Compressive Properties of Magnetorheological Elastomers

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Abstract

Magnetorheological Elastomer (MRE) were prepared with silicone rubber and carbonyl iron powder. When the excitation frequency is constant, the amplitude of the vibration acceleration of the vibration isolator decreases obviously with the increase of the coil current, which indicates that the excitation coil generates a magnetic field under the applied current, the MRE is in the magnetic field and the internal magnetic particles are The effect of the magnetic field force, the interaction force is enhanced, the elastic modulus of the MRE is increased, thereby increasing the stiffness of the vibration isolator and acting as the vibration isolation effect.

Keywords

magnetorheological; elastomercompressive properties.

1. Introduction

Magnetorheological elastomer is a new type of magnetic functional material in which ferromagnetic particles are dispersed in a polymer matrix[1-3]. In the presence of magnetic field or magnetic field, the rheological properties of the magnetorheological elastomer are characterized by the addition of magnetic field Can occur under continuous, rapid and reversible changes[4].

Magnetorheological elastomer is the most important evaluation index of its magnetron performance, especially in the dynamic environment of the magnetic control performance, directly related to the application of magnetorheological elastomers[5-6]. This paper mainly studies the performance of magnetorheological elastomers in compression mode

2. Experiments

2.1 Preparation of MRE

MRE is mainly composed of magnetic particles and matrix. The magnetic particles were uniformly dispersed in the matrix, and a certain amount of catalyst was added to prepare MRE[7-8]. Firstly,using the balance to take the appropriate quality of carbonyl iron powder and 184 silicone rubber, into the mortar by mixing and mixing for 10min, the mixture into the vacuum oven, the extraction of air for 10min, filter out the air in the mixture;Then，add 10% of the catalyst with a volume ratio of 184 silicone rubber to the kneaded mixture. The mixture was stirred for 10 min. The kneaded mixture was placed in a vacuum oven again, the air was taken for 10 min, and the air in the agitator was filtered again. Finally, the mold was cleaned using an ultrasonic cleaner, and then the mixture was poured into a mold and placed in a homemade magnetic field device. The whole apparatus was placed in a vacuum oven and heated to a temperature of 120 °C for 1.5 h to prepare MRE.As shown in Figure 1[9-11].

Fig. 1 magnetorheological elastomers

2.2 Extrusion stress test

Figure 2 and Figure3 show the test platform of the vibration isolator. The use of motor installation eccentric wheel way to produce exciting force, the regulator adjusts the motor input voltage, and then change the motor speed, to achieve the excitation frequency changes.

By changing the experimental conditions, the acceleration amplitude of the vibration platform is collected to test the vibration isolation effect of the magnetorheological elastomer isolator.

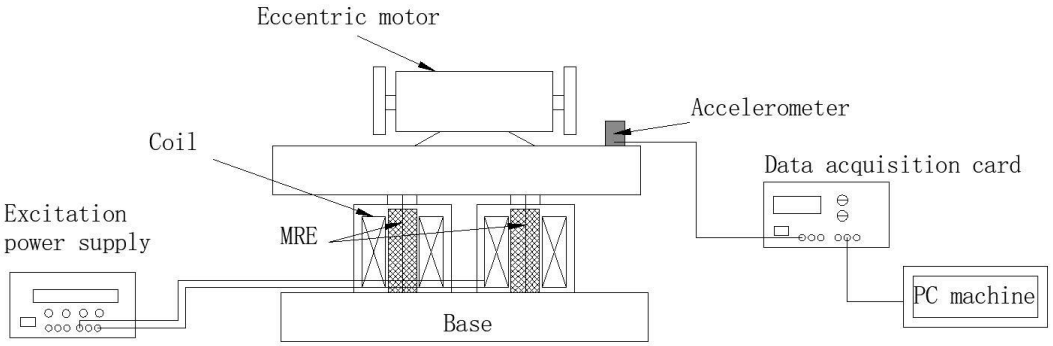

Fig. 2 Schematic diagram of vibration response test platform

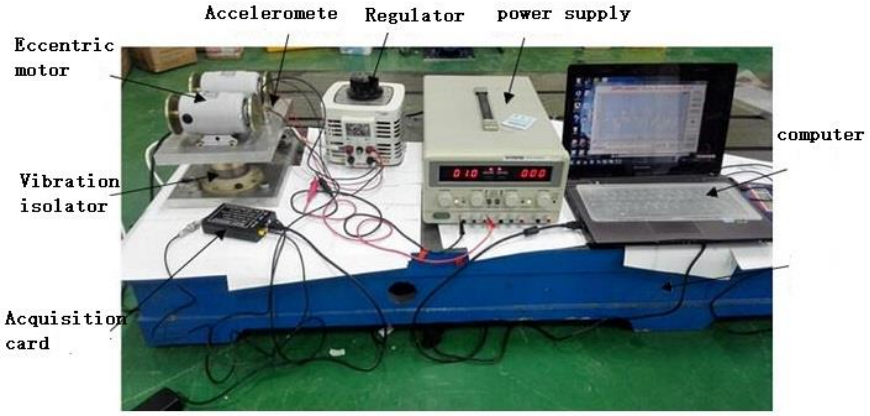

Fig. 3 Vibration isolation test platform

Set the external excitation frequency of 20Hz, set the current from 0 to 0.5A, 1A, 1.5A, 2A, through the acceleration sensor to collect the vibration frequency of the vibration isolator; set the excitation frequency of 30Hz, 40Hz, 50Hz, 60Hz, Under the same conditions, the vibration frequency of the vibration isolator is tested.

3. Results and Discussion

The test method of the hybrid vibration isolator is the same as that of the MRE isolator. The vibration isolation performance of the hybrid vibration isolator is analyzed by changing the excitation frequency and the applied current. Figure 4-8 for the excitation frequency is set to 20Hz, the acquisition card to collect the experimental data.

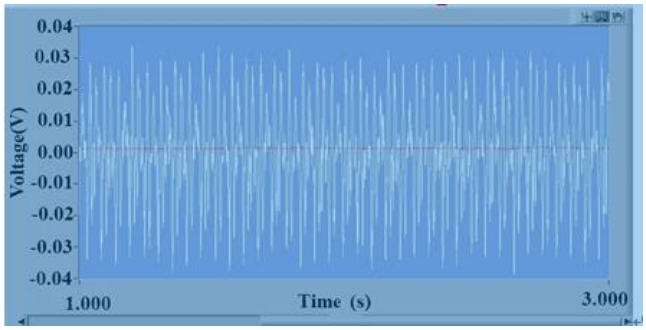

Fig. 4 0A current, the vibration system responds

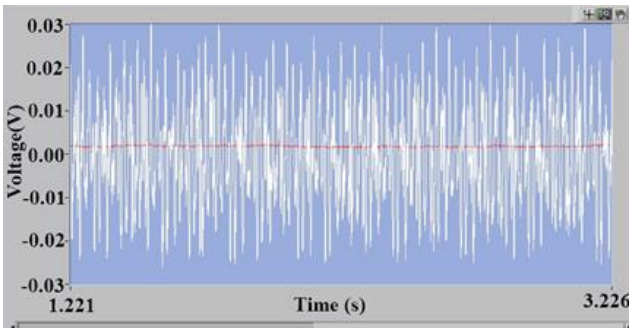

Fig. 5 0.5A current, the vibration system responds

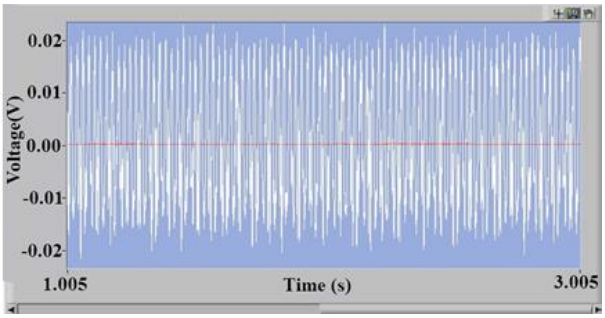

Fig. 6 1A current, the vibration system responds

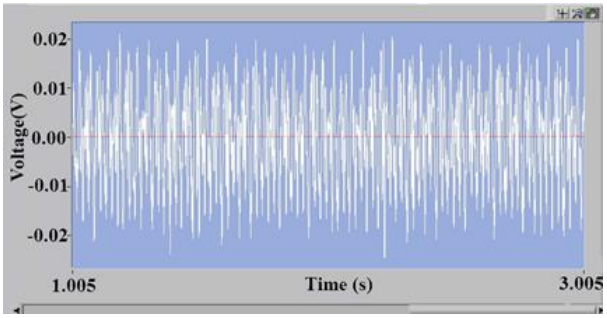

Fig. 7 1.5A current, the vibration system responds

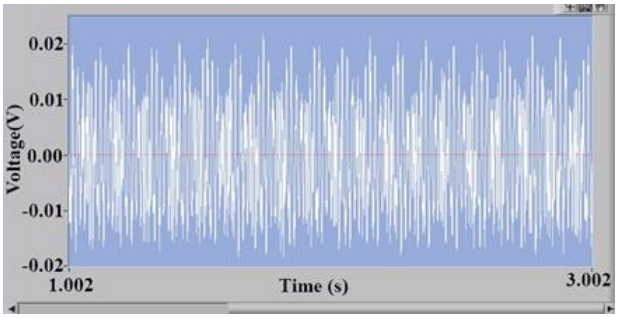

Fig. 8 2A current, the vibration system responds

4. Conclusion

With the increase of the applied current, the vibration isolation effect of the vibration isolator is obvious, and the acceleration amplitude of the vibration is obviously reduced. This shows that the magnetic field environment, the magneto-rheological elastomer stiffness and damping changes; specifically, the MRF in a single particle under the action of magnetic field force, condensed into a chain structure, so MRF viscosity increases, increased damping. MRE in the magnetic field environment, the internal magnetic particle chain by the force, the interaction force to strengthen, MRE elastic modulus increases. MRE and MRF mechanical properties change, making the hybrid elastomer stiffness and damping become larger, hybrid vibration isolator vibration attenuation rate greater isolation better.

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