4152-01

What is claimed is:

1. A process for preparing a sulfurized alkaline earth metal alkylphenate, comprising:

(a) reacting

(i) an alkylphenol, wherein the alkyl group contains about 6 to about 24 carbon atoms, with:

(ii) an alkaline earth metal hydroxide or an alkaline earth metal oxide in an amount of about 0.4 to about 10 moles per mole of alkylphenol charged to the reaction; and

(iii) a sulfur source in an amount to provide about 0.8 to about 3 moles sulfur (as S) per mole of alkylphenol charged to the reaction; in the presence of

(iv) an alkylene glycol or dialkylene glycol, or ether thereof, in an amount of about 0.2 to about 2 moles per mole of alkylphenol charged to the reaction; and including in the reaction mixture

(v) an oil of lubricating viscosity;

and optionally further reacting the product thereof with:

(vi) carbon dioxide;

thereby forming a sulfurized alkaline earth metal alkylphenate composition in oil;

(b) heating said alkylphenate composition to about 120 to 280°C or 200 to about 250°C;

(c) supplying steam to said alkylphenate composition;

(d) removing said steam under reduced pressure; and

(e) filtering the resulting composition to provide, as the filtrate, a sulfurized alkaline earth metal alkylphenate in oil.

2. The process of claim 1 wherein the alkylphenol comprises p-dodecylphenol.

3. The process of claim 1 or claim 2 wherein the alkaline earth metal hydroxide or oxide comprises calcium hydroxide.

4. The process of any one of claims 1 to 3 wherein the amount alkaline earth metal hydroxide or oxide is about 1 to about 5 moles per mole of alkylphenol charged to the reaction.

5. The process of any one of claims 1 to 4 wherein the optional further reacting with carbon dioxide in optional step (vi) is conducted.

6. The process of any of claims 1 through 5 wherein the amount of alkaline earth metal hydroxide or oxide is suitable to provide a product with a total base number of about 200 to about 600 on an oil free basis.

7. The process of any of claims 1 through 5 wherein the amount of the alkaline earth metal hydroxide or oxide is suitable to provide a product with a total base number of about 100 to about 350.

8. The process of any one of claims 1 to 7 wherein the sulfur source comprises elemental sulfur and the amount of sulfur is about 1 to about 2.5 moles per mole of alkylphenol charged to the reaction.

9. The process of any one of claims 1 through 8 wherein the alkylene glycol or dialkylene glycol, or ether thereof, comprises ethylene glycol or propylene glycol.

10. The process of any one of claims 1 through 9 wherein the alkylene glycol or dialkylene glycol, or ether thereof, comprises ethylene glycol.

11. The process of any one of claims 1 through 10 wherein the amount of alkylene glycol is about 1.0 to about 1.5 moles per mole of alkylphenol charged to the reaction.

12. The process of any one of claim 1 through 11 wherein the oil of lubricating viscosity comprises a mineral oil.

13. The process of any one of claims 1 through 12 wherein the oil of lubricating viscosity is present at the time of removal of the steam in step (d) in an amount of about 20 to about 60 parts by weight per 100 parts by weight of alkylphenol charged to the reaction.

14. The process of any one of claims 1 through 13 wherein the optional reaction with carbon dioxide is conducted and the amount of carbon dioxide supplied is about 10 to about 50 parts by weight per 100 parts by weight of alkylphenol charged to the reaction.

15. The process of any one of claims 1 through 14 wherein the steam is supplied at superatmospheric pressure and at a temperature of about 120°C to about 250°C.

16. The process of any one of claims 1 through 15 wherein volatile materials are removed along with removal of the steam.

17. The process of any one of claims 1 through 16 wherein the steam is removed at a pressure of about 1.3 to about 53 kPa (10 to 400 mmHg).

18. The process of any one of claims 1 through 17 wherein the amount of steam is about 3 to about 36 parts by weight per 100 parts by weight of alkylphenol charged to the reaction.

19. The process of any one of claims 1 through 18 wherein the filtration employs the use of a filter aid.

20. The product prepared by the process of any of claims 1 through 19.

21. A lubricant composition comprising an oil of lubricating viscosity and the product of claim 20.

22. The lubricant composition of claim 21 further comprising at least one of a supplemental overbased detergent, a dispersant, an antioxidant, a viscosity improver, an anti-wear agent, a pour point depressant, or an extreme pressure agent.

