ABSTRACT
Magnetic fluid constitutes ferrite particle, surfactant and carrier. The ultra-fine particles with strong magnetism can disperse stably in the liquid due to the action of the surfactant. If the carrier is silicon oil, it is called a silicon-based ferrofluid. For this research, we synthesize a series of Fe3O4 silicon-based ferrofluids with various concentrations by coprecipitation method. The conditions of the chemical reaction were carefully tuned to obtain the optimum ones. The ferrofluids produced accordingly are highly stable with high magnetization. Then we apply to linear dampers using different concentration silicon-based ferrofluids. The effects of these dampers to vibration reduction were studied. The main difference between dampers using conventional damper oil and those using silicone-based magnetic fluid is that the viscosity of the later one can be altered as needed. Through the control of the magnetic field to the damper, the vibration reduction system becomes intelligent. Also, the possibility of direct contact between damper components can be eliminated completely due to the repulsive force between the magnetic fluid and the non-magnetic materials, which can prevent excessive wear due to dry friction. All these miracles are due to the face that as a magnetic field is applied, the magnetic particles in magnetic fluids will agglomerate and form chains along the direction of the field. If the direction of the vortices resulted from the relative of moving components is not parallel to the direction of the magnetic field, the viscosity of the fluid will be enhanced and are controllable. Furthermore, the silicone-based magnetic fluid will tend to move to the location of the highest field strength. By properly designing the magnetic field, the amount of fluid used will reduce tremendously. In this research, silicone-based magnetic fluids of different grades and different concentrations were produced. Their mechanical properties were measured at different magnetic strengths. A linear damper using these fluids as damper fluid was tested in order to understand the effects of the damper with different magnetic fluids. A database then was constructed accordingly base on the test results. A control methodology was developed based on the database and was used to control system vibration actively through the computer control. Such a damper, which its viscosity is controlled by a computer based on this database, subdues external forces to the system and reduce the vibration level of the system. This system can be used in highly accurate instruments, vehicles, or machines which are required a low vibration level. Also the results can be uses a guideline by industries in the design of magnetic fluid dampers.

Keywords: Magnetic Fluid; Suspension

RONALD MOSKOWITZ. "DESIGNING WITH FERROFLUIDS" MECHANICAL ENGINEERING, FEBRUARY (1975) 

K. RAJ ETAL. "ADVANCE IN FERROFLUID TECHNOLOGY" JOURNAL OF MAGNETISM AND MAGNETIC MATERIAL, VOL. 149 (1995) 

K. RAJ AND R. MOSKOWITZ. "A REVIEW OF DAMPING APPLICATIONS OF FERROFLUIDS" IEEE TRANSACTIONS ON MAGNETICS, VOL. 16, (1938) 

W. C. ELMORE. "FERROMAGNETIC COLLOID FOR STUDYING MAGNETIC STRUCTURES" PHYS. REV., VOL. 54, 309 (1938) 


R. E. ROSENSWEIG. "FERROHYDRODYNAMICS" CAMBRIDGE UNIVERSITY PRESS (1985) 

RONALD E. ROSENSWEIG. "FLUID DYNAMICS AND SCIENCE OF MAGNETIC LIQUIDS" VOL. 48 (1979) 


M. S. DABABNEH, N. Y. AYOUB, I. ODEH AND N. M. LAHAM. "VISCOSITY RESISTIVITY AND SURFACE TENSION MEASUREMENTS OF Fe3O4 FERROFLUID" J. MAGN. MATER., VOL. 125, P34 (1993) 

AHID D. NASHIF, DAVID I. G. JONES AND JOHN P. HENDERSON. "VIBRATION DAMPING". 

WILLIAM WEAVER, JR. STEPHEN P. TIMOSHENKO AND DONOVAN H. YOUNG. "VIBRATION PROBLEMS IN ENGINEERING". 

LEONARD MEIROVITCH. "ELEMENTS OF VIBRATION ANALYSIS" (1986) 


洪振義,邱煜佳. "矽油基磁性流體於振動控制之研究" 大葉大學機械工程研究所碩士論文 民國 87年 6月。 

劉啟台. "工程力學觀念分析《力動篇》" 文笙書局股份有限公司 民國 85年 12月。 

翁通楹 編譯. 機械設計手冊《上》,高力圖書有限公司,民國 87年 7月。 

陳木 編譯. 機械振動概論,徐氏基金會,民國 74年 6月。 

蕭燁 機械振動力學導論,台灣商務印書館,民國 87年 6月。