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Enhancement of Damping Force of Classical Hydraulic Damper into Semi Active Damper using MR Approach

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***Abstract*— Vibration concealment can be considered as a standout amongst the most vital parameter influencing the execution of Mechanical structures and related security and solace. To diminish the framework vibration of such frameworks, a functioning vibration control system is required. the enhancement of damping force of classical hydraulic damper into semi active damper using MR approach is presented in this paper. The three unique liquids with iron particles volume division of 30%, 35 % and 40 % were set up in this investigation. It is seen that with increment in iron particles volume division and higher excitation current, damper execution improves. The damper set with thickest liquid experiences the issue of functionality at most reduced damping current. Among the 1 Degree of opportunity set utilized in this examination, the set with liquid YV2M2 with 35 % iron particles volume portion gives better execution usefulness perspective. The outcomes acquired from Damping power with MR Fluid and Magnetic Field is 40 percent more than Damping Force with customary Hydraulic Fluid.**

***Index Terms*— Hydraulic damper, vibration, MR fluid.**

I. Introduction

Magneto-Rheological dampers and the related devices have been under development for many years, but their commercial application started in late 2000A.D. in some expensive passenger vehicles. These Magneto-Rheological dampers fall under semi-active category. The Magneto-Rheological fluids, which are used in such devices, can change from liquid to semisolid when they come under the influence of magnetic field [1]. These damper have many benefits like, low cost of manufacturing, quick response, ability to change the viscosity in few milliseconds, fluids depend on the size of particles, properties of the carrier fluid used, additives and stabilizing agents used, applied magnetic field, operating construction, low operating power requirements and more effectiveness for vibration absorption The properties of temperature, concentration and density of particles, etc. Magnetic flux density generated in the damper due electric coil is proportional to the applied field [2]. Magnetic flux density generated in the damper due electric coil is proportional to the applied field.

The properties of the Magneto-Rheological suspension, the working mode (shear mode, flow mode or squeeze mode) and the design of the magnetic circuit consisting of Magneto-Rheological fluid, flux guide and coil considerably influence the properties of the actuator. The design of the magnetic circuit of a Magneto-Rheological fluid actuator is analyzed by finite-element-method. Yang et al. [3] presented a Magneto-Rheological damper design methodology, which was based on the magnetic circuit design according to the requirement of adaptive structure characteristics.

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II. METHOD TO PREPARE MAGNETO-RHEOLOGICAL FLUID

In this study, three different Magneto-Rheological fluids designated as YV1M1, YV2M2 and YV3M3 are prepared with 30%, 35% and 40% of volume fraction of iron particles. The ingredients required for the preparation of 200 ml of Magneto-Rheological fluid are as given in Table 1. The AP 3 grade Grease is first mixed in paraffin oil using mechanical stirred for about 20 minutes till the grease is dissolved in the oil completely. Then the oil is allowed to settle for about three hours. The iron particles are then added in the mixture of Grease and oil. This mixture is stirred for 15 to 20 minutes, until all particles get mixed in the oil completely[4].

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Table 1: The details of ingredients

Details of ingredients	YV1 M1(30 %iron particles)	YV2 M2(35 %iron particles)	YV3M3 (40 %iron particles)
Low viscosity oil (Paraffin oil)	140 ml	130 ml	120 ml
Iron Particles(around50 micron)	210.6 gm	245.7 gm	280.8 gm
AP 3 grease(12% of Oil weight)	14.1 gm	13.5 gm	12.09 gm

III. CALCULATION TO PREPARE MAGNETO-RHEOLOGICAL FLUID

The calculations of ingredients which are required to prepare 200ml of three different types of Magneto-Rheological fluids (YV1M1, YV2M2 and YV3M3) are as given below. The composition of the MR fluid preparation is referred from literature [5&6].

For YV1M1: (70% paraffin oil + 30% iron particles)

1. 200ml of fluid X 70/100 of paraffin oil = 140ml of paraffin oil

140ml X specific gravity of low viscosity paraffin oil 0.84 = 117.6gm

2. 117.6gm of paraffin oil X 12/100 = 14.1gm of AP3 grease
3. 200ml of fluid X 30/100 of iron particles = 60 ml of iron particles

60 X 3.51 = 210.6gm of iron particles.

For YV2M2: (65% paraffin oil + 35% iron particles)

1. 200ml of fluid X 65/100 of paraffin oil = 130ml of paraffin oil

130ml X specific gravity of low viscosity paraffin oil 0.84 = 109.2gm

2. 109.2gm of paraffin oil X 12/100 = 13.1gm of AP3 grease
3. 200ml of fluid X 35/100 of iron particles = 70 ml of iron particles

