



AN INVESTIGATION OF ELECTRO- RHEOLOGICAL FLUIDS IN ENGINEERING

Tam Dinh Truong

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School of Architectural, Civil and Mechanical Engineering
Victoria University of Technology

Footscray Campus
PO BOX 14428 MCMC
Melbourne, Victoria 8001
Australia

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ABSTRACT

The essential characteristic of controllable fluids is their ability to change their rheological behaviour under an electrical field. These materials are referred as Electro-Rheological (ER) fluids. An ER fluid is a mixture of a base fluid, usually some type insulating liquid such as mineral or silicone oil, with suspension particles, such as cornstarch, zeolite, glass bead or cellulose. When there is no electric field, particles are randomly suspended in the base liquid. When an electric field is applied, the particles in the fluid form chains bridging the conductors of opposite polarity and turn the liquid into a solid-like gel. The process is seemingly reversible once the electric field is removed. The process takes place within milliseconds. In this thesis, shear and valve modes of operation are considered for one particular ER fluid from a practically oriented design point of view.

Chapter 1 provides background information concerning ER fluids and ER devices in practical applications. Chapter 2 describes a prediction tool for the shear mode of operation based on the Bingham model. The prediction model is based on the (solid to liquid) weight fraction, applied electric field and strain rate. An ER clutch with a single disk was designed, and tested to validate the model. In Chapter 3, an ER valve experiment is presented to relate the force-displacement behaviour with varying applied voltage, weight fraction and other operating conditions (volume flow rate, cyclic frequency and stroke length). A new model for an ER damper in fluctuating flow is also presented in Chapter 4. This new model is a modification of the uniform flow Bingham plastic model. Comparison between the predictions from the model and observations

from the experiments is also given in Chapter 4. In Chapter 5, an overview is given of this work's contribution and future work is discussed.

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Doctor of Philosophy Proforma

I, Tam Dinh Truong, declare that the PhD thesis entitle “ An Investigation of Electro-Rheological Fluids in Engineering” is no more than 100,000 words in length, exclusive of tables, figures, appendices, references, and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

Signature

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Date: