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DELIVERING QUALITY SCIENCE TO THE WORLD

Preparation of Magnetorheological Elastomers

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Abstract: Magnetorheological elastomers are a branch of magnetorheological materials composed of micron-scale ferromagnetic particles and liquid macromolecular polymers. The particles are ordered to form an ordered chain structure under the pre-applied solidified magnetic field. After curing the particles remain unchanged in this structure, and there is no problem of particle settling and sealing. It can be widely used in intelligent mechanisms, vibration shock absorber and sensors and other fields.
Keywords: Magnetorheological elastomer, magnetic field, particles

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1. INTRODUCTION

Magnetorheological materials are a kind of intelligent materials, and their rheological properties can change rapidly with the change of magnetic field. These materials are usually composed of micron-sized ferrite particles dispersed in a fluid or elastomer. The first discovered magnetorheological material is the MR fluid, a colloidal suspension that can change its phase between the liquid and the solid under magnetic field control. However, due to the magnetorheological fluid appeared grain settling, poor stability, the need for sealing and other issues, so the magnetorheological elastomer came into being, because of its good controllability, reversible, fast response, good stability and so on. The model has good application prospect in vibration isolation and vibration damping. Such as Bartłomiej Dyniewicz uses a magnetorheological elastomer for semi-active control of structural element vibrations, which effectively reduces vibration [1]. CY Yang designs a new magneto-rheological elastomer isolator with shear-compression mode. The natural frequency of the elastomer isolator varies greatly with the applied variable current, and the amplitude of the vibration is widely attenuated [2].

2. DEVELOPMENT STATUS AT HOME AND ABROAD

At present, the application of this new material is still in its infancy, but some scholars and

experts at home and abroad have made a pioneering exploration. In recent years, researchers in France, Sweden, Canada, Singapore and other countries have also conducted studies on the properties of magnetorheological elastomers.

In preparation, Yancheng Li's paper deals with the brief introduction of materials and the design of magnetorheological elastomer devices due to the need to consider the effects of matrix, particles, additives, preparation processes, devices and so on [3]. Biswajit Nayak pointed out in the study that the addition of carbon black improves the mechanical properties of magnetorheological elastomers [4]. S. Aguib evaluated the rheological properties of the load elastomer with and without the effect of a magnetic field [5]. M Yu proposed a new method for the preparation of magnetorheological elastomers [6]. S. Raa Khimi and K. L. Pickering prepare isotropic and anisotropic magnetorheological elastomers containing unmodified and silane-modified iron sand particles in a natural rubber matrix [7]. A. M. Biller studied the interaction between two particles made of isotropic linearly polarizable magnetic material and embedded in the elastomeric matrix [8]. Ioan Bica studied the graphene nanoparticles for the preparation of mixed conductive magnetorheological elastomers [9]. Benxiang Ju manufactures a new type of polyurethane material and serves as a matrix for MRE. The effects of several factors on the mechanical properties of MRE samples are studied experimentally [10].

The research on rheological materials in China started later, and the research scope was mainly in the field of magnetorheological fluids and their applications. Research papers on magnetorheological elastomers have been published since 2002. China University of Science and Technology is at the forefront of its research.

In order to develop high performance magnetorheological elastomers suitable for engineering applications, a variety of factors have been studied to study the factors affecting the performance of magnetorheological elastomers. Therefore, the effect of different factors on the performance of magnetorheological elastomers is the hotspot in the field of magneto-rheological elastomer materials at home and abroad. The research on its performance is focused on the analysis of mechanical properties, including shear, stretching, compression, but also its magnetic, electrical research. When it comes to application of the device, the thickness of the rheological elastomer directly affects the structural optimization of the device, so it is necessary to study the influence of the thickness of the magnetorheological elastomer.

3. PREPARATION OF MAGNETIC FLUX ELASTOMER

3.1 Experimental apparatus

1) Magnet: The required magnetic field required to produce a magnetorheological elastomer, providing a maximum magnetic induction of about 800 mT.

Fig.1 Magnetic

2) Electronic balance: Used to weigh, the model is HZT-A +200.

Fig.2 Electronic balance

3) Mortar: Used to place and stir the material called.

Fig.3 Mortar

4) Vacuum drying oven: Used to extract the air in the mixed material, and heating.

