[0005] Several published studies have demonstrated that turbocharger use, engine design, engine coatings, piston shape, fuel choice, and/or engine oil additives may contribute to an increase in LSPI events. One theory suggests that auto-ignition of engine oil droplets that enter the engine combustion chamber from the piston crevice (the space between the piston ring pack and cylinder liner) may be one cause of LSPI events. Accordingly, there is a need for engine oil additive components and/or combinations that are effective to reduce or eliminate LSPI in boosted internal combustion engines.

SUMMARY AND TERMS

[0006] The present disclosure relates to a lubricating oil composition and method of operating a boosted internal combustion engine. The lubricating oil composition includes greater than 50 wt.% of a base oil of lubricating viscosity, at least 0.3 wt.% of an overbased detergent having a total base number (TBN) greater than 225 mg KOH/g, and at least 0.2 wt.% of a low-based/neutral detergent having a TBN less than or equal to 175 mg KOH/g, wherein a total amount of calcium from the overbased and low-based/neutral detergent ranges from greater than 1100 ppm by weight to less than 2400 ppm by weight based on a total weight of the lubricating oil composition. The lubricating oil composition may be effective to reduce low-speed pre-ignition events in the boosted internal combustion engine lubricated with the lubricating oil composition.

[0006a] In one aspect of the present disclosure, there is provided a lubricating oil composition comprising:

greater than 50 wt.% of a base oil of lubricating viscosity;

at least 0.3 wt.% of an overbased detergent having a total base number of greater than 225 mg KOH/g, measured by the method of ASTM D-2896, and

at least 0.2 wt.% of a low-based/neutral detergent having a total base number of up to 175 mg KOH/g, measured by the method of ASTM D-2896, wherein a total amount of calcium from the overbased and low-based/neutral detergent ranges from greater than 1100 ppm by weight to less than 2400 ppm by weight based on a total weight of the lubricating oil composition.

[0006b] In another aspect of the present disclosure, there is provided a method for reducing low-speed pre-ignition events in a boosted internal combustion engine comprising:

lubricating a boosted internal combustion engine with a lubricating oil composition comprising

greater than 50 wt.% of a base oil of lubricating viscosity;

at least 0.3 wt.% of an overbased detergent having a total base number of greater than 225 mg KOH/g, measured by the method of ASTM D-2896; and

at least 0.2 wt.% of a low-based/neutral detergent having a total base number of up to 175 mg KOH/g, measured by the method of ASTM D-2896; wherein a total amount of calcium from the overbased and low-based/neutral detergent ranges from greater than 1100 ppm by weight to less than 2400 ppm by weight based on a total weight of the lubricating oil composition, and

operating the engine lubricated with the lubricating oil composition.

[0007] In another embodiment, the disclosure provides a method for reducing low-speed pre-ignition events in a boosted internal combustion engine. The method includes a step of lubricating the boosted internal combustion engine with a lubricating oil composition including greater than 50 wt.% of a base oil of lubricating viscosity, at least 0.3 wt.% of an overbased detergent having a TBN greater than 225 mg KOH/g, and at least 0.2 wt.% of a low-based/neutral detergent having a TBN up to 175 mg KOH/g. A total amount of calcium from the overbased and low-based/neutral detergent ranges from greater than 1100 ppm by weight to less than 2400 ppm by weight based on a total weight of the lubricating oil composition. The boosted internal combustion engine is operated and lubricated with the lubricating oil composition whereby the low-speed pre-ignition events in the engine lubricated with the lubricating oil composition may be reduced.