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Coupled Aging Effects in Nanofiber-Reinforced Siloxane Foams

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Abstract. This study investigates the combined effects of ionizing radiation and thermal treatments on the aging of siloxane foams containing small amounts of carbon nanofibers. Our siloxane foams were exposed to accelerated aging conditions for more than two years, resulting in very low dose rates. In addition, foams were aged under compressive load to evaluate the strength of the porous microstructure. Samples were characterized by differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), Fourier transform infrared spectroscopy (FTIR), nuclear magnetic resonance spectroscopy (NMR), Mössbauer, mass spectroscopy, electron paramagnetic resonance spectroscopy (EPR), solvent swelling, imaging techniques, uniaxial compressive load testing and tear testing. No significant changes in thermal stability or chemistry of the accelerated aged foam were observed, although gas evolution was detected. Changes in crystallization levels at low temperatures, microstructure, and mechanical properties were observed for foams with and without carbon nanofibers. In particular, foams aged under compressive load showed irreversible deformation of the porous microstructure. This study demonstrates that aging effects were enhanced when thermal and radiolysis were coupled together and that the addition of carbon nanofibers did not improve aging effects.

Keywords: radiolysis, accelerated aging, polysiloxanes, RTV foams, carbon nanofibers.

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