Incorporation of cobalt ferrite on the field dependent performances of magnetorheological grease

ABSTRACT

Magnetorheological grease (MRG) is one of the smart materials that experiences a high off state viscosity, which hassles the operation of devices at the beginning and causes more energy consumption upon operation. Therefore, this paper investigates the off-state viscosity of MR lithium-based grease with various percentages of cobalt ferrite (CoFe2O4), as these particles are believed to potentially enhance the field-dependent stress of MRG by reducing the off-state viscosity and increasing mobility of the magnetic particles as the magnetic field applied. The MRG with various concentrations of CoFe2O4 at a ratio of 1 e5 wt.% were investigated via Field-Emission Scanning Electron Microscopy (FESEM) and Vibrating Sample Magnetometer (VSM) to analyze their morphology and magnetic properties, respectively. The rheological test of MRG samples in terms of viscosity, shear stress and yield stress were investigated upon shear rate, using rheometer. The results demonstrated that with the incorporation of 5wt.% CoFe2O4 particles, the initial off-state viscosity was reduced by 86% as compared to the pure MRG. The presence of CoFe2O4 particles triggered more chaotic motion thus restricted the formation of agglomeration of particles during shearing process. Meanwhile, the initial viscosity of MRG increased as a 0.64 T of magnetic field was applied along with the increased of CoFe2O4 particles. In fact, there was an enhancement of shear stress and yield stress on the CoFe2O4 incorporated MRG samples as compared with pure MRG. This study underlined the influence of CoFe2O4 particles, which could reduce the initial viscosity of MRG and improve the rheological properties upon the application of magnetic field.