Fluid-Particle Separation of Magnetorheological (MR) Fluid in MR Machining Application

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ABSTRACT

The presented work is an investigation of fluid-particle separation phenomena and compression stress resistance performance of magnetorheological (MR) fluids under squeeze mode. The squeeze mode is very significant to MR machining application. Material used in this study was silicone oil based MR fluid with 20% volume fraction of carbonyl iron particle. Compression test was performed by integrating the developed squeeze mode testing rig with a 50 kN Universal Testing Machine (UTM). The tests were conducted at constant speed and current. Each test was conducted at an initial gap of 2 mm and was stopped at a final gap of 0.5 mm. Force-displacement data was recorded and was analysed using TestExpert® II software. Full factorials with 27 experiments were designed using Design Expert 7 software. Three factors investigated in the design of experiments were carrier fluid viscosity, supplied current, and compression speed. Responses measured were strain energy and compression stress at maximum strain. Macro images of the phenomenon were recorded and evaluated qualitatively. From the compression stress-strain results, carrier fluid viscosity was significant to vary the MR fluid properties. The observed phenomenon shows that fluid-particle separation occurred in the low viscosity carrier fluid, low compression speed and high applied current. The parameters effect on strain energy and compression stress suggests that the fluidparticle
separation is significant to the squeeze mode MR fluid performance. The relationship
between stress resistance performance and fluid-particle separation phenomena were significant in designing innovative MR fluid devices.

KEYWORDS: Magnetorheological Fluids; Particle Separation; Squeeze Flow Mode; Stress Resistance

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