The antiwear properties of zinc dialkyldithiophosphate (ZDDP), dispersants, and mixtures of ZDDP and different dispersants have been evaluated using pin-on-flat Plint wear machine. Tribochemical interactions between ZDDP and dispersants have been investigated under boundary lubrication conditions by means of X-ray absorption near edge structure (XANES) spectroscopy, probing the P, S, N, and B absorption edges. The results show that the dispersants, except for the borated bis-succinimide, do not show any wear protection by themselves in the base oil. The dispersants also do not affect the antiwear property of ZDDP under the given testing conditions. The borated bis-succinimide alone shows good antiwear property. The N K-edge XANES analysis indicates that dispersants contribute to the chemical composition of the tribofilms and form mixed ammonium/zinc polyphosphates. Both additives absorb on the rubbed surface. Boron chemistry in the surface and the bulk of tribofilms is distinctly different. On the surface, boron appears as a mixture of hexagonal h-BN and cubic c-BN, whereas in the bulk it is composed of tetrahedral and trigonal boron entities (boron oxides). Phosphorus in the tribofilms is present mainly in the form of medium-chain polyphosphate on the surface and short chain polyphosphate in the bulk. Sulfur appears in the tribofilms mainly as sulfide S-II, possibly zinc sulfide. The presence of dispersants in oil blends does not disturb the polyphosphate (and sulfide) formation, but it affects the chain length of the polyphosphate in the tribofilms.