Fig.4 Vacuum drying oven

3.2 Preparation program

Magnetorheological elastomers (MREs) are micro-sized ferromagnetic particles dispersed in the liquid polymer, in the role of external magnetic field under the magnetization and the formation of ordered structure of the composite material.

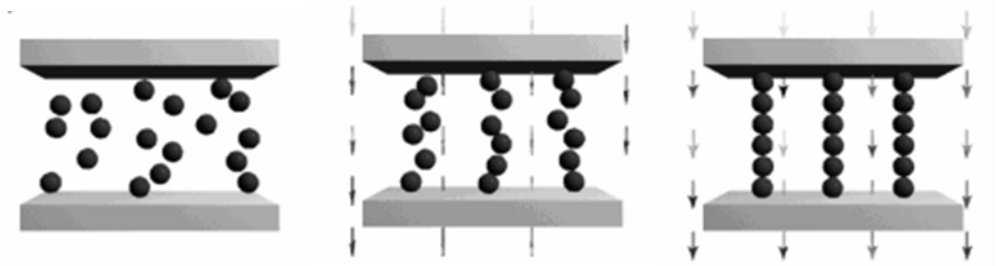

Fig.5 Microstructures of the MRE curing process

Based on the minimum energy principle, a system always has to adjust, so that the total energy of the system to a minimum, and thus in a stable balance. The particle distribution in Fig.5 coincides with the minimum energy principle for the magnetic field, and the particles are polarized and arranged along the direction of the magnetic field to show anisotropy.

The magnetron elastomer is mainly composed of ferromagnetic particles, matrix material and catalyst. The ferromagnetic particles used in this experiment are carbonyl iron powder of MPS-MRF-35. The matrix material is Dow Corning 184 silicone rubber, which contains matrix material and catalyst, The quality ratio by 10: 1 mixed to join. The best performance volume ratio of 27%, is to prepare a total volume of 20mL of the magnetorheological elastomer, the preparation steps are divided into three steps:

1. First, the weight of the balance will be used to calculate, respectively, by weighing 42.39g of carbonyl iron powder and 15.33g of silicone rubber, into the mortar by mixing and mixing

for 10min, the mixture placed in vacuum drying Box, the extraction of air for 10min, filter out the air in the mixture;

2. Second, weighed the catalyst for the weight of 1.533g, added to the mortar, again manually mixing 10min, into the vacuum oven, the extraction of air for 10min, filter out the air in the mixture;

3. Third, the mixture into the prepared mold, quickly into the curing magnetic field, the entire device into a vacuum oven heating, until the temperature reaches 120 degrees, and then continue to heat for 1 hour, you can complete the preparation of a magnetorheological elasticity body.

Fig.6 is a magnetorheological elastomer sample prepared at a cured magnetic field.

Fig.6 Magnetic rheological elastomers have field preparation samples

The preparation of magnetic rheological elastomers is divided into field and no field preparation. When prepared in magnetic field environment, the solid magnetic field is generally uniform magnetic field. Although it can form microstructure such as mesh and columnar, it is still in the direction of magnetic field of the linear chain structure. The above procedure is described in the preparation procedure in a magnetic field environment. In the absence of field conditions, only the solidified magnetic field is removed. So the current preparation of the elastomer in the field performance is more excellent.

4. CONCLUSION

In this paper, the preparation experiments of MRE samples were carried out. In the process of preparation, the suitable materials and the required hardware were selected. By observing and comparing the samples prepared with a magnetic field and a non-magnetic field by electron microscopy, it can be concluded that it is a viscoplastic body under magnetic field conditions and is Newtonian fluid under no magnetic field conditions. Therefore, the elastomers prepared at present Magnetic field performance is more excellent and higher rheological effect.

This paper describes the process of preparing magnetorheological elastomers based on the minimum energy principle and produces the test samples. The sample can achieve the desired

target and has better controllability, reversibility, quick response and good stability than liquid. Especially, its magnetic effect is manifested in that the elastic modulus of magnetorheological elastomer changes with the magnetic field, that is to say, the stiffness changes.

Rotary kiln is also used in the production of saloon with production capacity by burning specific clay soil that possesses adequate quantity of silica, alumina, and iron oxides. The external diameter of the kiln is.

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