Yasushi, JP2005320441 teaches the use of a mixed borate ester of bis-ethoxylated alkyl amides and glycerol monoesters in low sulfur formulations as antiwear additives.

None of the lubricants previously described address the problem of friction modification in a diesel engine oil with a mixed borate ester incorporating an hydrocarbyl polyol having at least three hydroxyl groups.

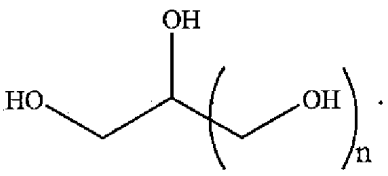
SUMMARY OF THE INVENTION

In one aspect, there is provided a lubricating oil additive composition comprising a reaction product obtained by reacting

(a) a nitrogen-containing reactant, wherein the nitrogen-containing reactant comprises an alkyl dialkanolamide, an alkyl alkoxylated alkanolamide, an alkyl alkanolamine, an alkyl alkoxylated alkanolamine or mixtures thereof, and wherein the nitrogen-containing reactant contains less than 10 mass percent of glycerol alkyl ester, with

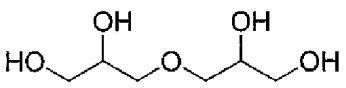
(b) a source of boron, and

(c) the reaction product obtained from step (b) with a hydrocarbyl polyol, having at least three hydroxyl groups having the structure of Formula III, IV or V:



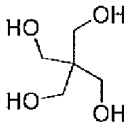
(III)

wherein n is 1 or 2;



diglycerol

(IV); or



pentaerythritol (V).

In one aspect, there is provided a lubricating oil composition comprising

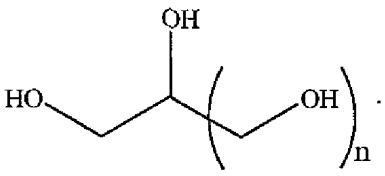
A. major amount of an oil of lubricating viscosity and

B. a lubricating oil additive composition comprising a reaction product obtained by reacting

(i) a nitrogen-containing reactant, wherein the nitrogen-containing reactant comprises alkyl dialkanolamide, an alkyl alkoxylated alkanolamide, an alkyl alkanolamine, an alkyl alkoxylated alkanolamine or mixtures thereof, and wherein the nitrogen-containing reactant contains less than 10 mass percent of glycerol alkyl ester, with

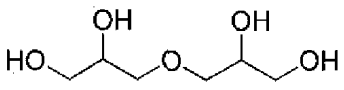
(ii) a source of boron, and

(iii) the reaction product obtained from step (ii) with a hydrocarbyl polyol, having at least three hydroxyl groups having the structure of Formula III, IV or V:

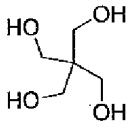


(III)

wherein n is 1 or 2;



diglycerol (IV); or



pentaerythritol (V).

In one aspect, there is provided a method for reducing friction in an internal combustion engine comprising lubricating said engine with a lubricating oil composition comprising the lubricating oil composition as described herein.

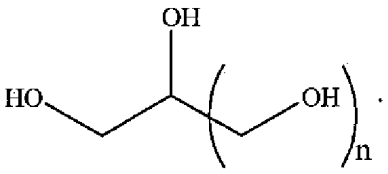
In one aspect, there is provided a lubricating oil additive concentrate comprising from 90 wt. % to 10 wt. % of an organic liquid diluent and from 10 wt. % to 90 wt. % of the lubricating oil additive composition as described herein.

In one aspect, there is provided a method of preparing a lubricating oil additive composition comprising reacting

(a) a nitrogen-containing reactant, wherein the nitrogen-containing reactant comprises an alkyl alkanolamide, an alkyl alkoxylated alkanolamide, an alkyl alkanolamine, an alkyl alkoxylated alkanolamine or mixtures thereof, and wherein the nitrogen-containing reactant contains less than 10 mass percent of glycerol alkyl ester, with

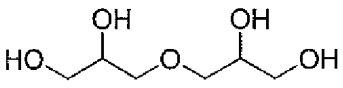
(b) a source of boron, and

(c) the reaction product obtained from step (b) with a hydrocarbyl polyol, having at least three hydroxyl groups having the structure of Formula III, IV or V:



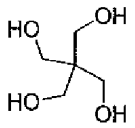
(III)

wherein n is 1 or 2;



diglycerol

(IV); or



pentaerythritol

(V).

