SUMMARY OF THE INVENTION

In accordance with one aspect of the present disclosure, there is provided a Zinc-free transmission oil composition for construction machinery comprising:

(a) a major amount of an oil of lubricating viscosity,

(b) at least 0.25 wt. % of a dithiophosphorylated carboxylic acid compound, wherein the dithiophosphorylated carboxylic acid is 3-[[bis(2-methylpropoxy)phosphinothioyl]thio]-2-methyl-propanoic acid, and

(c) A succinimide dispersant derived from a polyisobutylene group of 1200 molecular weight or less.

In another aspect, there is provided is a method for lubricating the transmission of a construction machine comprising lubricating the transmission with a Zinc-free transmission oil composition comprising:

(a) a major amount of an oil of lubricating viscosity,

(b) at least 0.25 wt. % of a dithiophosphorylated carboxylic acid compound, wherein the dithiophosphorylated carboxylic acid is 3-[[bis(2-methylpropoxy)phosphinothioyl]thio]-2-methyl-propanoic acid, and

(c) a succinimide dispersant derived from a polyisobutylene group of 1200 molecular weight or less.

Definitions:

The following terms will be used throughout the specification and will have the following meanings unless otherwise indicated.

The term "a major amount" of a base oil refers to where the amount of the base oil is at least 40 wt. % of the lubricating oil composition. In some embodiments, "a major amount" of a base oil refers to an amount of the base oil more than 50 wt.%, more than 60 wt.%, more than 70 wt.%, more than 80 wt.%, or more than 90 wt.% of the lubricating oil composition.

WHAT IS CLAIMED IS:

1. A Zinc-free transmission oil composition for construction machinery comprising:

(a) a major amount of an oil of lubricating viscosity,

(b) at least 0.25 wt. % of a dithiophosphorylated carboxylic acid compound, wherein the dithiophosphorylated carboxylic acid is 3-[[bis(2-methylpropoxy)phosphinothioyl]thio]-2-methyl-propanoic acid, and

(c) a succinimide dispersant derived from a polyisobutylene group of 1200 molecular weight or less.

2. The transmission oil composition of claim 1 wherein the dithiophosphorylated carboxylic acid compound is present at 0.25 to 2 wt. %.

3. The transmission oil composition of claim 1 wherein the dithiophosphorylated carboxylic acid compound is present at 0.25 to 1 wt. %.

4. The transmission oil composition of claim 1 wherein the succinimide dispersant is derived from a polyisobutylene group of from 450 to 1200 molecular weight.

5. The transmission oil composition of claim 1 wherein the succinimide dispersant is derived from a polyisobutylene group of from 750 to 1000 molecular weight..

6. The transmission oil composition of claim 1 further comprising a detergent selected from sulfonate, phenate, or a mixture thereof.

7. The transmission oil composition of claim 1 further comprising a friction modifier.

8. The transmission oil composition of claim 7 wherein the friction modifier is a fatty acid amide.

9. The transmission oil composition of claim 1 wherein the succinimide dispersant is present from 1 to 20 wt.% in the transmission oil composition.

10. A method for lubricating the transmission of a construction machine comprising lubricating the transmission with a Zinc-free transmission oil composition comprising:

(a) a major amount of an oil of lubricating viscosity,

(b) at least 0.25 wt. % of a dithiophosphorylated carboxylic acid compound, wherein the dithiophosphorylated carboxylic acid is 3-[[bis(2-methylpropoxy)phosphinothioyl]thio]-2-methyl-propanoic acid, and

(c) a succinimide dispersant derived from a polyisobutylene group of 1200 molecular weight or less.

11. The method of claim 10 wherein the dithiophosphorylated carboxylic acid compound is present at 0.25 to 2 wt. %.

12. The method of claim 10 wherein the dithiophosphorylated carboxylic acid compound is present at 0.25 to 1 wt. %.

13. The method of claim 10 wherein the succinimide dispersant is derived from a polyisobutylene group of 450-1200 molecular weight.

14. The method of claim 10 wherein the succinimide dispersant is derived from a polyisobutylene group of 750 to 1000 molecular weight.

15. The method of claim 10 further comprising a detergent selected from sulfonate, phenate, or a mixture thereof.

16. The method of claim 10 further comprising a friction modifier

17. The method of claim 10 wherein the friction modifier is a fatty acid amide.