

The National Program Synthetic Turf/Recycled Tire Crumb Research: Characterization of a Crumb Rubber Lot for Use in In Vitro and In Vivo Studies

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Artificial turf athletic fields have been growing in popularity due to decreased maintenance required relative to conventional fields. Crumb rubber (CR) used as an infill in artificial turf has brought public health concerns in recent years. The National Toxicology Program (NTP) is conducting research to improve the understanding of human health impacts following exposure to CR. As a part of the NTP research program, a lot of CR prepared by combining material from multiple commercial sources was analyzed using a variety of techniques to generate information on chemical and physical characteristics. Optical and scanning electron microscopy demonstrated that the lot consists of a range of particle sizes (0.1 to 4 mm) and types (dark and light rubber, visible inclusions, fibers). Thermogravimetric analysis revealed that the lot contains a minute fraction of volatile organic compounds (VOCs) and ~8% inorganics by weight. Elemental analysis by inductively coupled plasma with atomic emission spectrometry or mass spectrometry (MS) identified zinc, aluminum, cobalt and other metals and metalloids totaling ~2.9% by weight. Analysis for VOCs by gas chromatography (GC) and MS with head space sampling detected a large number of constituents; 33 compounds were identified totaling ~0.0007% by weight in CR. Extraction of CR with multiple solvents covering different polarities showed that 0.6% and ~8% by weight, respectively, were extracted with water and methylene chloride, demonstrating that the majority of the extractable material consists of relatively non-polar organics. Analysis of methylene chloride extract by GC/MS identified 42 compounds with high confidence using authentic standards or reference library spectra, 7 of which were also identified in the VOC analysis, and 62 compounds with lower confidence using reference library spectra, 9 of which were also identified in the VOC analysis. An additional ~200 compounds previously reported to be in CR were investigated but were not detected in the extracts of the current lot. Analysis of solvent extracts of CR by liquid chromatography MS did not reveal any new analytes that were not previously detected by GC/MS. These data demonstrate that VOCs and metals constitute a very small fraction of CR lot.