23. A method for lubricating an internal combustion engine, comprising supplying thereto the lubricant composition of claim 21 or claim 22.

24. A method for improving the filterability of an alkaline earth metal in a process comprising (a) reacting

(i) an alkylphenol, wherein the alkyl group contains about 6 to about 24 carbon atoms, with:

(ii) an alkaline earth metal hydroxide or an alkaline earth metal oxide in an amount of about 0.4 to about 10 moles per mole of alkylphenol charged to the reaction; and

(iii) a sulfur source in an amount to provide about 0.8 to about 3 moles sulfur (as S) per mole of alkylphenol charged to the reaction; in the presence of

(iv) an alkylene glycol or dialkylene glycol, or ether thereof, in an amount of about 0.2 to about 2 moles per mole of alkylphenol charged to the reaction; and including in the reaction mixture

(v) an oil of lubricating viscosity;

and optionally further reacting the product thereof with:

(vi) carbon dioxide;

thereby forming a sulfurized alkaline earth metal alkylphenate composition in oil;

(b) heating said alkylphenate composition to about 120 to 280°C or 200 to about 250°C; said improvement comprising:

(c) supplying steam to said alkylphenate composition; and

(d) removing said steam under reduced pressure; prior to

(e) filtering the resulting composition to provide, as the filtrate, a sulfurized alkaline earth metal alkylphenate in oil.

25. The method of claim 24 wherein the filtering is accomplished by use of a filter aid and the amount of said filter aid used is less than about 3 weight percent based on the final batch yield.

26. The method of claim 25 wherein the amount of filter aid used is about 0.8 to about 2 weight percent based on the final batch yield.

27. A method for reducing the amount of monomeric alkylphenol in the product of a process comprising (a) reacting

(i) an alkylphenol, wherein the alkyl group contains about 6 to about 24 carbon atoms, with:

(ii) an alkaline earth metal hydroxide or an alkaline earth metal oxide in an amount of about 0.4 to about 10 moles per mole of alkylphenol charged to the reaction; and

(iii) a sulfur source in an amount to provide about 0.8 to about 3 moles sulfur (as S) per mole of alkylphenol charged to the reaction; in the presence of

(iv) an alkylene glycol or dialkylene glycol, or ether thereof, in an amount of about 0.2 to about 2 moles per mole of alkylphenol charged to the reaction; and including in the reaction mixture

(v) an oil of lubricating viscosity;

and optionally further reacting the product thereof with:

(vi) carbon dioxide;

thereby forming a sulfurized alkaline earth metal alkylphenate composition in oil;

(b) heating said alkylphenate composition to about 120 to 280°C or 200 to about 250°C; said reduction arising from:

(c) supplying steam to said alkylphenate composition; and

(d) removing said steam under reduced pressure; prior to

(e) filtering the resulting composition to provide, as the filtrate, a sulfurized alkaline earth metal alkylphenate in oil.

The Claims defining the invention are as follows:

1. A process for preparing a sulfurized alkaline earth metal alkylphenate, comprising:

(a) reacting

(i) an alkylphenol, wherein the alkyl group contains 6 to 24 carbon atoms, with:

(ii) an alkaline earth metal hydroxide or an alkaline earth metal oxide in an amount of 0.4 to 10 moles per mole of alkylphenol charged to the reaction; and

(iii) a sulfur source in an amount to provide 0.8 to 3 moles sulfur (as S) per mole of alkylphenol charged to the reaction; in the presence of

(iv) an alkylene glycol or dialkylene glycol, or ether thereof, in an amount of 0.2 to 2 moles per mole of alkylphenol charged to the reaction; and including in the reaction mixture

(v) an oil of lubricating viscosity;

and optionally further reacting the product thereof with:

(vi) carbon dioxide;

thereby forming a sulfurized alkaline earth metal alkylphenate composition in oil;

(b) heating said alkylphenate composition to 120 to 280°C or 200 to 250°C;

(c) supplying steam to said alkylphenate composition;

(d) removing said steam under reduced pressure; and

(e) filtering the resulting composition to provide, as the filtrate, a sulfurized alkaline earth metal alkylphenate in oil.

