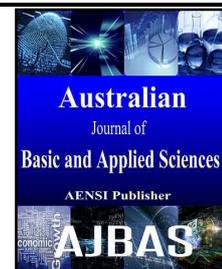




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# Synthesis of Magnetorheological Fluids and Their Applications in Brake

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### ABSTRACT

In this current research work we made study on vibration reduction possibilities of magnetorheological fluids in various magnetic fields and various concentrations of suspension particles. The experimentation of magnetorheological fluid applied in mechanical and physical transmission and even shock absorbing dampers, gives us visual representation of the behaviour of their magical fluid.

## INTRODUCTION

MR fluids are well known as controllable fluids. These fluids are mainly composed of nano or micro sized magnetic particles in its carrier fluid (Kamble and Kolekar, 2014). These fluids are literally magical fluids because they always yield desirable results to the researchers. Various applications of this fluid drew the concentration of many researchers towards it. Many emerging researchers are working on effect of different materials of MR fluids (Fang *et al.*, 2008), (Fang *et al.*, 2010), (Guerrero-Sanchez *et al.*, 2007), (Jang *et al.*, 2005), (Kamble *et al.*, 2015), (Ko *et al.*, 2009), (Lopez-Lopez *et al.*, 2007) and (Gomez-Ramirez *et al.*, 2009), different applications involving MR fluids and effect of different parameters of MR fluids (Bell *et al.*, 2007), (Bell *et al.*, 2008), (Kuzhir *et al.*, 2009), (Lopez Lopez *et al.*, 2009) and (Ngatu *et al.*, 2008).

MR fluids contain the nano/micro sized magnetic particles in carrier fluid which are main component of this smart fluid. Whenever we apply the magnetic field, the particles of this fluid start reacting to it and yield us desirable results. Rheological properties of these fluids are studied by many researchers (Kolekar *et al.*, 2014), (Kamble, Kolekar and Madivalar, 2015), (Jolly Carlson and Munoz., 1996), (Ginder and Davis, 1994), (López-López *et al.*, 2005) and (de Vicente *et al.*, 2004). These MR fluids composed of mainly three types of materials, they are;

- Carrier oil
- Suspension/magnetic particles
- Surfactants

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**Carrier oil:**

It constitutes the major part of the MR fluids. These oils are mainly synthetic oils such as silicone oil, honge oil, castor oil etc. different oils can be chosen by the kind of application. So the different applications will have different kinds of carrier oil.

**Suspension/magnetic Particles:**

Main reason behind the success of these MR fluids are magnetic particles. These fluids are suspended uniformly in the carrier oil in order to obtain desired results. Generally size of these particles varies from nano to few microns. Even the size of the particle greatly influences the variation in results of MR fluids. Cobalt, Nickel, Iron or composition of these ferrous materials can be used as magnetic particles to obtain good results.

**Surfactants:**

These are the agent in MR fluid which is used to avoid the alluviation process of magnetic particles. Surfactants have property to stabilize the suspension particles and make them to disperse uniformly throughout the carrier oil. Some of surfactant are oleic acid, fine white lithium grease, citric acid etc.

**2. Synthesis Technology of Magnetic Liquid:**

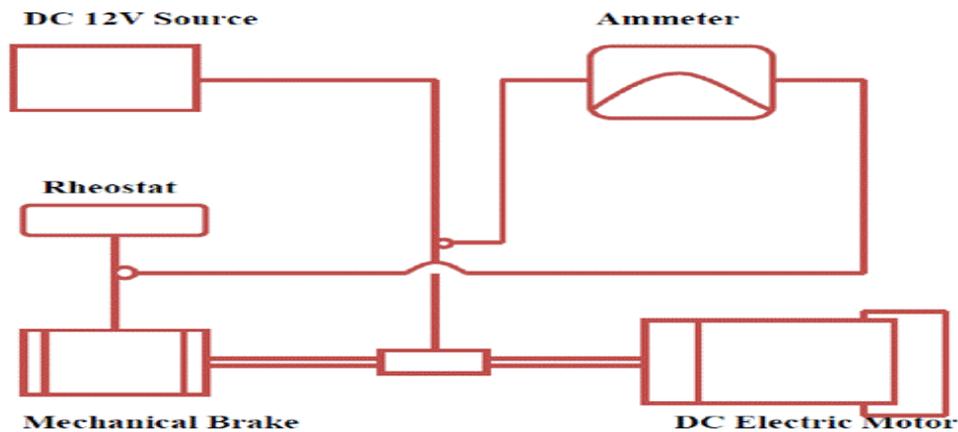
Initially take the carrier oil as per required quantity then pour the chosen surfactant to the measured quantity in to the carrier. The both components have to be stirred and mixed uniformly. This stirring process is done by electric stirrer. The stirring process must be carried out for an hour in order to obtain good results. After an hour pour the magnetic particles of required quantity to the mixture of carrier oil and surfactant. Again stirring process is repeated for one more hour to ensure the uniformity of the magnetic particles. While carrying all these mentioned processes, one has to take extreme care of handling process of the magnetic particles. And have to avoid formation of bubbles in the fluid. Synthesis methods of MR fluid can be seen in many articles (Kolekar *et al*, 2014), (Kamble *et al*, 2014-2015) and (Premalatha, Elizabeth, Chokkalingam and Mahendran, 2012).

