including less than 5, such as less than 1, such as less than 0.5, such as less than 0.1, mole % of unreacted alkylphenol starting material.

12. The detergent of any claims 1 to 11 in the form of a complex/hybrid detergent prepared from a mixture of more than one metal surfactant where at least one of the surfactants is a phenate and at least one of the surfactants is not a phenate.

13. A method of making a detergent of any of claims 1 to 12 comprising reacting an overbased sulphurised calcium phenate with ethylene carbonate, propylene carbonate or butylene carbonate; preferably, and if necessary, the reaction taking place after any water present in the overbased sulphurised calcium phenate has been removed.

14. A lubricating oil composition comprising or made by mixing:

(A) an oil of lubricating viscosity in a 50 mass % or more; and

(B) as an additive component, in a less than 50 mass %, a detergent as claimed in any of claims 1 to 12.

15. The composition of claim 14 further comprising one or more additive components, different from (B), selected from one or more ashless dispersants, detergents, corrosion inhibitors, antioxidants, pour point depressants, antiwear agents, friction modifiers, demulsifiers, antifoaming agents and viscosity modifiers.

16. A method of lubricating surfaces of an internal combustion engine during its operation which comprises

(iv) providing a lubricating oil composition of claim 14 or claim 15 to the crankcase of the internal combustion engine;

(v) providing a hydrocarbon fuel in the combustion chamber of the engine; and

(vi) combusting the fuel in the combustion chamber.