Behavior of MR fluid in response to external excitations

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Abstract

This paper predicts the behavior of MR fluids under magnetic fields. MRF-122EG MR fluid is investigated in this study which is hydrocarbon oil based MR fluids. The current values responsible for generating magnetic flux density are determined. It is quite clear that maximum magnetic flux density is 1 tesla corresponding to the current of 4.6 Amp. It is also evident that yield stress of MR fluid depends upon the magnetic flux density produced by fluid particles. The amount of fluid particles is responsible for increase in shear stress produced by MR fluid. However the amount of fluid particles should not increase 60% otherwise the sedimentation problem is encountered.

Introduction

This paper shows the relationship between yield stress and magnetic field in shear mode is obtained from number of experiments. Experiments are conducted at 10 rpm as shown in figure below, which is very low speed, so that effects of viscosity on the applied torque are kept minimal. And thus can be neglected. Results of the experiment are tabulated in Table 1. The same data is shown graphically in Fig. 1. Equation 1 is used to calculate the yield stress from the resisting torque offered by the Servo Motor.

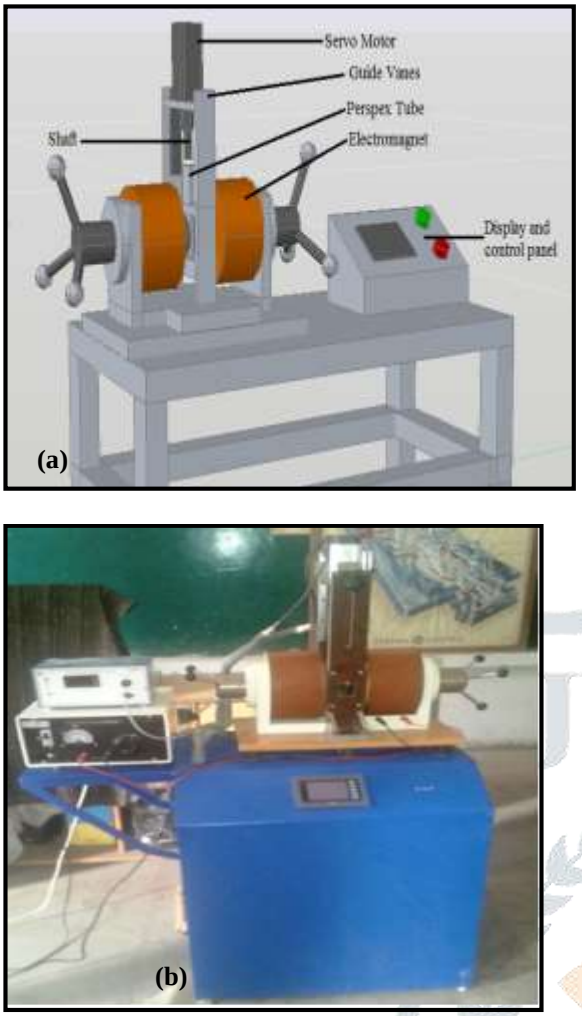

Fig. 1 Views of the set up

Table 1: Results of the Experiment

Current(Amp)	Magnetic Flux Density (Tesla)	Torque (Nm)	Yield Stress (kPa)
0	0	0.06	3.230478
0.2	0.0108	0.08	4.307305
0.4	0.174	0.1	5.384131
0.6	0.241	0.14	7.537783
0.8	0.266	0.18	9.691435
1	0.328	0.23	12.3835
1.2	0.413	0.25	13.46033
1.4	0.456	0.3	16.15239
1.6	0.47	0.36	19.38287
1.8	0.52	0.4	21.53652
2	0.586	0.43	23.15176
2.2	0.626	0.46	24.767
2.4	0.665	0.5	26.92065
2.6	0.701	0.52	27.99748
2.8	0.743	0.53	28.53589
3	0.782	0.54	29.07431

3.2	0.812	0.54	29.07431
3.4	0.85	0.56	30.15113
3.6	0.891	0.56	30.15113
3.8	0.92	0.57	30.68955
4	0.948	0.58	31.22796
4.2	0.978	0.58	31.22796
4.4	1.009	0.59	31.76637
4.6	1.03	0.59	31.76637

From thus graph, it is evident that yield stress of MR fluid depends upon the magnetic flux density produced by fluid particles. The amount of fluid particles is responsible for increase in shear stress produced by MR fluid. However the amount of fluid particles should not increase 60% otherwise the sedimentation problem is encountered.