An embodiment of the present invention is directed to a lubricating oil additive composition comprising the reaction product of a (a) nitrogen-containing reactant, wherein the nitrogen-containing reactant comprises an alkyl alkanolamide, an alkyl alkoxylated alkanolamide, an alkyl alkanolamine, an alkyl alkoxylated alkanolamine or mixtures thereof, and wherein the nitrogen-containing reactant contains less than 10 mass percent of glycerol alkyl ester; (b) a source of boron; and (c) a hydrocarbyl polyol, having at least three hydroxyl groups.

An embodiment of the present invention is directed to a lubricating oil composition comprising (A) major amount of an oil of lubricating viscosity and (B) a lubricating oil additive composition comprising the reaction product of (i) nitrogen-containing reactant, wherein the nitrogen-containing reactant comprises an alkyl alkanolamide, an alkyl alkoxylated alkanolamide, an alkyl alkanolamine, an alkyl alkoxylated alkanolamine or mixtures thereof, and wherein the nitrogen-containing reactant contains less than 10 mass percent of glycerol alkyl ester, (ii) a source of boron, and (iii) a hydrocarbyl polyol, having at least three hydroxyl groups.

An embodiment of the present invention is directed to a method for reducing friction in an internal combustion engine comprising lubricating said engine with a lubricating oil composition comprising the lubricating oil composition comprising (A) major amount of an oil of lubricating viscosity and (B) a lubricating oil additive composition comprising the reaction product of (i) nitrogen-containing reactant, wherein the nitrogen-containing reactant comprises an alkyl alkanolamide, an alkyl alkoxylated alkanolamide, an alkyl alkanolamine, an alkyl alkoxylated alkanolamine or mixtures thereof, and wherein the nitrogen-containing reactant contains less than 10 mass percent of glycerol alkyl ester, (ii) a source of boron, and (iii) a hydrocarbyl polyol, having at least three hydroxyl groups.

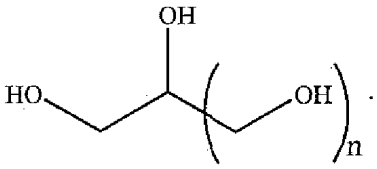
WHAT IS CLAIMED IS:

1. A lubricating oil additive composition comprising a reaction product obtained by reacting

(a) a nitrogen-containing reactant, wherein the nitrogen-containing reactant comprises an alkyl dialkanolamide, an alkyl alkoxylated alkanolamide, an alkyl alkanolamine, an alkyl alkoxylated alkanolamine or mixtures thereof, and wherein the nitrogen-containing reactant contains less than 10 mass percent of glycerol alkyl ester, with

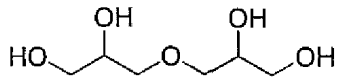
(b) a source of boron, and

(c) the reaction product obtained from step (b) with a hydrocarbyl polyol, having at least three hydroxyl groups having the structure of Formula III, IV or V:



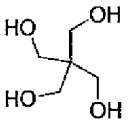
(III)

wherein n is 1 or 2;



diglycerol

(IV); or



pentaerythritol

(V).

2. The lubricating oil additive composition of Claim 1 wherein the nitrogen-containing reactant comprises a bis-ethoxy alkylamine or a bis-ethoxy alkylamide.

3. The lubricating oil additive composition of Claim 2 wherein the alkyl group in the bis-ethoxy alkyl amine comprises oleyl, dodecyl, or 2-ethylhexyl.

4. The lubricating oil additive composition of Claim 2 wherein the alkyl group in the bis-ethoxy alkyl amide is derived from coconut oil.

5. The lubricating oil additive composition of Claim 1 wherein the source of boron is boric acid.

6. The lubricating oil additive composition of Claim 1 wherein the hydrocarbyl polyol comprises glycerol or pentaerythritol.

