CFD simulation of magnetorheological fluid for Pin-Bushing condition

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Abstract

Magneto-rheological (MR) fluid is one of smart material which can be changed the rheological properties and also change its stiffness and damping characteristics when the magnetic field is applied. As MR fluid can be used as lubricant due to its controllable mechanical properties, a pin-bushing system can be one of a potential application. A bushing is an independent plain bearing that is inserted into a housing to provide a bearing surface for rotary applications. The lubrication characteristics and load carrying capacity in Pin-Bush interface with MR fluid lubrication can be altered according to the strength of a magnetic field strength. In this study, computational fluid dynamic (CFD) simulation and the friction tests are carried out to evaluate the MR effect at the contact surface of pin-bushing system. The Bingham model for MR fluid at the contact interface is mathematically defined for the simulation. From the simulation, the flow of MR fluid, friction coefficient at the contact interface, and distribution of a magnetic field strength at the interface are calculated and presented as a function of a magnetic field strength. The simulation results are validated by the friction tests, measuring the friction coefficients at the contact interface under the constant magnetic field condition. The results show that the lubrication of MR fluid has effects on friction and load carrying capacity at the contact interface under the applied magnetic field. The results from this study can be used to estimate the feasibility of usage of MR fluid as a lubricant in pin-bushing system.

Keywords

Magnetorheological(MR) fluid; Pin-bushing; CFD Simulation; Friction