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Huang, S-C. and A. T. Pauli, 2008, "Particle Size Effect of Crumb Rubber on Rheology and Morphology of Asphalt Binders with Long-term Aging." *Road Materials and Pavement Design*, 9: 73-95.

Abstract: Two different particle sizes of crumb rubber at three different concentrations were mixed with two asphalts to investigate the effect of rubber particles on the fundamental internal microstructure of asphalt binders with respect to their long-term aging performance. The rheological, morphological, and chemical properties of unaged and aged unmodified and rubber modified asphalt binders were studied as a function of long-term oxidative aging. Based on the limited study, the results indicate that the amounts of rubber particles added into asphalt binder are asphalt dependent. For highly incompatible asphalt, rubber concentration has substantial effect on the long-term flow properties of asphalt binders. For compatible asphalt, addition of rubber increased the elasticity of asphalts and also reduced viscosity buildup with aging. In addition, particle size of rubber does not show significant differences in terms of its effect on the long-term aging characteristics of asphalt binder. Furthermore, results from atomic force microscopy (AFM) showed that some fractions of the rubber particles may be dissolved in the asphalt due to devulcanization of the rubber, and hence, could explain the appearance of "new" material in the AFM image of the recovered asphalt samples.