SUMMARY OF THE INVENTION

[0014a] In one aspect, there is provided a natural gas engine lubricating oil composition comprising (a) a major amount of an oil of lubricating viscosity, (b) one or more phosphorus-containing anti-wear additives, (c) one or more oil soluble overbased alkaline earth metal-containing detergents in an amount of at least 0.5 wt.% based on the total weight of the natural gas engine lubricating oil composition; and (d) one or more oil soluble neutral alkali metal-containing detergents in an amount of at least 0.5 wt.% based on the total weight of the natural gas engine lubricating oil composition, wherein the natural gas engine lubricating oil composition contains from 0.005 to 0.03 weight percent of phosphorus, based on the total weight of the natural gas engine lubricating oil composition, wherein the one or more oil soluble overbased alkaline earth metal-containing detergents comprise one or more oil soluble overbased alkaline earth metal phenates and the one or more oil soluble neutral alkali metal-containing detergents comprise one or more oil soluble neutral alkali metal sulfonates.

[0014b] In another aspect, there is provided a method for preventing or inhibiting exhaust valve seat recession in a natural gas fueled engine, the method comprising lubricating the natural gas fueled engine with the natural gas engine lubricating oil composition as mentioned above.

[0015] In accordance with one embodiment of the present disclosure, a natural gas engine lubricating oil composition is provided comprising (a) a major amount of an oil of lubricating viscosity, (b) one or more phosphorus-containing anti-wear additives, (c) one or more oil soluble overbased alkaline earth metal-containing detergents; and (d) one or more oil soluble neutral alkali metal-containing detergents, wherein the natural gas engine lubricating oil composition contains no more than about 0.03 weight percent of phosphorus, based on the total weight of the natural gas engine lubricating oil composition.

[0016] In accordance with a second embodiment of the present disclosure, a natural gas engine lubricating oil composition is provided comprising (a) a major amount of an oil of lubricating viscosity, (b) one or more phosphorus-containing anti-wear additives, (c) one or more oil soluble overbased alkaline earth metal-containing detergents: (d) one or more oil soluble neutral alkali metal-containing detergents; (e) one or more ashless dispersants, and (f) one or more antioxidants, wherein the natural gas engine lubricating oil composition contains no more than about 0.03 weight percent of phosphorus, based on the total weight of the natural gas engine lubricating oil composition.

[0017] In accordance with a third embodiment of the present disclosure, there is provided a method for preventing or inhibiting exhaust valve seat recession in a natural gas fueled engine, the method comprising lubricating the engine with a natural gas engine lubricating oil composition comprising (a) a major amount of an oil of lubricating viscosity, (b) one or more phosphorus-containing anti-wear additives, (c) one or more oil soluble overbased alkaline earth metal-containing detergents; and (d) one or more oil soluble neutral alkali metal-containing detergents, wherein the natural gas engine lubricating oil composition

contains no more than about 0.03 weight percent of phosphorus, based on the total weight of the natural gas engine lubricating oil composition.

[0018] In accordance with a fourth embodiment of the present disclosure, there is provided a method for enhancing the life of an exhaust valve in a natural gas fueled engine as evidenced by protection or inhibition in exhaust valve seat recession in the natural gas fueled engine, the method comprising lubricating the natural gas fueled engine with a natural gas engine lubricating oil composition comprising (a) a major amount of an oil of lubricating viscosity, (b) one or more phosphorus-containing anti-wear additives, (c) one or more oil soluble overbased alkaline earth metal-containing detergents; and (d) one or more oil soluble neutral alkali metal-containing detergents, wherein the natural gas engine lubricating oil composition contains no more than about 0.03 weight percent of phosphorus, based on the total weight of the natural gas engine lubricating oil composition.

[0019] In accordance with a fifth embodiment of the present disclosure, the use of a natural gas engine lubricating oil composition comprising (a) a major amount of an oil of lubricating viscosity, (b) one or more phosphorus-containing anti-wear additives, (c) one or more oil soluble overbased alkaline earth metal-containing detergents; and (d) one or more oil soluble neutral alkali metal-containing detergents, wherein the natural gas engine lubricating oil composition contains no more than about 0.03 weight percent of phosphorus, based on the total weight of the natural gas engine lubricating oil composition, for the purpose of preventing or inhibiting exhaust valve seat recession in a natural gas fueled engine is provided.