2. The process of claim 1, wherein the alkylphenol comprises p-dodecylphenol.

3. The process of claim 1 or claim 2, wherein the amount alkaline earth metal hydroxide or oxide is 1 to 5 moles per mole of alkylphenol charged to the reaction.

4. The process of any one of claims 1 to 3, wherein the amount of alkaline earth metal hydroxide or oxide is suitable to provide a product with a total base number of 200 to 600 or 100 to 350 on an oil free basis.

5. The process of any one of claims 1 to 4, wherein the alkylene glycol or dialkylene glycol, or ether thereof, comprises ethylene glycol or propylene glycol.

6. The process of any one of claims 1 to 5, wherein the oil of lubricating viscosity is present at the time of removal of the steam in step (d) in an amount of 20 to 60 parts by weight per 100 parts by weight of alkylphenol charged to the reaction.

7. The process of any one of claims 1 to 6, wherein the steam is supplied at superatmospheric pressure and at a temperature of 120°C to 250°C.

8. The process of any one of claims 1 to 7, wherein volatile materials are removed along with removal of the steam.

9. The process of any one of claims 1 to 8, wherein the amount of steam is 3 to 36 parts by weight per 100 parts by weight of alkylphenol charged to the reaction.

10. A product prepared by the process of any one of claims 1 to 9.

11. A lubricant composition comprising an oil of lubricating viscosity and the product of claim 10.

12. A method for lubricating an internal combustion engine, comprising supplying thereto the lubricant composition of claim 11.

13. A method for improving the filterability of an alkaline earth metal in a process comprising:

(a) reacting

(i) an alkylphenol, wherein the alkyl group contains 6 to 24 carbon atoms, with:

(ii) an alkaline earth metal hydroxide or an alkaline earth metal oxide in an amount of 0.4 to 10 moles per mole of alkylphenol charged to the reaction; and

(iii) a sulfur source in an amount to provide 0.8 to 3 moles sulfur (as S) per mole of alkylphenol charged to the reaction; in the presence of

(iv) an alkylene glycol or dialkylene glycol, or ether thereof, in an amount of 0.2 to 2 moles per mole of alkylphenol charged to the reaction; and including in the reaction mixture

(v) an oil of lubricating viscosity;

and optionally further reacting the product thereof with:

(vi) carbon dioxide;

thereby forming a sulfurized alkaline earth metal alkylphenate composition in oil;

(b) heating said alkylphenate composition to 120 to 280°C or 200 to 250°C;

said improvement comprising:

(c) supplying steam to said alkylphenate composition; and

(d) removing said steam under reduced pressure; prior to

(e) filtering the resulting composition to provide, as the filtrate, a sulfurized alkaline earth metal alkylphenate in oil.

14. The method of claim 13, wherein the filtering is accomplished by use of a filter aid and the amount of said filter aid used is less than 3 weight percent based on the final batch yield.

15. A method for reducing the amount of monomeric alkylphenol in the product of a process comprising:

(a) reacting

(i) an alkylphenol, wherein the alkyl group contains 6 to 24 carbon atoms, with:

(ii) an alkaline earth metal hydroxide or an alkaline earth metal oxide in an amount of 0.4 to 10 moles per mole of alkylphenol charged to the reaction; and

(iii) a sulfur source in an amount to provide 0.8 to 3 moles sulfur (as S) per mole of alkylphenol charged to the reaction; in the presence of

(iv) an alkylene glycol or dialkylene glycol, or ether thereof, in an amount of 0.2 to 2 moles per mole of alkylphenol charged to the reaction; and including in the reaction mixture

(v) an oil of lubricating viscosity;

and optionally further reacting the product thereof with:

(vi) carbon dioxide;

thereby forming a sulfurized alkaline earth metal alkylphenate composition in oil;

(b) heating said alkylphenate composition to 120 to 280°C or 200 to 250°C;

said reduction arising from:

(c) supplying steam to said alkylphenate composition; and

(d) removing said steam under reduced pressure; prior to

(e) filtering the resulting composition to provide, as the filtrate, a sulfurized alkaline earth metal alkylphenate in oil.