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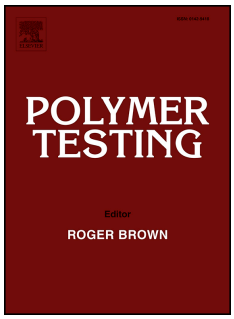

Critical matters in using Attenuated Total Reflectance Fourier Transform Infrared to characterize the polymer degradation in Styrene–Butadiene–Styrene-modified asphalt binders

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Critical matters in using Attenuated Total Reflectance Fourier Transform Infrared to characterize the polymer degradation in Styrene–Butadiene–Styrene-modified Asphalt Binders

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ABSTRACT

Styrene–Butadiene–Styrene (SBS) polymer is widely employed as an outstanding asphalt modifier. However, inevitable field aging will cause degradation of SBS polymer and consequently shortened pavement lifespan. To characterize the SBS degradation of SBS-modified asphalt (SBSMA), infrared spectroscopy is frequently utilized and the infrared intensity of 966 cm^{-1} peak is usually employed as an SBS content indicator. However, in this study, Attenuated Total Reflection Fourier Transform Infrared (ATR-FTIR), which is a promising alternative to conventional transmission-FTIR, yielded an abnormal 966 cm^{-1} peak intensity growth after asphalt aging. To investigate this phenomenon, two types of SBSMAs (radial and linear) were laboratorial aged and their infrared spectra obtained by ART-FTIR and transmission-FTIR were compared. It was found that aging significantly reduced the SBS polymer particle size and facilitated SBS dispersion, and a more uniform SBS dispersion combined with the relatively shallow scanning depth of ATR-FTIR (2 μm) caused the different result between ATR-FTIR and transmission-FTIR. A mathematical model was presented to explain this phenomenon. Moreover, a novel infrared index specially developed for ATR-FTIR was proposed to assess the degradation of SBS polymer.

Keywords: ATR-FTIR; SBS-modified asphalt; aging; fluorescence microscopy; modeling