Development of Magneto-Rheological Fluid Suspension System for Two Wheeler

Saurabh Bachate[1], Akshay Choudhari[2], Mangesh Gurav[3], Sanket Desai[4], Lahu Asule[5] S.B.Killedar[6]

[1,2,3,4,5]*Students of Dr.D.Y.Patil Pratishthan's College of Engineering Salokhenagar, Kolhapur-416007*
[6]*Professer, Dept. of Mechanical Engineering, Dr.D.Y.Patil Pratishthan's College of Engineering Salokhenagar, Kolhapur, Maharashtra, India.*

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Abstract - *Nowadays, people require high quality for everything. Vibration in today's increasingly high speed vehicles including automobiles severely affects their ride comfort and safety. Certainly, comfort in moving vehicle is people's concern so it is desired to have performance suspension system for vehicles. To improve the ride comfort, effective vibration control of suspension systems is increasing necessary. Ride quality is concerned with sensation or feel of passenger in the environment of moving vehicle. So we develop and implement a two wheeler suspension systems with MR fluid damper. In this, vertical acceleration of main mass is substantially reduced by using controlled MR damper compared to passive system.*

*Key Words***:** MR fluid, Ride comfort, safety, Suspension system, Damper.

1. INTRODUCTION

In particular, it has been found that Magneto-Rheological fluid can be quite promising for vibration reduction applications. MR dampers are semi active devices that contain magneto rheological fluids. After applications of magnetic field the fluid changes from liquid to semi solid state in few milliseconds, so result is an infinitely variable, controllable damper capable of large damping forces. MR damper offer an attractive solution to energy absorption in mechanical system and structures can be considered as 'fail-safe' devices.

Varieties of smart materials already exist, and are being researched extensively. Some everyday items are already incorporating smart materials (coffeepots, cars, glasses) and the number of applications for them is growing rapidly. Magneto rheological materials (MR fluid) are class of smart materials whose rheological properties (e.g. Viscosity) may be varied by applying a magnetic field. Under influence of magnetic field, the suspended magnetic particles interact to form a structure that resists shear deformation or flow. This change in material appears as a rapid increase in apparent viscosity or in the development of semisolid state.

1.1 What is MR fluid?

A Magneto-rheological fluid is a type of smart fluid in a carrier fluid; usually type of oil when subjected to a magnetic field, fluid greatly increases its apparent viscosity, to point of becoming viscoelastic solid. Importantly, yield stress of fluid when in its active state can be controlled very accurately by varying magnetic field intensity. The upshot is that fluids ability to transmit force can be controlled with an electromagnet which gives rise to its many possible control based applications.

2. DESIGN AND DEVELOPMENT

In system design we mainly considered following parameters:-

2.1. Properties of MR fluid

The main properties of MR fluid which influence on system applications such as Off-state viscosity, Yield stress, Durability and In-use thickening, Temperature range, Particle sedimentation etc.

2.2. Selection of MR fluid component

The change in one or more components or in their properties affects MR effect. Hence, need to study various properties of this component which will help in formulation of MR fluids to suit different industrial applications. There are basically three components in an MR fluid i.e. Liquid Carrier, Metal particles, stabilizing additives.

2.3. Damper components

Damper consists of hydraulic cylinder, containing MR fluid and magnetic coil which is implemented on damper and has duty to produce necessary magnetic field.

2.4. Scope of Future Improvement

Arrangement should be provided to expand the scope of work in future. The system will make more effective by providing sensors to system. These MR dampers not only find their applications in automobile industry bot also extend their uses in other areas such as prosthetic limbs, earthquake dampers, aircraft industry for isolating vibration from aircraft structures and aircraft landing gears.
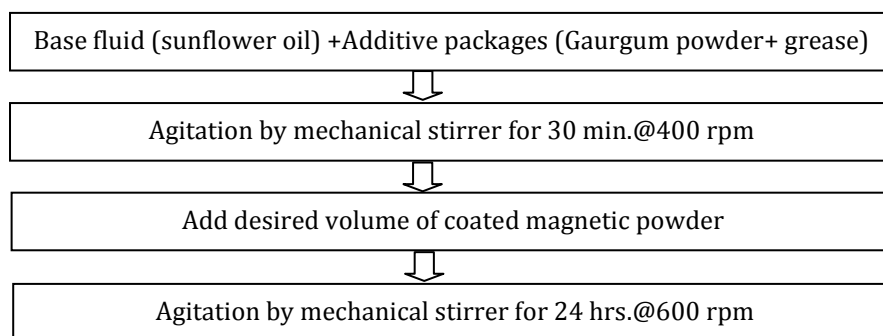
2.5. Synthesis of MR fluid

The synthesis of MR fluid mainly consists of various stages which include selection of MRF components and decision of synthesis route. The formulation of MR fluid involves:

2.5.1. Selection of components

- Selection of magnetic materials (i.e. electrolytic iron powder)
- Ball milling for reduction of size of EI powder, if necessary.
- Selection of suitable carrier fluids (i.e. Sunflower oil).
- Selection of suitable additives (grease).

2.5.2. Coating of magnetic particles

2.5.3. Flow Chart

Base fluid (sunflower oil) +Additive packages (Gaurgum powder+ grease)

⬇

Agitation by mechanical stirrer for 30 min.@400 rpm

⬇

Add desired volume of coated magnetic powder

⬇

| Agitation by mechanical stirrer for 24 hrs.@600 rpm |
|:---:|

2.5.4. Synthesis of fluid Samples

For taking trial, we make 3 samples by varying the percentage of oil and iron powder.