70 X 3.51 = 245.7gm of iron particles.

For YV3M3: (60% paraffin oil + 40% iron particles)

1. 200ml of fluid X 60/100 of paraffin oil = 120ml of paraffin oil

120ml X specific gravity of low viscosity paraffin oil 0.84 = 100.8gm

2. 100.8gm of paraffin oil X 12/100 = 12.09gm of AP3 grease
3. 200ml of fluid X 40/100 of iron particles = 80 ml of iron particles

80 X 3.51 = 280.8gm of iron particles.

IV. MAGNETO-RHEOLOGICAL FLUID CHARACTERISTICS TESTING

The magnetic induction (H) and the flux density (B) of the above mentioned three types of Magneto-Rheological fluids are determined experimentally. The experimental set for the same, consists of an electromagnet, digital Gauss meter and sensor rod arrangement as shown in fig.1. The sensor probe was dipped in the cup having 30 ml Magneto-Rheological fluid and this arrangement was kept in the electromagnetic field generated by the coil.

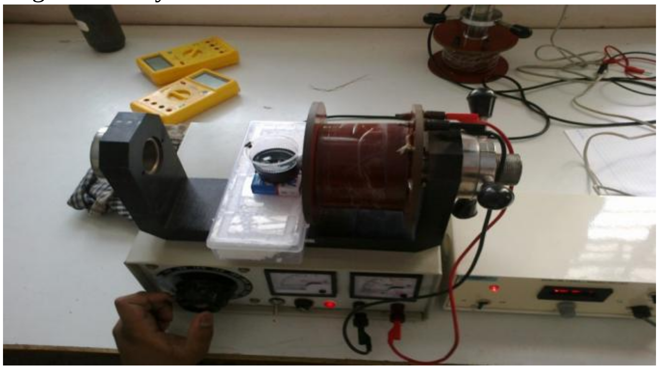

Fig. 1: Experimental set up for Magneto-Rheological Fluid characterization

This experimental arrangement can be explained with the help of block diagram, as shown in Fig. 2. The current (I) of the coil is varied as 0.3, 0.6, 0.9, 1.2, 1.5, 1.8 and 2.1 Amperes. To vary magnetic induction (H) and flux density (B) is measured using sensor and digital gauss meter. The magnitude of magnetic induction and flux density for Magneto-Rheological fluids YV1M1, YV3M3 and YV2M2 are given in Tables 2, 3 and 4 respectively.

Table 2: Characteristics for YV1M1 (30% Fe particles)

	Current in Amp	Magnetic Flux Density (Tesla) 'B'	Magnetic induction (Amp/m) H
1.	0.3	109	9432
2.	0.6	210	18864
3.	0.9	343	28296
4.	1.2	464	37728
5.	1.5	560	47160
6.	1.8	624	56292
7.	2.1	654	66024

Table 3: Characteristics for YV3M3 (40% Fe particle)

Sr . No	Current in Amp	Magnetic Flux Density (Tesla) 'B'	Magnetic induction (Amp/m) H
1.	0.3	199	9432
2.	0.6	392	18864
3.	0.9	562	28296
4.	1.2	723	37728
5.	1.5	910	47160
6.	1.8	1065	56292
7.	2.1	1177	66024

Table 4: Characteristics for YV2M2 (35% Fe particles)

Sr. No	**Current in Amp**	**Magnetic Flux Density (Tesla) 'B'**	**Magnetic induction (Amp/m)H**
1.	0.3	130	9432
2.	0.6	258	18864
3.	0.9	400	28296
4.	1.2	554	37728
5.	1.5	681	47160
6.	1.8	785	56292
7.	2.1	856	66024

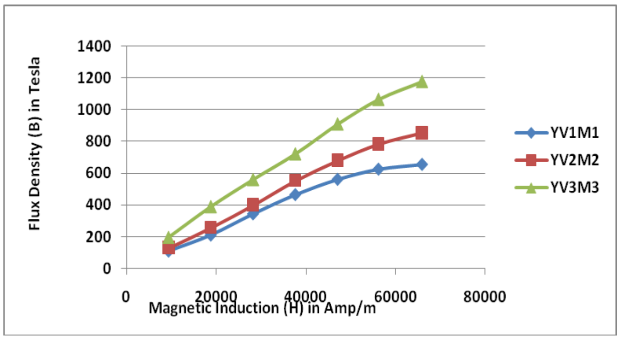

Fig. 2: B-H curve for YV1M1, YV2M2 and YV3M3

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Fig. 3: Experimental Set up

Fig. 4: Experimental Set up with Magnet

The fig. 3 and 4 represents actual experimental setup for Enhancement of Damping Force of Classical Hydraulic Damper into semi active damper using MR Approach. The hydraulic damper is modified and filled with MR Fluid by varying volume fraction of oil and iron particles and it is tested in M/s Autoshox industry, Kolhapur

