Epoxy resin / fly ash composites: Effect of sonication time on thermo-mechanical behavior

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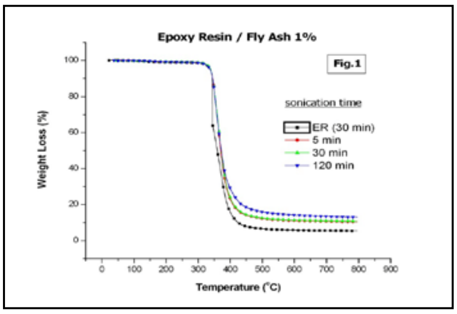
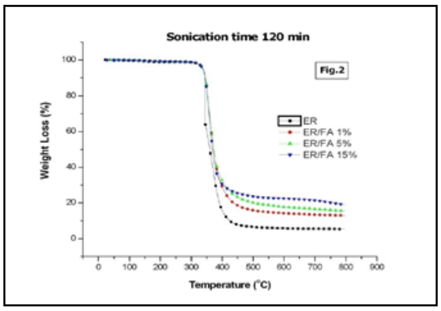
In this work the thermo-mechanical properties of epoxy resin (ER) composites filled with fly ash (FA) has been investigated [1-3]. Fly ash was produced at the power stations of Kozani region and it is rich in CaO, due to the origin of the burned lignite. When embedded into a polymer matrix, FA appears in the form of aggregates. In order to suppress the possible formation of fly ash agglomerates and/or bundles, high speed shearing for 15 minutes and sonication for 5, 30 or 120 minutes was applied. Fly ash weight content was equal to 1, 2 or 5 %. Several complementary experimental techniques (such as SEM, DMA, DSC and TGA) were employed to study the dispersion of fly ash particulates within the epoxy matrix, the dynamic mechanical behavior and the thermal properties of the composites. SEM examinations reveal that, after longer sonication time, the fly ash morphology changes from a discontinuous set of aggregated clusters to a more homogeneous dispersion of the fly ash particles. It was also found that the storage modulus (E΄) for the sample with 1% of FA after 120 min of sonication is 16,7% higher than that of the pure epoxy. However, it is slightly affected in the rubbery state. Glass transition temperature (T_g), as estimated by DMA and DSC measurements, is slightly decreasing by increasing the fly ash content and the sonication time. In addition, in the filled samples, T_g is lower than that of the neat resin. These variations could be explained on the basis of deaggregation and better dispersion of the fly ash particulates and to free volume increase due to sonication process. TGA experiments confirm that the incorporation of fly ash inclusions enhances the thermal properties of the epoxy matrix. All the composites studied show good thermal stability for temperatures up to 330 ^{o}C with a maximum decomposition temperature higher than 360 ^{o}C (Figures 1,2). A small increase to the calculated residual weight (char content) with increasing fly ash concentration is also observed.





Figures 1 and 2: Typical TGA plots for the epoxy resin / fly ash composites

References

[1]. K.W.-Y. Wong and R.W. Truss, Compos. Science and Technology, **52**, 3, 361(1994).
[2]. J. Gu, G. Wu and Q. Zhang, Materials Sc. and Engineering: A, **452**, 614 (2007).
[3]. I. Ahmad and A. Mahanwam, Journal of Minerals & Materials Characterization & Engineering, **9**, 3,183 (2010).

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