

Synthetic Turf/Crumb Rubber Research Program

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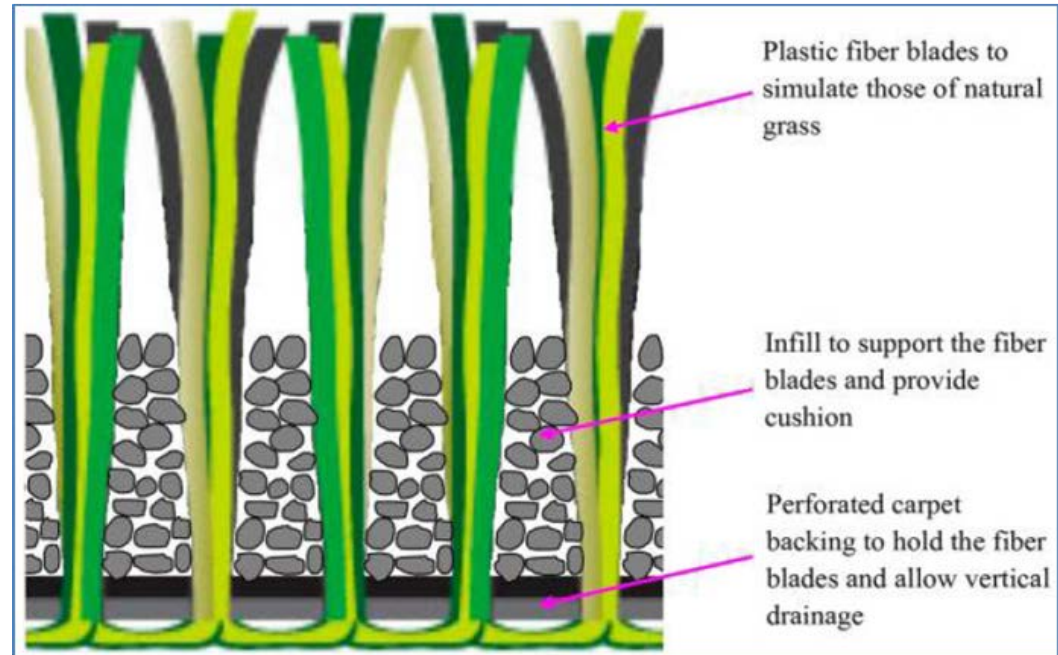


- Background
- Literature Summary
- OEHHA and Federal Efforts
- NTP Research Program
- Feasibility Considerations
- Next Steps



“Substance” of Concern

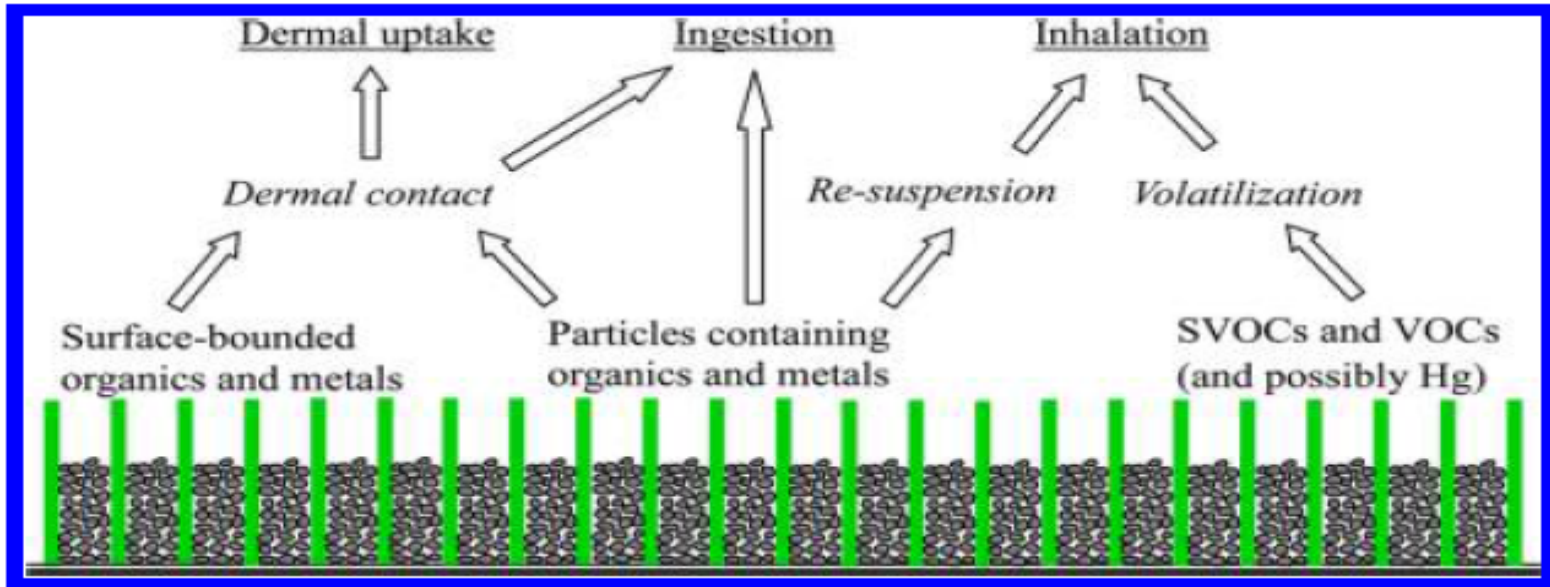
- Installed in indoor and outdoor facilities
- Played on by children and adults
- Crumb can stick to players' skin, clothes, and hair