**3. Mr Brake Experimental Setup:**

Experimental set up consists of DC 12V power source which provides the constant continuous supply to the DC electric motor. An Ammeter measures current and a rheostat which is for adjusting the resistance. MR brake is connected to DC electric motor through a shaft by which the rotational motion is transmitted to brake for required action.



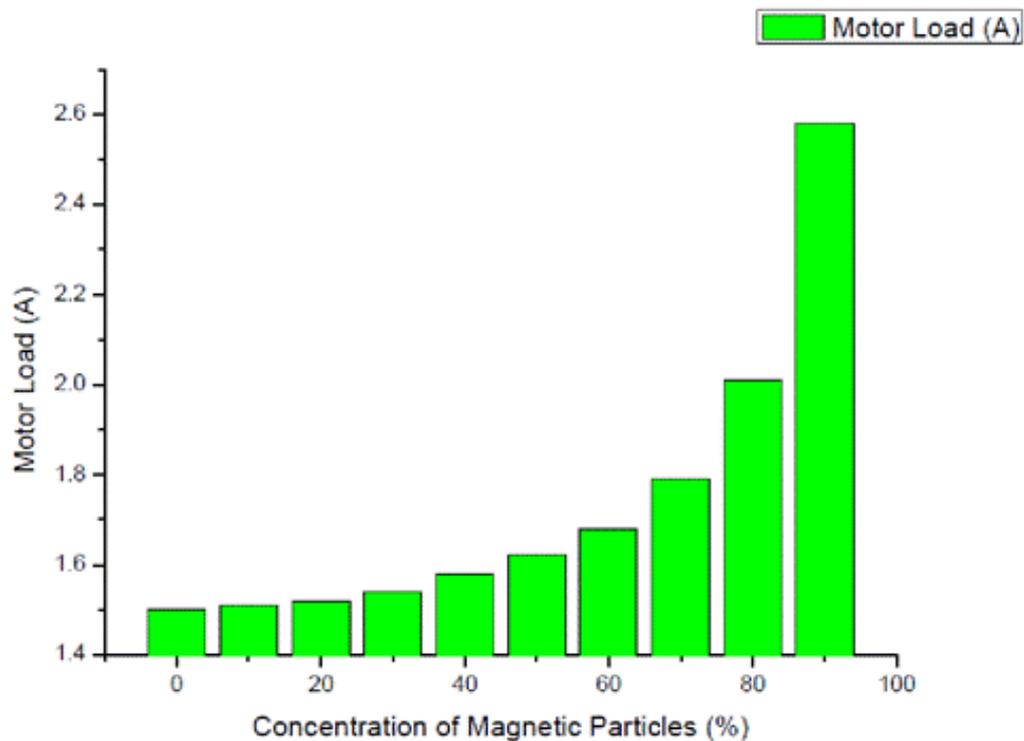
**Fig. 1:** Set up of coupling of brake and motor.



