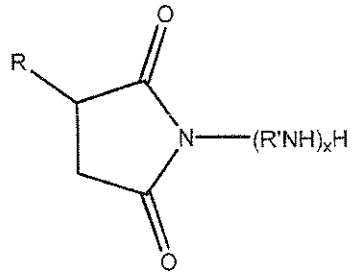
weight polyisobutenyl (950 M.W.) succinic anhydride (PIBSA) in preparing the alkenyl succinimide of polyethylene polyamine.

Molybdenum succinimide complexes are also described in U.S. Patent Application Publication No. 2009/0325833. These complexes when derived from high molecular weight alkylamines exhibit good friction, wear and oxidation inhibition. These complexes are prepared by post-treating the amine portion of the succinimide with maleic anhydride, at a charge mole ratio of maleic anhydride to succinimide of about 1:1, followed by a further post-treatment with molybdenum trioxide.

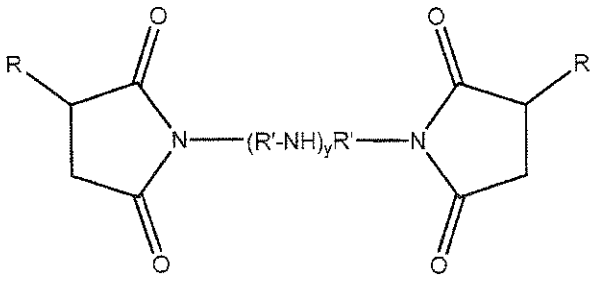
SUMMARY OF THE DISCLOSURE~~INVENTION~~

In accordance with one embodiment of the present disclosure~~invention~~, there is provided a process for preparing a molybdated succinimide complex, the process comprising:

(a) reacting an alkyl or alkenyl mono- or bis-succinimide of a polyamine of formula I or formula II or mixtures thereof:



Formula (I)



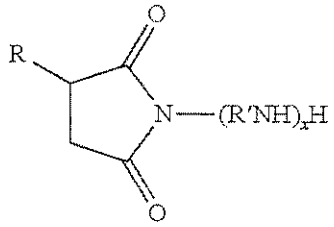
Formula (II)

wherein R is an alkyl or alkenyl group having a number average molecular weight of about 500 to about 5,000, R' is a straight or branched-chain alkylene group having 2 to 3 carbon atoms, x is 1 to 11, and y is 1 to 10, with an α,β-unsaturated mono-carboxylic acid or carboxylic acid ester, in a charge mole ratio of the α,β-unsaturated mono-carboxylic acid or carboxylic acid ester to the succinimide of formula I or formula II or mixtures thereof of greater than 1.05:1 to about 6:1, and wherein the reaction temperature is in the range of from greater than 80°C to no greater than about 150°C; and

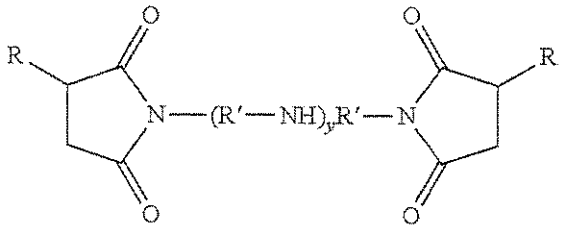
(b) reacting the succinimide product of step (a) with an acidic molybdenum compound to provide the molybdated succinimide complex, wherein the molybdated succinimide complex is a liquid at room temperature.

In one aspect, there is provided a process for preparing a molybdated succinimide complex, the process comprising: (a) reacting an alkyl or alkenyl mono- or bis-succinimide of a polyamine of formula I or formula II or mixtures thereof:

Formula (I)



Formula (II)



wherein R is an alkyl or alkenyl group having a number average molecular weight of about 500 to about 5,000, R' is a straight or branched-chain alkylene group having 2 to 3 carbon atoms, x is 2 to 11, and y is 1 to 10, with an α,β-unsaturated mono-carboxylic acid or carboxylic acid ester, in a charge mole ratio of the α,β-unsaturated mono-carboxylic acid or carboxylic acid ester to the succinimide of formula I or formula II or mixtures thereof of

greater than 1.05:1 to about 6:1, and wherein the reaction temperature is in the range of from greater than 80° C. to no greater than about 150° C.; and

(b) reacting the succinimide product of step (a) with an acidic molybdenum compound to provide the molybdated succinimide complex, wherein the molybdated succinimide complex is a liquid at room temperature.

Among other factors, the present disclosure~~invention~~ is based on the surprising discovery of an improved molybdated succinimide complex and an improved process for its preparation. It has been found that molybdenum succinimide complexes derived from high molecular weight alkyl or alkenyl succinimides where the amine portion of the molecule has been post-treated with an α,β-unsaturated mono-carboxylic acid or carboxylic acid ester results in a product that exhibits low friction and wear.

Another advantage of the present process is that the reaction of an alkyl or alkenyl succinimide of a polyamine with an α,β-unsaturated mono-carboxylic acid or carboxylic acid ester can be carried out at a temperature no greater than about 150°C.

The post-treatment with an α,β-unsaturated mono-carboxylic acid or carboxylic acid ester at no greater than about 150° Cadvantageously allows for a product which has improved friction reduction when incorporated into a lubricating oil composition and used in an internal combustion engine.

It has been further discovered that when the charge mole ratio of the α,β-unsaturated mono-carboxylic acid or carboxylic acid ester to the succinimide of formula I or formula II or mixtures thereof is from greater than 1.05:1 to about 6:1, the resulting product exhibits surprisingly improved wear performance over those that have been post-treated where the charge mole ratio of the α,β-unsaturated mono-carboxylic acid or carboxylic acid ester to the succinimide of formula I or formula II or mixtures thereof is about 1:1.