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Coefficient of friction and wear maps as a function of contact pressure and base oil viscosity for railway greases in pure sliding lab tests

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Pure sliding tests with abundant lubrication were carried out in a tribometer under two different pressure conditions, sphere-disc (1150 MPa) and pin-disc (2.5 MPa), to evaluate the performance of railway greases in terms of coefficient of friction (CoF) and wear. The test conditions (sliding speed, temperature, humidity, materials, roughness, pressure, and hardness ratio of the contacting bodies) were selected to simulate heavy-haul field conditions in Brazilian railways. Nine railway greases of NLGI 2 consistency were evaluated. Three of them are commercial greases. The others were specifically formulated so that the effects of the thickener and the viscosity of the base oil on the grease performance could be isolated since these greases have the same additive package but different thickener types and base oil viscosities. Before and after tests, all specimens were characterized using an optical microscope (OM), 2D rugosimeter, white light interferometer, scanning electron microscope (SEM), and energy scatter X-ray spectroscopy (EDS). Such characterizations aimed to quantify the geometrical changes of the test specimens due to wear and analyze the tribofilm morphology and composition. Friction and wear values were analyzed as a function of base oil viscosity and thickener type. All low-pressure tests showed lower CoF and higher wear values than those observed for the high-pressure tests. The CoF results evidenced the effect of the additive package (additive type and amount) during the high-pressure tests but not during the low-pressure tests. Lithium thickened greases showed lower CoF than Calcium thickened greases, regardless of the contact pressure and additive package. The high-pressure tests showed a low friction coefficient for high viscosity base oils, indicating a possible transition between boundary to mixed lubrication regimes. A trend of reduced wear with increased viscosity is observed for all greases and contact pressures, as expected for tests with abundant lubrication due to lube film formation. The thickener effect on wear is relevant only at low contact pressures, in which case the calcium thickener provides better wear resistance than the lithium one.