Effect of steel hardness and composition on wear behavior of low viscosity PAO formulated with dodecanoic acid and ionic liquid additives

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Two ionic liquids (ILs), tributylmethylphosphonium dimethylphosphate (PP) and 1-butyl-1-methylpyrrolidinium tris(pentafluoroethyl)trifluorophosphate (BMP), were used as lubricant additives in low viscosity polyalphaolefin 8 cSt (PAO8). The tribological behavior of these ILs was compared with well-known organic friction modifier, dodecanoic acid (C12). The tests were performed using a ball-on-disk tribometer with alumina ball as the counterpart on steel disk. Two steel materials, AISI 52100 steel and AISI 316L stainless steel, were used for investigating the influence of their chemical composition and hardness on the tribological performance of the lubricant. A range of advanced analytical tools are used to analyze the wear and the tribofilms, including infinite focus microscopy (IFM), scanning electron microscopy equipped with a focused ion beam (SEM-FIB), scanning-transmission electron microscopy equipped with an x-ray energy dispersive spectroscopy (STEM-EDS), and x-ray photoelectron spectroscopy (XPS). The most important factors controlling wear are the tribofilm chemical composition and the hardness and chemical composition of the steel. Among all additives studied, BMP on the stainless steel gave a durable tribofilm resulting in excellent antiwear properties.

Keywords: Low viscosity PAO, ionic liquids, tribofilm, hardness, wear.

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