Research of Vibraation Control by Silicon-based Ferrofluid

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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 Ferro fluid. For this research, we synthesize a series of Fe3o4 silicon-based Ferro fluids with various concentrations by co precipitation method. The conditions of the chemical reaction were carefully tuned to obtain the optimum ones. The Ferro fluids produced accordingly are highly stable with high magnetization. Then we apply to linear dampers using different concentration silicon-based Ferro fluids. 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, are due to the fact 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 motion 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-base 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 them was constructed accordingly based 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 law vibration level. Also the results can be uses as a guideline by industries in the design of magnetic fluid dampers.

Keywords :

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REFERENCES

(1)"Preparation of Dilution-Stable Aqueous Magnetic Fluids,"by Sanaa E.Khalafalla and Feorge W.Reimers,IEEE transactions on magnetics,vol.Mag-16,No.2,March1980 (2)"A Basic Theory and Application of Magnetohydrodyamics,"by 黃忠良,1988 (3):Fluid Dyamics and Science of Magnetic Liquids,"by Ronald E.Rosensweig. (4)"Particle Size Distribution of a Laboratory-Synthesized Magnetic Fluid,"by R.V.Mehta,Journal of Magnetism and Magnetic Material 123,P262-226,1993 (5)"Ordered structures in Fe3O4 kerosene-bsed ferrofluids,"by Chin-Yin Hong,I.J.Jang,H.E.Hrong,C.J.Hsu,Y.D.Yao,and H.C.Yang,Journal of applied physics,81,4275(1997) (6)"Magnetic Fluids-Engineering Applications,"by B.M.Berkovsky,and V.F.Medvedev,and M.S.Krakov. (7)"Magnetic Fluids Guidebook : Properties and Applications,"by V.E.Fertman. (8)"Viscosity,Resistivity and Surface Tension Measurement of Fe3O4 Ferrofluid,"by M.S.Dababneh,and N.Y.Ayoub,and I.Oden,and N.MLaham,Journal of Magnetism and magnetic materials 125,p34-38,1993 (9)"Designing with ferrofluids ,"by Ronald Moskowitz,Mechanical Engineering,February 1975. (10)"Advances in ferrofluid techology,"by K.Rajetal.,Journal of magnetism and maanetic materials 1995 (11)"A review of damping applications of ferrofluids,"by K.Raj and R.Moskowitz Transactions on

magnetics,vol.mag-16,No.2,March1980. (12)"Semiactive control of electromagnetic damper by neural networks and fuzzy reasoning,"by Kanamori,Mituru ,Ishihara,Yoshiyuki,Todaka Japan Society of mechanical engineers,Part C v 59 n 566 Oct 1993.p3003-3007. (13)"Performance of a viscous damper using electrorheological fluid",by Otani,A.Kobayashi,N.;Tadaishi,Y.Seismic Engineering American Society of Mechanical Engineers.PVP v275-2 1994 ASME New York p93-97 (14):Electrorheological dampers and aemi-active structral control,"by McClamroch,N.Harris;Ortiz David S.Univ.of Michigan,Ann Arbor,MI,USA IEEE cConference on Decision Control v 1 1994.IEEE,piscataeay,Nj,USA,94CH4360-3.p97-102.