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**Comparison of an Oil-Miscible Ionic Liquid and ZDDP as a Lubricant Anti-Wear Additive**Jun Qu<sup>1,\*</sup>, Huimin Luo<sup>2</sup>, Miaofang Chi<sup>1</sup>, Cheng Ma<sup>1</sup>, Peter J. Blau<sup>1</sup>, Sheng Dai<sup>3</sup>, and Michael B. Viola<sup>4</sup><sup>1</sup>Materials Science and Technology Division, Oak Ridge National Laboratory<sup>2</sup>Energy and Transportation Science Division, Oak Ridge National Laboratory<sup>3</sup>Chemical Sciences Division, Oak Ridge National Laboratory<sup>4</sup>Research & Development Center, General Motors Corp.**Abstract**

This paper reports the anti-scuffing/anti-wear behavior and mechanism of an oil-miscible ionic liquid (IL), trihexyltetradecylphosphonium bis(2-ethylhexyl)phosphate, in a base oil at 1.0 wt% concentration under both room and elevated temperatures. Results are benchmarked against those for a conventional anti-wear additive, zinc dialkyl-dithiophosphate (ZDDP). Reciprocating sliding, boundary lubrication tests were conducted using a piston ring segment against a cylinder liner piece cut from actual automotive engine components. Although the IL and ZDDP worked equally well to prevent scuffing and reduce wear in the room-temperature tests, the IL significantly outperformed ZDDP in the 100 °C tests. The top surfaces and cross sections of the worn surfaces were characterized to reveal the morphology, thickness, nanostructure, and chemical composition of the IL-induced tribo-films.

Keywords: oil-soluble ionic liquid, lubricant, additive, anti-wear, tribo-film, ZDDP

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