Sr.no.	Sample Name	Base Oil	Iron Powder	Grease	Gaurgum Powder
1	ESu45	Sunflower 49% by wt.	Electrolytic iron powder 45% by wt.	2%	4%
2	ESu55	Sunflower 40% by wt	Electrolytic iron powder 55% by wt	2%	3%
3	ESu60	Sunflower 35.2% by wt	Electrolytic iron powder 60% by wt	2%	3%

2.6. CONSTRUCTION
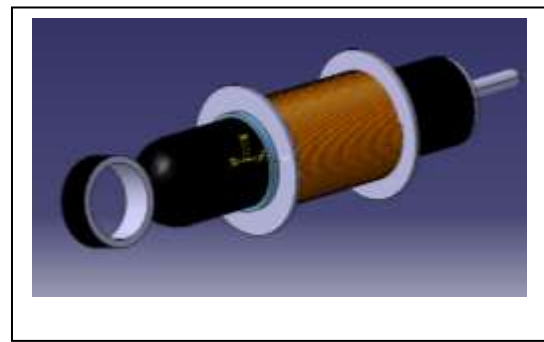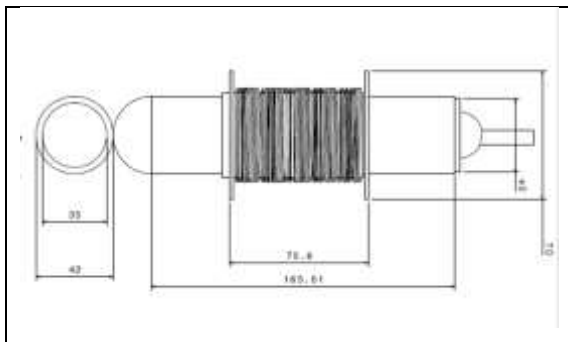
2.6.1. List of components

- MR Fluid containing Electrolyte iron powder, Sunflower oil, Gaurgum powder, Grease etc.

- MR Damper

- Battery

- Electromagnetic coil

3. WORKING

The MR fluid is a smart fluid whose properties can be controlled in presence of magnetic field. In the absence of magnetic field, the rheological properties of the MR fluid are similar to that of base fluid except that it is slightly thicker due to the presence of metal particles.
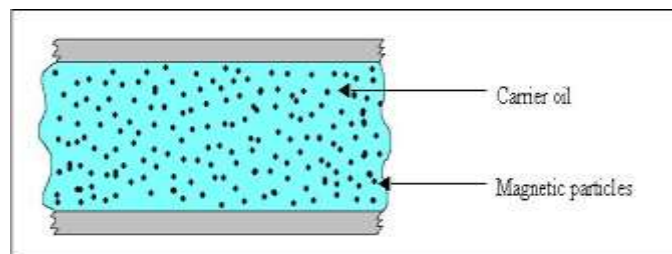

Fig -1: MR Fluid under normal condition (when magnetic current is not applied)

In the absence of magnetic field, these metal particles align themselves along the direction of flow however when a magnetic field is applied each metal particles becomes a dipole aligning itself along the direction of magnetic field. Thus a chain like structure is formed along the line of magnetic flux which offers mechanical resistance to the flow resulting in an increase in the viscosity of fluid. This mechanical resistance created due to the chain column imparts yield strength to the fluid, making it stiff like a semi-solid. MR effect is reversible. When the magnetic field is removed the fluid returns to its original condition where fluid motion is controlled by varying its viscosity with the help of magnetization.
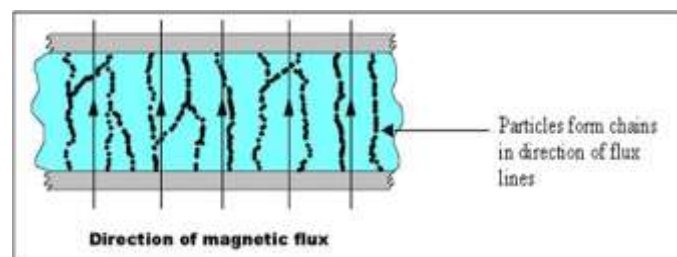

Fig -2: MR fluid under magnetic field

MR damper consists of hydraulic cylinder containing MR fluid and electromagnetic coil which implemented on damper and has to produce necessary magnetic field when current passes from battery to the electromagnetic coil, it gets energized and magnetic field is generated. Under action of magnetic field, MR fluid passes through valve and can reversibly change from free-flowing linear viscous MR fluid to semi solid with controllable yield strength instantaneously. Different parts of MR fluid damper are as follows:

Fig -3: Structure of MRF damper

3.1 Piston

In all dampers main piston contains primary valving components and produces majority of damping forces.

3.2. Main piston tube

This is the tube where main piston operates. In Monotube damper it is also outer tube.

3.3. Valve

3.4. Outer Tube

4. CONCLUSION

The primary objective of this project is to determine feasibility of magneto rheological fluid dampers for motorcycle rear suspension systems. Providing background of magnetorheological technologies and motorcycle suspension system history, it is concluded that magnetorheological fluid dampers for motorcycles would be a perfect application of technology. We also conclude that magnetorheological fluid dampers have better shock absorbing property than passive hydraulic absorbers. Hence MR fluid damper can be used as rear suspension system for two wheeler to improve stability and handling of the vehicle.

5. REFERENCES

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