Review of Scientific Literature

Below is a partial list of the scientific literature that have found that artificial turf fields do not cause an adverse health risk in humans and are safe for use. Summaries and links to these studies can be found on the USEPA website at https://www.epa.gov/chemical-research/december-2016-status-report-federal-research-action-plan-recycled-tire-crumb.

- "...it appears that the health risks for players who use artificial turf are not significant and that it is completely safe to engage in sports activities on this type of outdoor field." Beausoleil, et al (2009).
- Researchers "designed a comprehensive hazard assessment to evaluate and address potential human health and environmental concerns associated with the use of tire crumb in playgrounds. Human health concerns were addressed using conventional hazard analyses, mutagenicity assays, and aquatic toxicity tests of extracted tire crumb. Hazard to children appears to be minimal. We conclude that the use of tire crumb in playgrounds results in minimal hazard to children and the receiving environment." Birkholz, et al (2003).
- "PM2.5 and associated elements (including lead and other heavy metals) were either below the level of detection or at similar concentrations above artificial turf athletic fields and upwind of the fields." "The large majority of air samples collected from above artificial turf had VOC concentrations that were below the limit of detection. "Fewer bacteria were detected on artificial turf compared to natural turf." California Office of Environmental Health Hazard Assessment, (2010).
- "Health risk assessment studies suggested that users of artificial turf fields, even professional athletes, were not exposed to elevated risks. Preliminary life cycle assessment suggested that the environmental impacts of artificial turf fields were lower than equivalent grass fields." Cheng, et al. (2014).
- "In spite of the conservative nature of the assessment, cancer risks were only slightly above de minimis levels for all scenarios evaluated including children playing at the indoor facility, the scenario with the highest exposure. The calculated risks are well within typical risk levels in the community from ambient pollution sources and are below target risks associated with many air toxics regulatory programs. Chronic non-cancer risks were not elevated above a Hazard Index of 1." "Cancer risks are slightly above de minimis in all scenarios." Connecticut Department of Public Health (CDPH), (2010).
- "Based on the information reviewed none of the risk assessments showed concentrations of contaminants that would be at a level of concern, even under conservative assumptions and thus it does not appear that the ingestion of tire crumb would pose a significant health risk for children or adults." Denly, et al. (2008).
- "Cancer and noncancer risk levels were at or below de minimis levels of concern. The scenario with the highest exposure was children playing on the indoor field. Based upon these findings,

outdoor and indoor synthetic turf fields are not associated with elevated adverse health risks." Ginsberg, et al. (2011).

- "Based on the available literature on exposure to rubber crumb by swallowing, inhalation and skin contact and our experimental investigations on skin contact we conclude, that there is not a significant health risk due to the presence of rubber infill for football players an artificial turf pitch with rubber infill from used car tyres." Hofstra, U. (2007a).
- "On the basis of estimated exposure values and the doses/concentrations which can cause harmful effects in humans or in animal experiments, it is concluded that the use of artificial turf halls does not cause any elevated health risk. This applies to children, older children, juniors and adults. The estimated Margins of Safety (MOS) also give no cause for concern." Norwegian Institute of Public Health and the Radium Hospital. (2006).
- "...crumb rubber may be used as an infill without significant impact on groundwater quality...Analysis of crumb rubber samples digested in acid revealed that the lead concentration in the crumb rubber samples were well below the federal hazard standard for lead in soil...A risk assessment for aquatic life protection...found that for the three types of crumb rubber, aquatic toxicity was found to be unlikely...A public health evaluation was conducted on the results from the ambient air sampling and concluded that the measured levels of chemicals in air at the Thomas Jefferson and John Mullaly Fields do not raise a concern for non-cancer or cancer health effects for people who use or visit the fields...the findings do not indicate that these fields are a significant source of exposure to respirable particulate matter" New York Department of Environmental Conservation (NYDEC). (2009).
- Playing sports on synthetic turf fields with rubber granulate is safe Dutch National Institute for Public Health and the Environment. Substances are more or less 'enclosed' in the granulate, which means that the effect of these substances on human health is virtually negligible. No link with leukemia. (RIVM National Institute for Public Health and the Environment, 2016)
- Dr. Archie Bleyer, a pediatric oncologist who chaired the Children's Cancer Group (Swiss agency) for a decade, cited more than 41 sources in a peer-reviewed journal, *Sports Medicine*, stating the science does not support the hypothesis that recycled rubber is unsafe. He added that by providing more playing surfaces and thereby promoting healthier lifestyles, recycled rubber actually lessened the likelihood of cancer. (Sports Medicine, 2017)
- Recycled rubber infill causes a very low level of concern, the concern for lifetime cancer risk is very low given the concentrations of PAHs typically measured in European sports grounds. The concern from metals is negligible given that the data indicated that the levels are below the limits allowed in the current toys legislation. No concerns were identified from the concentrations of phthalates, benzothiazole and methyl isobutyl ketone as these are below the concentrations that would lead to health problems. European Chemicals Agency, 2017