Many molybdenum technologies that appear in the patent literature deliver high levels of color when used even at moderate levels in crankcase oils. A non-discoloring molybdenum source is important because highly colored oils imply to the end consumer that the oil is "used" and therefore not capable of delivering the maximum amount of protection to the engine. When these highly colored molybdenum sources are used at low levels, e.g. 100-150 ppm delivered molybdenum as is typically required for oxidation, deposit and wear control, discoloration is not substantial but may still be visible. However, when these highly colored molybdenum compounds are used at high levels, e.g. 400-1000 ppm (or higher) delivered molybdenum as is generally required for friction modification, discoloration is often significant. Traditionally, the color of fully formulated crankcase oils has been determined using the ASTM D 6045 color scale. The amount of acceptable finished lubricant darkening depends on the customer and application. While there are no set standards for the amount of discoloration or darkening that is allowed; certain customers may find it difficult to market and sell such dark crankcase oils. Moreover, many of the molybdenum technologies that appear in the patent literature contain sulfur which can further lead to discoloration. Some forms of sulfur can also be detrimental and corrosive to copper, however sulfur incorporation can have beneficial properties such as antiwear functions of serve as friction modifiers when employed in finished lubricants. Accordingly one aspect of the present invention is directed to the preparation of a sulfurized molybdenum complex having improved color and sulfur functionality while treating the complex with compounds to mitigate the active sulfur detriments.

SUMMARY OF THE DISCLOSURE~~INVENTION~~

The disclosure~~invention~~ is directed to oil soluble additive compositions and lubricating oil compositions derived from a process for preparing a sulfurized oil soluble molybdenum complex having reduced active sulfur comprising: reacting an acidic molybdenum compound with an amide derived from a carboxylic acid component an polyamine component in a ratio from 2:1 to 1:1; thereafter sulfurizing to provide a sulfurized oil soluble molybdenum which is subsequently treated with at least one compound capable of reacting with the active sulfur of step b).

Accordingly, an aspect of the present disclosure~~invention~~ is directed to a process for preparing a sulfurized oil soluble molybdenum complex having reduced active sulfur comprising:

a. reacting an acidic molybdenum compound with a basic nitrogen derived from an amide reaction product of a C_{4-40} aliphatic carboxylic acid component and a polyamine having 2 to 10 nitrogen atoms; wherein the charge mole ratio of the carboxylic acid component to the polyamine component is about 2:1 to 1:1:

b. reacting the product of step a) with a sulfur-containing compound in amounts to provide a sulfurized oil soluble molybdenum complex having 1 to 4 moles of sulfur per mole of molybdenum and active sulfur; and

c. reacting the product of step b) with at least one compound capable of reacting with the active sulfur of step b) to thereby reduce the active sulfur in the product of step b).

In one aspect, there is provided a process for preparing a sulfurized oil soluble molybdenum complex having reduced active sulfur comprising:

a. reacting an acidic molybdenum compound with a basic nitrogen derived from an amide reaction product of a C_{4-40} aliphatic carboxylic acid component and a polyamine having 2 to 10 nitrogen atoms; wherein the charge mole ratio of the carboxylic acid component to the polyamine component is 2:1 to 1:1;

b. reacting the product of step a) with a sulfur-containing compound in amounts to provide a sulfurized oil soluble molybdenum complex having 1 to 4 moles of sulfur per mole of molybdenum and active sulfur; and

c. reacting the product of step b) with at least one compound capable of reacting with the active sulfur of step b) to thereby reduce the active sulfur in the product of step b), wherein the compound capable of reacting with the active sulfur of step b) is a basic nitrogen-containing compound.

In another aspect, there is provided a lubricating oil composition comprising an oil of lubricating viscosity and the product produced by the process as defined herein.

The charge mole ratio CMR of the carboxylic acid component to the polyamine component can influence the friction reducing properties; accordingly one aspect is directed to a CMR of about 1.7:1 to 1:1. In another aspect, the CMR is 1.7:1 to 1.3:1. In one aspect the polyamine is ethylenediamine or a polyalkylene polyamine and more preferably a polyethylene polyamine which would include tetraethylenepentamine, diethylenetriamine, and ethylenediamine. The reactants and CMR are selected so that there about 0.2 to 1, more preferably from 0.2 to 0.7, and even more preferably 0.4 to 0.7 atoms of molybdenum are present per basic nitrogen atom. In another embodiment the reactants and CMR are selected so that there about 0.2 to 1 atoms of molybdenum are present per basic nitrogen atom. The amide is conveniently prepared by the reaction product of a monocarboxylic fatty acid (particularly isostearic acid, stearic acid, lauric acid, myrstic acid and palmitic acid, and even more preferably isostearic acid and stearic acid) with the polyalkylene amine. Particularly a polyamide of isostearic and tetraethylenepentamine, diethylenetriamine, and ethylenediamine having a CMR of 1.7:1 to 1.3:1.

In one aspect the acidic molybdenum compound is molybdenum added with the addition of a promoter more preferably water employing an elemental sulfur source. This reaction for convenience is conducted with the addition of a diluent.

An aspect is directed to selecting a suitable compound which is capable of reacting with the active sulfur after completion of step b) and thereafter proceeding under suitable reaction conditions so that the resulting reaction product has a reduced active sulfur. Suitable compounds capable of reacting with the active sulfur in step c) are selected from at least one halogen-free inorganic salt; at least one unsaturated compound; at least one hydrocarbyl phosphite; at least one basic nitrogen-containing compound; and mixtures thereof. In one aspect the basic nitrogen-containing compound is selected from the group consisting of at least one amine or amide. In a further aspect, the at least one basic nitrogen-containing compound is an amide selected from the reaction product of at least one fatty acid with at least one polyalkylene polyamine. In one aspect the halogen fee inorganic salt is an alkali metal salt, more particularly a sodium sulfide aqueous solution which after reaction is separated from the organic phase. In one aspect at least one unsaturated compound is an is a terminal monoolefinic aliphatic hydrocarbon having 8 to 36 carbon atoms. In another aspect the compound capable of reacting with the active sulfur is a unsaturated fatty acid derivative selected from unsaturated fatty acid amide or unsaturated fatty acid amine having from 8 to 22 atoms in the unsaturated fatty acid; with oleyl amine being particularly preferred. In another aspect the compound capable of reacting with the active sulfur in step c) is selected from the reaction product of at least one carboxylic acid with a polyalkylene polyamine; particularly a polyamide of isostearic and tetraethylenepentamine, diethylenetriamine, and ethylenediamine; and even more particularly is directed to a polyamide of isostearic acid and diethylenetriamine. In another aspect, the same amide reaction product is used that is employed in step a) is additionally employed in step c).

Another aspect of the present disclosure~~invention~~ is directed to a lubricating composition comprising a major amount of an oil of lubricating viscosity and a minor amount of the product prepared by the process used for preparing a sulfurized oil soluble molybdenum complex having reduced active sulfur comprising:

a. reacting an acidic molybdenum compound with a basic nitrogen derived from an amide reaction product of a C_{4-40} aliphatic carboxylic acid component and a polyamine having 2 to 10 nitrogen atoms;