Loss factor behavior of thermally aged magnetorheological elastomers

ABSTRACT

Polymer composites have been widely used as damping materials in various applications due to the ability of reducing the vibrations. However, the environmental and surrounding thermal exposure towards polymer composites have affected their mechanical properties and lifecycle. Therefore, this paper presents the effect of material-temperature dependence on the loss factor and phase shift angle characteristics. Two types of unageing and aging silicone-rubber-based magnetorheological elastomer (SR-MRE) with different concentrations of carbonyl iron particles (CIPs), 30 and 60 wt%, are utilized in this study. The morphological, magnetic, and rheological properties related to the loss factor and phase shift angle are characterized using a low-vacuum scanning electron microscopy, and vibrating sample magnetometer and rheometer, respectively. The morphological analysis of SR-MRE consisting of 30 wt% CIPs revealed a smoother surface area when compared to 60 wt% CIPs after thermal aging due to the improvement of CIPs dispersion in the presence of heat. Nevertheless, the rheological analysis demonstrated inimitable rheological properties due to different in-rubber structures, shear deformation condition, as well as the influence of magnetic field. No significant changes of loss factor occurred at a low CIPs concentration, whilst the loss factor increased at a higher CIPs concentration. On that basis, it has been determined that the proposed changes of the polymer chain network due to the long-term temperature exposure of different concentrations of CIPs might explain the unique rheological properties of the unaged and aged SR-MRE.