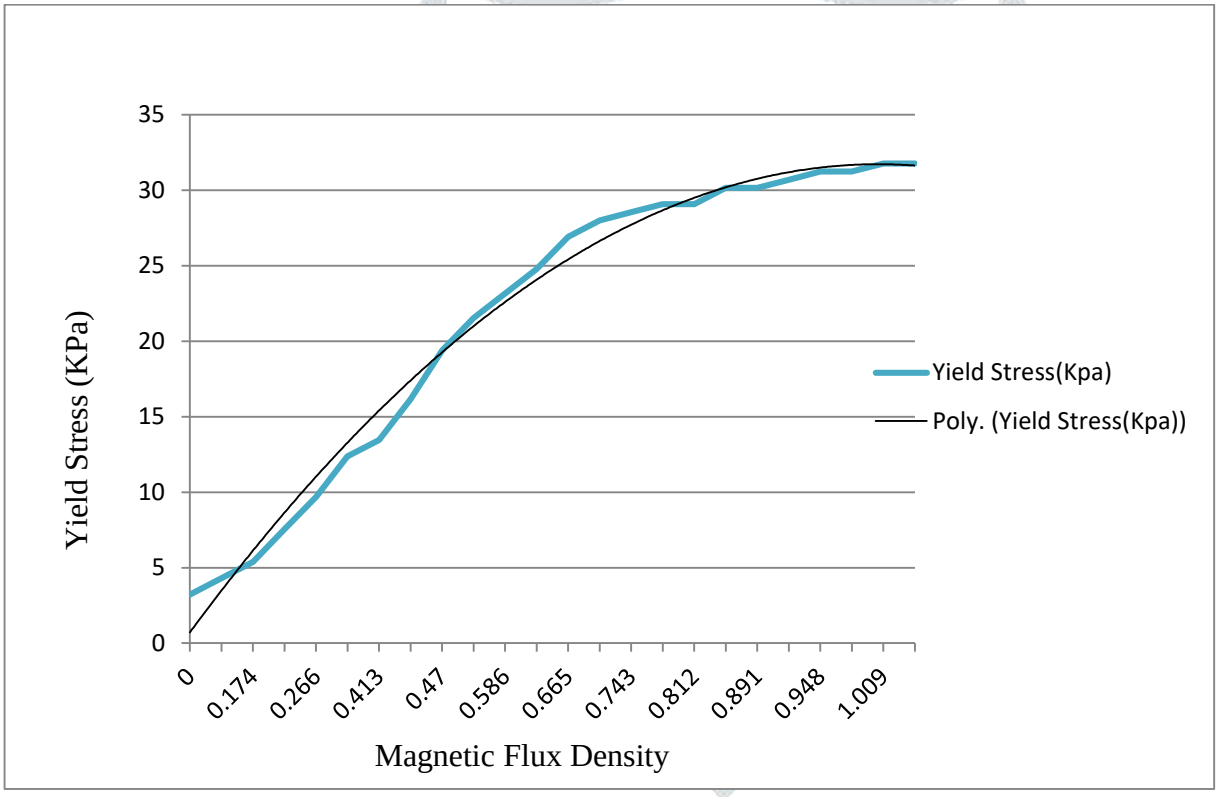

Fig. 1: Plot of experimental values between Yield Stress and Magnetic Flux Density

Experimental values

Current(Amp)	Values
0.6	0.241
0.8	0.266
1	0.328
1.2	0.413
1.4	0.456
1.6	0.47
1.8	0.52
2	0.586
2.2	0.626

2.4	0.665
2.6	0.701
2.8	0.743
3	0.782
3.2	0.812
3.4	0.85
3.6	0.891
3.8	0.92
4	0.948
4.2	0.978
4.4	1.009
4.6	1.03

The current values responsible for generating magnetic flux density are shown in the table below. From this table it is quite clear that maximum magnetic flux density is 1 tesla corresponding to the current of 4.6 Amp. This magnetic flux density is responsible for magnetizing the fluid particles .

3 Conclusions

In this paper, behavior of MR Fluid in ON state under experimental conditions is discussed. Results of the experiment and a plot between yield stress and magnetic flux density are also presented. From these results it is clear that magnetic flux density is the function of amount of fluid particles and these particles should not be more than 60%.

References

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