Data Article

Dynamic mechanical analysis data of PEG/amorphous-silica composites

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A B S T R A C T

Data in this article presents the dynamic thermomechanical properties of PEG/amorphous-silica composites with different silica content, i.e. 0, 20 and 40% by weight. These composites were prepared using a solid-state method. The morphology of the amorphous-silica filler powder was determined using the transmission electron microscopes (TEM). Furthermore, the storage modulus ($G'$) data as a function of temperature were determined from the dynamic mechanical analysis (DMA) data in a shear mode. Moreover, the melting temperature and the activation energy for the degradation of each sample were also reported.

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1. Data

Data presented in this work describes the dynamic thermomechanical properties of PEG/amorphous-silica composites. In order to show the morphology of the amorphous silica filler about the characteristics of the composites, a transmission electron microscope (TEM) was used and the data is presented in Fig. 1.

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The composites were prepared by mixing with a solid-state method. The formation of the composites was confirmed using XRD patterns of the pure PEG and the composites as shown in Fig. 2.

The shear storage moduli data as a function of applied temperature for all specimens are presented in Fig. 3. These data were processed to determine the melting temperature and the activation energy for the degradation of PEG/silica composites which are presented in Table 1.

2. Experimental design, materials, and methods

The PEG/amorphous-silica composites with composition variation were prepared by using silica filler which was obtained from purified local silica sand. The sample preparation of the silica filler used in this data article was taken from a stage section in the recently related work [2].

The composites were prepared using the solid-state method. The mixture of PEG and amorphous silica was heated at 50 °C then was cooled to room temperature to allow solidification. The filler content was 0, 20 and 40% amorphous SiO2 by weight, and thus the samples were designated as P100, PA20, and PA40, respectively.

The melting temperature is investigated by using the minimum value of the derivative of storage modulus, whereas the activation energy for degradation is determined from the Arrhenius equation

\[ f = f_0 \exp \left( \frac{-E_a}{RT} \right) \]  (1)
where $f$ is the applied frequency, $T$ is the transition temperature (in this work, the transition temperature in this range temperature can be associated with the melting of the polymer, so that $T = T_m$), $R$ is the universal gas constant, and $E_a$ is the activation energy for degradation. Here, we relate the degradation with the melting temperature for various applied frequencies. Then, for a particular sample, by plotting $T_m$ versus logarithmic frequency, a line will be obtained and from its slope, the activation energy for degradation of the sample can be gained. The plots for all samples are shown in Fig. 4.

Fig. 1. The TEM micrograph of the amorphous silica powders.

Fig. 2. X-ray diffraction patterns (Cu-Kα radiation) of pure PEG (P100), pure amorphous silica (A100) and PEG/amorphous-silica composites (PA20 and PA40).
**Fig. 3.** DMA shear storage modulus vs. Temperature for pure PEG and PEG/amorphous silica at 1 Hz.

**Table 1**
Melting temperature and degradation activation energy ($E_a$) of pure PEG and PEG/silica composites.

| Silica content (%wt.) | $T_m$ (°C) | $E_a$ (kJ/mol) |
|-----------------------|------------|----------------|
| 0                     | 41.7       | 352            |
| 20                    | 48.3       | 451            |
| 40                    | 50.0       | 528            |

**Fig. 4.** Plots of $\ln (f \text{ in Hz})$ against $1000/T$ according to the Arrhenius equation for the PEG/amorphous-silica composites.
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Transparency document

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References

[1] F. Nur Aini, Musyarofah, Mashuri Triwikantoro, S. Firdaus, S. Pratapa, Dynamic mechanical properties of PEG 4000 + quartz composites, Adv. Mater. Res. 1112 (2015) 385–388. https://doi.org/10.4028/www.scientific.net/AMR.1112.385.

[2] S. Pratapa, T. Wahyuni, N.A. Fauziyah, G.A. Apriliyana, M. Mashuri, S. Firdaus, Synthesis and thermomechanical characterization of PEG/cristobalite composites, J. Mech. Sci. Technol. 31 (2017) 3653–3656. https://doi.org/10.1007/s12206-017-0703-2.