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Investigations on properties of polyhedral oligomeric silsesquioxane (POSS) and halloysites nanotubes (HNT) reinforced polyurethane elastomer hybrid nano-composites

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The improvement of various properties of polyurethane elastomer-thermoplastic polyurethane (TPU) is still of great interest for scientists and researchers due to the expansion of its application areas. In this study, TPU matrix was reinforced with polyhedral oligomeric silsesquioxane (POSS) and halloysites nanotubes (HNT) by addition of them as separately and in hybrid forms. The preparation of composites was carried out using a lab-scale micro-compounder with the loading ratios from 0.5 wt% to 2.0 wt%. The test samples were prepared using injection-molding. As for TPU/POSS/HNT hybrid composites, the loading percentages were (0.5%, 0.5%), (1.0%, 1.0%), (0.5%, 1.5%), and (1.5%, 0.5%). Mechanical, damping, tribological, melt flow and morphological properties of TPU based composites were reported by performing tensile and hardness test, dynamic mechanical analysis (DMA), abrasion resistance test, melt flow index test, and scanning electron microscopy (SEM) methods, respectively. The mechanical properties are improved with the incorporations of HNT and POSS nanoparticles as their both individual and hybrid forms which were revealed by tensile test. HNT and POSS additions at their lowest loading ratios (0.5%) level up the tensile strength of TPU to nearly 20% and 12% higher values, respectively. Further additions of these fillers cause reductions for strength values of composites. No remarkable differences are observed in percent elongation and elastic modulus of TPU after HNT and POSS inclusions. Shore hardness of unfilled TPU slightly increases with the incorporation of the HNT and POSS. According to DMA analysis, the highest loss modulus is observed for 1.0% POSS loaded composite. HNT and POSS containing composites yield higher values in tan δ for the lowest filling ratios. As the SEM micrographs of selected composites examined, formations of agglomerates are observed for higher loading level of HNT and POSS nanoparticles. Homogeneity of their mixing in TPU matrix decreases as the concentrations of POSS and HNT increase. As a comparison, HNT containing composites exhibit slightly higher values over POSS filled composites. This greater reinforcing effect of 1D structured HNT may stem from its larger surface area and aspect ratio relative to POSS with particulate structure.

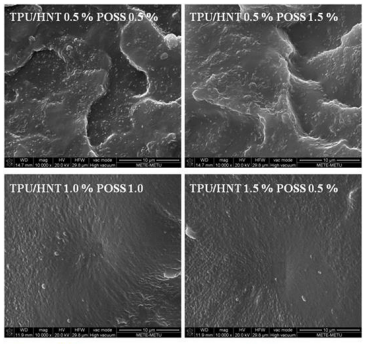


Figure 1: SEM micro-images of hybrid composites with 10,000 magnifications

Biography

Alinda Öykü Akar is a Researcher in an industry, who focuses on different studies while collaborating with universities. She works on new formulations of polyurethane elastomer, in response to need of industry while providing unique solutions for process troubleshooting and application related issues. She works on projects for reinforcement of thermoplastics and optimization studies for produced composites in accordance to material characterizations. Her researches on polymeric composites aim to sustain systematic investigation on mechanical, physical, thermal and morphological properties of composite materials. Her academic studies are concerned with biodegradable and biocompatible polymer composites. She is pursuing her PhD in process optimization studies of polyurethane elastomer through DOE and modeling studies while conducting material characterization techniques for investigation of produced material to figure out effect of different process parameters for optimization study.

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