[0020] By lubricating a natural gas fueled internal combustion engine with a natural gas engine lubricating oil composition comprising (a) a major amount of an oil of lubricating viscosity, (b) one or more phosphorus-containing anti-wear additives, (c) one or more oil

WHAT IS CLAIMED IS:

1. A natural gas engine lubricating oil composition comprising (a) a major amount of an oil of lubricating viscosity, (b) one or more phosphorus-containing anti-wear additives, (c) one or more oil soluble overbased alkaline earth metal-containing detergents in an amount of at least 0.5 wt.% based on the total weight of the natural gas engine lubricating oil composition; and (d) one or more oil soluble neutral alkali metal-containing detergents in an amount of at least 0.5 wt.% based on the total weight of the natural gas engine lubricating oil composition, wherein the natural gas engine lubricating oil composition contains from 0.005 to 0.03 weight percent of phosphorus, based on the total weight of the natural gas engine lubricating oil composition,

wherein the one or more oil soluble overbased alkaline earth metal-containing detergents comprise one or more oil soluble overbased alkaline earth metal phenates and the one or more oil soluble neutral alkali metal-containing detergents comprise one or more oil soluble neutral alkali metal sulfonates.

2. The natural gas engine lubricating oil composition according to Claim 1, wherein the one or more phosphorus-containing anti-wear additives are selected from the group consisting of a hydrocarbyl phosphite, a hydrocarbyl phosphate and mixtures thereof.

3. The natural gas engine lubricating oil composition according to Claim 1, wherein the one or more phosphorus-containing anti-wear additives comprises a zinc alkyldithiophosphate.

4. The natural gas engine lubricating oil composition according to Claims 1-3, wherein the alkaline earth metal of the one or more oil soluble overbased alkaline earth metal-containing detergents include calcium or magnesium.

5. The natural gas engine lubricating oil composition according to Claims 1-4, wherein the one or more oil soluble overbased alkaline earth metal-containing detergents have a base number (BN) of from greater than 50 to 200 as determined using ASTM D 2896.

6. The natural gas engine lubricating oil composition according to Claims 1-4, wherein the one or more oil soluble overbased alkaline earth metal-containing detergents have a BN of from 250 to 450 as determined using ASTM D 2896.

7. The natural gas engine lubricating oil composition according to Claims 1-6, wherein the alkali metal of the one or more oil soluble neutral alkali metal-containing detergents include sodium and potassium.

8. The natural gas engine lubricating oil composition according to Claim 1, wherein the one or more oil soluble overbased alkaline earth metal-containing detergents comprise a calcium phenate and the one or more oil soluble neutral alkali metal-containing detergents comprise a sodium sulfonate.

9. The natural gas engine lubricating oil composition according to Claims 1-8, comprising:

0.15 to 1.5 wt. % of the one or more phosphorus-containing anti-wear additives,

0.5 wt. % to 1.5 wt. % of the one or more oil soluble overbased alkaline earth metal-containing detergents, and

0.5 wt. % to 2.0 wt. % of the one or more oil soluble neutral alkali metal-containing detergents, based on the total weight of the natural gas engine lubricating oil composition.

10. The natural gas engine lubricating oil composition according to Claims 1-9, wherein the natural gas engine lubricating oil composition further comprises one or more natural gas engine lubricating oil composition additives selected from the group consisting of an ashless dispersant, antioxidant, rust inhibitor, dehazing agent, demulsifying agent, metal deactivating agent, friction modifier, pour point depressant, antifoaming agent, co-solvent, package compatibiliser, corrosion-inhibitor, dye, extreme pressure agent and mixtures thereof.

11. The natural gas engine lubricating oil composition according to Claims 1-10, wherein the one or more ashless dispersants comprises a bissuccinimide.

12. The natural gas engine lubricating oil composition according to Claims 1-11, having a sulfated ash content of 0.15 to 0.3 wt. % as determined by ASTM D 874.

13. A method for preventing or inhibiting exhaust valve seat recession in a natural gas fueled engine, the method comprising lubricating the natural gas fueled engine with a natural gas engine lubricating oil composition according to Claims 1-12.