Tribological characteristics comparison of formulated palm trimethylolpropane ester and polyalphaolefin for cam/tappet interface of direct acting valve train system

ABSTRACT

Purpose: There is a continuous drive in automotive sector to shift from conventional lubricants to environmental friendly ones without adversely affecting critical tribological performance parameters. Because of their favorable tribological properties, chemically modified vegetable oils such as palm trimethylolpropane ester (TMP) are one of the potential candidates for the said role. To prove the suitability of TMP for applications involving boundary-lubrication regime such as cam/tappet interface of direct acting valve train system, a logical step forward is to investigate their compatibility with conventional lubricant additives. Design/methodology/approach: In this study, extreme pressure and tribological characteristics of TMP, formulated with glycerol mono-oleate (GMO), molybdenum dithiocarbamate (MoDTC) and zinc dialkyldithiophosphate (ZDDP), has been investigated using four-ball wear tester and valve train test rig. For comparison, additive-free and formulated versions of polyalphaolefin (PAO) were used as reference. Moreover, various surface characterization techniques were deployed to investigate mechanisms responsible for a particular tribological behavior. Findings: In additive-free form, TMP demonstrated better extreme pressure characteristics compared to PAO and lubricant additives which are actually optimized for conventional base-oils such as PAO, are also proved to be compatible with TMP to some extent, especially ZDDP. During cylinder head tests, additive-free TMP proved to be more effective compared to PAO in reducing friction of cam/tappet interface, but opposite behavior was seen when formulated lubricants were used. Therefore, there is a need to synthesize specialized friction modifiers, anti-wear and extreme pressure additives for TMP before using it as engine lubricant base-oil. Originality/value: In this study, additive-free and formulated versions of bio-lubricant are tested for cam/tappet interface of direct acting valve train system of commercial passenger car diesel engine for the very test time. Another important aspect of this research was comparison of important tribological performance parameters (friction torque, wear, rotational speed of tappet) of TMP-based lubricants with conventional lubricant base oil, that is, PAO and its formulated version.

Keyword: Wear; Lubricant additives; Bio-lubricants; Direct-acting valve train system; Friction torque; Tappet rotation