Multimodal Physicochemical Characterization of Tire Crumbs Used at Synthetic Turf Fields

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As part of a U.S. Federal Research Acton Plan to study possible environmental and human health implications of tire crumbs used as infill for synthetic turf, the Environmental Protection Agency (EPA) is evaluating the potential of human exposure to various chemicals from tire crumbs. Physicochemical characterization of tire crumbs from playing fields and from manufacturing plants, including minor- and trace-element composition, as well as particle size and general morphology, is fundamental to this evaluation. EPA chose a multimodal approach to these characterizations: high resolution-inductively coupled plasma mass spectrometry (HR-ICPMS) for sensitive trace-element concentrations of sample digests; X-ray fluorescence (XRF) for minor- and trace-element characterization of individual particle size fractions without digestion; scanning electron microscopy (SEM) for size distributions and morphology of fine particles; and energy dispersive X-Ray spectrometry (EDS) for information on elemental composition of selected particles imaged by SEM. Samples for elemental measurements by HR-ICPMS were digested using a modified version of EPA method 3051a. Low detection limits and suppression of spectral interferences in complex matrices are benefits of HR-ICPMS. Particle Size Analysis (PSA) was performed on samples using sequential sieving. A floatation procedure was used to separate the sand from the crumb in samples with significant sand. A screening X-ray fluorescence analysis was performed on crumb size ranges separated during the PSA analysis, as well as on un-sieved samples. SEM imaging of fine particles was performed with a 24 keV electron beam and electron backscatter detection (BSD). Particles with significant non-carbon elemental composition were analyzed by EDS. This presentation describes the performance and demonstrates the complementary information provided by this multimodal physicochemical characterization of tire crumbs.