World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:12, No:06, 2018

Magnetic Field Induced Tribological Properties of Magnetic Fluid

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Abstract : Magnetic fluid as a nanolubricant is a most recent field of study due to its unusual properties that can be tuned by applying a magnetic field. In present work, four ball tester has been used to investigate the tribological properties of the magnetic fluid having a 4 wt% of nanoparticles. The structural characterization of fluid shows crystallite size of particle is 11.7 nm and particles are nearly spherical in nature. The magnetic characterization shows the fluid saturation magnetization is 2.2 kA/m. The magnetic field applied using permanent strip magnet (0 to 1.6 mT) on the faces of the lock nut and fixing a solenoid (0 to 50 mT) around a shaft, such that shaft rotates freely. The magnetic flux line for both the systems analyzed using finite elemental analysis. The coefficient of friction increases with the application of magnetic field using permanent strip magnet compared to zero field value. While for the solenoid, it decreases at 20 mT. The wear scar diameter is lower for 1.1 mT and 20 mT when the magnetic field applied using permanent strip magnet and solenoid, respectively. The coefficient of friction and wear scar reduced by 29 % and 7 % at 20 mT using solenoid. The worn surface analysis carried out using Scanning Electron Microscope and Atomic Force Microscope to understand the wear mechanism. The results are explained on the basis of structure formation in a magnetic fluid upon application of magnetic field. It is concluded that the tribological properties of magnetic fluid depend on magnetic field and its applied direction.

Keywords : four ball tester, magnetic fluid, nanolubricant, tribology
Conference Title : ICTT 2018 : International Conference on Tribology Technology
Conference Location : Toronto, Canada
Conference Dates : June 21-22, 2018