**Fig. 2:** Graphical representation of setup used for testing of MR brake.

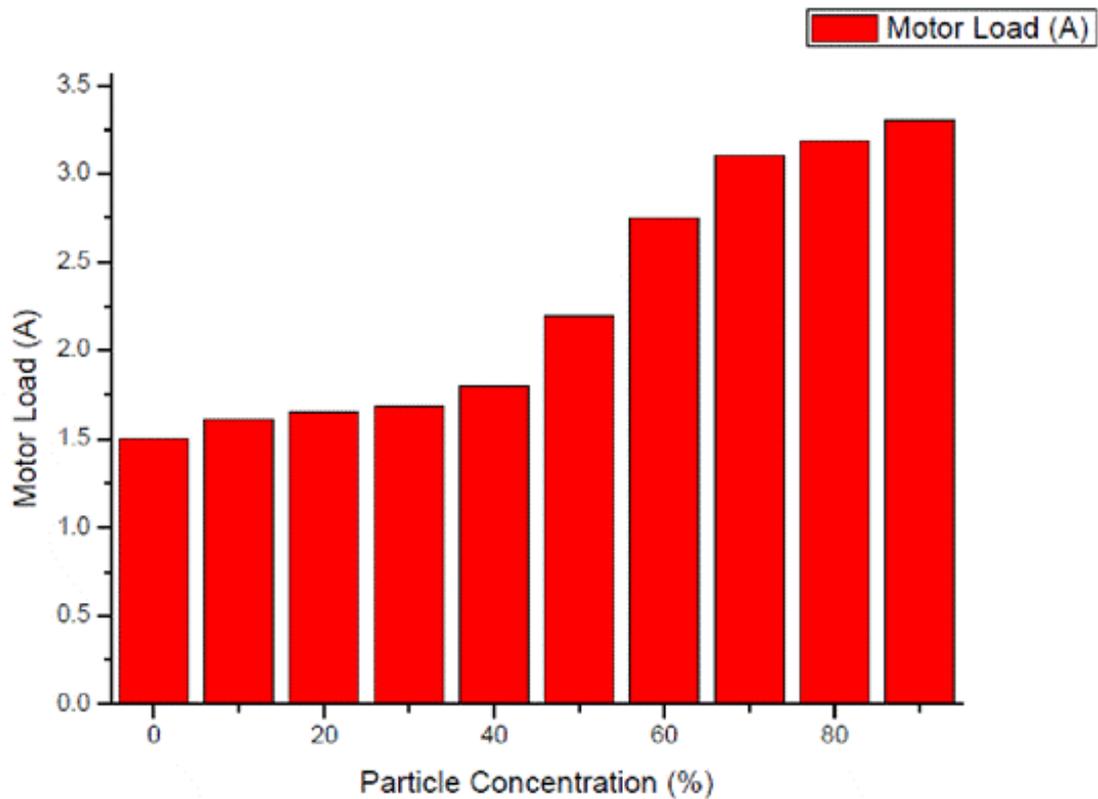
**Results:**

By figure 3 we can observe that the without any applied magnetic field, a higher concentration of suspension particles in MR fluid experiences the higher friction.



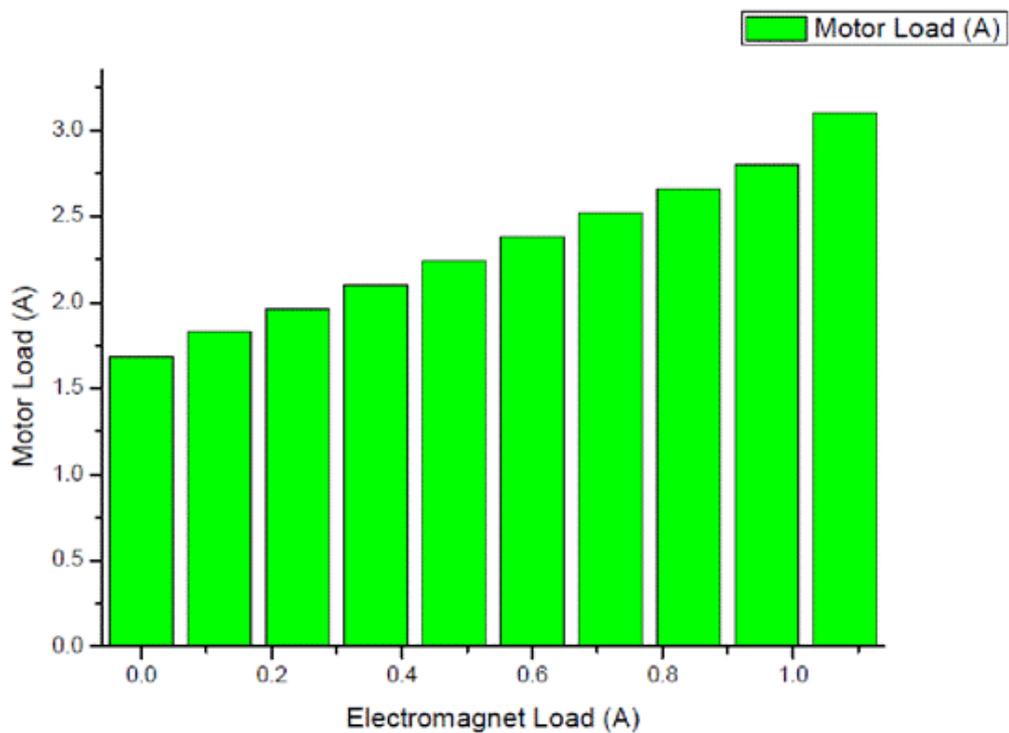
**Fig. 3:** Influence of suspension particle's concentration without any magnetic field.

All these suspension particles generate too much friction due to contact between all adjacent suspensions particles. When we apply DC current to the terminals of the electromagnet, flux is generated that which comes in contact with housing of electromagnet and the rotor. At the instant, the rotor and housing will get magnetized.



**Fig. 4:** Influence of suspension particle's concentration with constant magnetic field.

Without using prepared MR fluid in the brake, the rotor rotates easily without any kind of hurdle even with applied magnetic flux in the components. When MR fluid is induced between gap of rotor and stator, with application of DC current to the electromagnet a high friction is generated due to activated suspension particles which are present in the MR fluid. The same can be observed in the figure 4 and 5.



**Fig. 5:** Motor load at 40% magnetic particles with variable magnetic field.

As we all know that, MR fluid responds to various magnetic fields. So we can vary the force of the brake as much as we want at certain limits. Best advantage of MR fluid in transmission system is that there are no wear and tear losses between the mechanical parts which are present in the system.

### Conclusions:

In this current research initially it's explained that the methodology of synthesis of magnetorheological fluids, which is very helpful for other researchers to adopt the same. Then same prepared magnetorheological fluids are used in MR fluid Brake to test the conditions at various loads and explained them briefly. This study will surely be helpful for those who are working on the same field.

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