The dual functionality of epoxide and unsaturated sites in epoxidized natural rubber (ENR) permits different types of cross-linking reactions. Besides the normal vulcanization via double bonds, alternative cross-linking reactions could take place via ring opening of epoxide groups by dicarboxylic acids and diamines. We investigated the cross-linking reactions of silica-filled ENR50 with fumaric acid. The cross-linking reactions at 160 °C were assessed using a Monsanto rheometer. Supporting evidence of the reactions was provided by Fourier transform infrared spectroscopy (FT-IR), solvent swelling, and differential scanning calorimetry (DSC) analysis. FT-IR showed new absorbance peaks of hydroxyl and ester groups in agreement with the structures expected to form during the reactions between ENR50 and fumaric acid. The increase in cross-links led to a lower percentage of solvent swelling, higher glass transition temperature, and higher torque. Incorporation of silica filler has further increased the torque due to the stiffening effect of the filler. The amorphous silica used in the current work was prepared from rice husk. Leaching of the rice husk with dilute sulfuric acid before the combustion at 600 °C for 2 h led to the production of high-purity amorphous silica (>99% SiO₂).

ABSTRACT

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