The experimental is carried out with damper with MR Fluid and damper with MR Fluid long with Magnet. [7]

During the experimentation, it is concluded that damping force increases when magnetic force increases and it is increased 40 percent more than that actual damper shown in Table 5.

Table 5: Actual testing and it results of YV3M3 (40% iron particle)

Damping Force With regular Hydraulic Fluid (Kg/s)	Damping Force With MR Fluid Without magnetic Field(Kg/s)	Damping Force With MR Fluid With Magnetic Field(kg/s)
26	26	40.1
27.5	25	38
27	25.5	40.3

V. CONCLUSION

Magneto-rheological characteristic of Magneto-rheological fluids is affected by the percentage of iron particles volume fraction in it. Hence, three different fluids with iron particles volume fraction of 30%, 35 % and 40 % were prepared in this study. From the B-H curves of these fluids, it is observed that, as the percentage of iron particles volume fraction increases in the Magneto-rheological fluid, the magnetic flux density value also increases for the same value of magnetic induction. The trend of Magneto-rheological fluid characteristics is very much similar to the results from the literature.

From this study, it is observed that with increase in iron particles volume fraction and higher excitation current, damper performance improves. However, the damper set with thickest fluid suffers from the problem of workability at lowest damping current. Among the 1 Degree of freedom set used in this study, the set with fluid YV2M2 with 35 % iron particles volume fraction gives better performance workability point of view.

To study the effect of Magneto-Rheological fluids and external permanent magnet arrangement in one degree of freedom set on force-displacement characteristics these combinations of damper set with three fluids are tested from this study it is observed that increase in iron particles volume fraction damper performance also improve. However the 1 dof set with Magneto-Rheological fluid YV3M3 suffer from the workability and in turn efficiency among the damper set used in this study set with gap and turn efficiency.

The results obtained from Damping force with MR Fluid and Magnetic Field is 40 percent more than Damping Force with regular Hydraulic Fluid.

REFERENCES

[1] G. O. Young, "Synthetic structure of industrial plastics (Book style with paper title and editor)," in *Plastics*, 2nd ed. vol. 3, J. Peters, Ed. New York: McGraw-Hill, 1964, pp. 15–64.

[2] W.-K. Chen, *Linear Networks and Systems* (Book style). Belmont, CA: Wadsworth, 1993, pp. 123–135.

[3] H. Poor, *An Introduction to Signal Detection and Estimation*. New York: Springer-Verlag, 1985, ch. 4.

[4] B. Smith, "An approach to graphs of linear forms (Unpublished work style)," unpublished.

[5] E. H. Miller, "A note on reflector arrays (Periodical style—Accepted for publication)," *IEEE Trans. Antennas Propagat.*, to be published.

[6] J. Wang, "Fundamentals of erbium-doped fiber amplifiers arrays (Periodical style—Submitted for publication)," *IEEE J. Quantum Electron.*, submitted for publication.

[7] C. J. Kaufman, Rocky Mountain Research Lab., Boulder, CO, private communication, May 1995.

[8] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interfaces(Translation Journals style)," *IEEE Transl. J. Magn.Jpn.*, vol. 2, Aug. 1987, pp. 740–741 [*Dig. 9th Annu. Conf. Magnetics* Japan, 1982, p. 301].

[9] M. Young, *The Techincal Writers Handbook.* Mill Valley, CA: University Science, 1989.

[10] (Basic Book/Monograph Online Sources) J. K. Author. (year, month, day). *Title* (edition) [Type of medium]. Volume(issue). Available: http://www.(URL)

[11] J. Jones. (1991, May 10). Networks (2nd ed.) [Online]. Available: http://www.atm.com

[12] (Journal Online Sources style) K. Author. (year, month). Title. *Journal* [Type of medium]. Volume(issue), paging if given. Available: http://www.(URL)

[13] R. J. Vidmar. (1992, August). On the use of atmospheric plasmas as electromagnetic reflectors. *IEEE Trans. Plasma Sci.* [Online]. *21(3).* pp. 876—880. Available: http://www.halcyon.com/pub/journals/21ps03-vidmar