7. A lubricating oil composition comprising

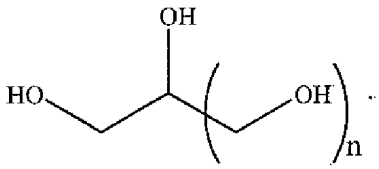
   A. major amount of an oil of lubricating viscosity and

   B. a lubricating oil additive composition comprising a reaction product obtained by reacting

      (i) a nitrogen-containing reactant, wherein the nitrogen-containing reactant comprises alkyl dialkanolamide, an alkyl alkoxylated alkanolamide, an alkyl alkanolamine, an alkyl alkoxylated alkanolamine or mixtures thereof, and wherein the nitrogen-containing reactant contains less than 10 mass percent of glycerol alkyl ester, with

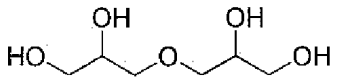
      (ii) a source of boron, and

      (iii) the reaction product obtained from step (ii) with a hydrocarbyl polyol, having at least three hydroxyl groups having the structure of Formula III, IV or V:



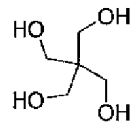
(III)

wherein n is 1 or 2;



diglycerol

(IV); or



pentaerythritol

(V).

8. The lubricating oil composition of Claim 7 wherein the nitrogen-containing reactant is a bis-ethoxy alkyl amine or a bis-ethoxy alkyl amide.

9. The lubricating oil composition of Claim 8 wherein the alkyl group in the bis-ethoxy alkyl amine comprises oleyl, dodecyl, or 2-ethylhexyl.

10. The lubricating oil composition of Claim 8 wherein the alkyl group in the bis-ethoxy alkyl amide is derived from coconut oil.

11. The lubricating oil composition of Claim 7 wherein the source of boron comprises boric acid.

12. The lubricating oil composition of Claim 7 wherein the hydrocarbyl polyol comprises glycerol or pentaerythritol.

13. A method for reducing friction in an internal combustion engine comprising lubricating said engine with a lubricating oil composition comprising the lubricating oil composition in Claim 7.

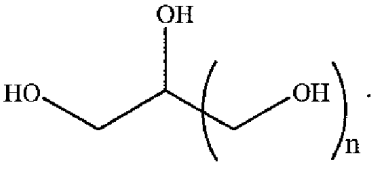
14. A lubricating oil additive concentrate comprising from 90 wt. % to 10 wt. % of an organic liquid diluent and from 10 wt. % to 90 wt. % of the lubricating oil additive composition of Claim 1.

15. A method of preparing a lubricating oil additive composition comprising reacting

(a) a nitrogen-containing reactant, wherein the nitrogen-containing reactant comprises an alkyl alkanolamide, an alkyl alkoxylated alkanolamide, an alkyl alkanolamine, an alkyl alkoxylated alkanolamine or mixtures thereof, and wherein the nitrogen-containing reactant contains less than 10 mass percent of glycerol alkyl ester, with

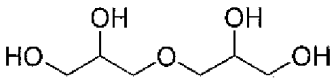
(b) a source of boron, and

(c) the reaction product obtained from step (b) with a hydrocarbyl polyol, having at least three hydroxyl groups having the structure of Formula III, IV or V:

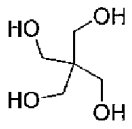


(III)

wherein n is 1 or 2;



diglycerol (IV); or



pentaerythritol (V).

16. The method of Claim 15 wherein the mole ratio of the nitrogen-containing reactant, the source of boron, and the hydrocarbyl polyol is from 1:0.2:0.2 to 1:2.5:2.5, respectively.

17. The method of Claim 15 wherein the nitrogen-containing reactant is a bis-ethoxy alkylamine or a bis-ethoxy alkylamide.

18. The method of Claim 17 wherein the alkyl group in the bis-ethoxy alkyl amine comprises oleyl, dodecyl, or 2-ethylhexyl.

19. The method of Claim 17 wherein the alkyl group in the bis-ethoxy alkyl amide is derived from coconut oil.

20. The method of Claim 15 wherein the source of boron comprises boric acid.

21. The method of Claim 15 wherein the hydrocarbyl polyol comprises glycerol or pentaerythritol.