Cheng H, Hu Y, Reinhard M. (2014) Environmental and health impacts of artificial turf: a review. *Environ Sci Technol.* 48(4): 2114-29. <http://dx.doi.org/10.1021/es4044193>



Potential Exposures



Cheng, et al. (2014)

- Major exposure pathways: dermal, ingestion, inhalation
- Includes: volatile, semi-volatile, and non-volatile organic compounds, metals, and particulate matter
- Exposure profile likely changes over the life of the field



Nomination to OHAT (Nov 2014) by a private citizen

- Residence near an artificial turf field
- Neighbor with blood cancer
- Request better information for schools and their neighbors

Request from OEHHA (Nov 2015)

- Short-term in vivo and in vitro toxicology studies on crumb rubber available within the next 18 months.
- Requesting NTP's expertise in toxicity testing and study design

Nomination for testing (Mar 2016) by a private citizen

- Cancer bioassay for crumb rubber via inhalation
- Characterization of chemicals that can be extracted from crumb rubber



- Human health studies
 - Predominantly injury and sports performance
 - Few occupational and mutagenicity studies
- Exposure studies
 - No change in hydroxypyrene in urine before/after play
 - PM₁₀, PM_{2.5}
 - VOCs/SVOCs: benzothiazole, benzopyrene, benzene, toluene, PAHs, phthalates, nitrosamine, naphthalene
 - Metals: Pb, Zn
 - Non-dioxin-like PCBs (NDL-PCBs), PCDDs, PCDFs



- Large study of artificial turfs in Italy (Menichini, 2011)
 - Estimated of 1×10^{-6} excess lifetime cancer risk for an intense 30-year activity based on Benzo[a]pyrene
- Connecticut Risk Assessment (Ginsberg, 2011)
 - Highest exposure scenario = children playing on the indoor field
 - Main contributor: benzothiazole (SVOC), 14-fold higher indoors than outdoors
 - No elevated health risks, consider ventilation
- OEHHA (2007)
 - 1.2×10^{-7} increased cancer risk for the one-time ingestion of tire shreds
 - 2.9×10^{-6} hand-to-mouth in children on playground (age 1-12) due to the chronic ingestion of chrysene



OEHHA Synthetic Turf Study

Multi-pronged effort in response to public concerns

- OEHHA is conducting a study on potential health effects from the use of synthetic turf fields and playground mats made from recycled tires
- Launched in 2015, aim to complete in 2018
- Extensive field sampling and analysis
 - New and “aged” fields
 - Rubber, artificial grass blades, playground mats, air at 3’ and on ground surface, surface wipes
 - Artificial lung, saliva, stomach, intestinal, and sweat extractions
- Personal biomonitoring

<http://oehha.ca.gov/risk/SyntheticTurfStudies.html>



US EPA, CDC/ATSDR and CPSC

- Includes outreach to key stakeholders, such as athletes and parents, and seeks to:
 - Fill important data and knowledge gaps
 - Characterize constituents of recycled tire crumb
 - Identify ways in which people may be exposed to tire crumb based on their activities on the fields
- By late 2016, the agencies will release a draft status report that describes the findings and conclusions of the research through that point in time.
- The report will also outline any additional research needs and next steps.



European Commission Request - June 8, 2016

- Identify any hazardous substances in the recycled rubber filling that may pose a health risk (such as polycyclic aromatic hydrocarbons (PAHs) which are already extensively restricted by EU legislation)
- Assess the risk resulting from skin, oral and inhalation exposure to these substances in recycled rubber filling used on both open air and indoor sports grounds
- The results of ECHA's preliminary evaluation are expected by January 2017 – to be published in February 2017.



What Role Can NTP Play?



NTP?
National Toxicology Program
U.S. Department of Health and Human Services

ATSDR Agency for Toxic Substances and Disease Registry





Unique, but Complementary

NTP Synthetic Turf/Crumb Rubber Research Program

- Goal: conduct short-term in vivo and in vitro toxicology studies on crumb rubber
 - Exposure scenarios similar to human experience
 - Feasibly completed in 18 months
 - Emphasis on health outcomes of most concern to the public, such as blood and brain cancer
- Not aiming to reach definitive hazard conclusions
- If warranted, future work will identify what exposure conditions (including dose) are (or are not) associated with adverse effects in a range of experimental systems

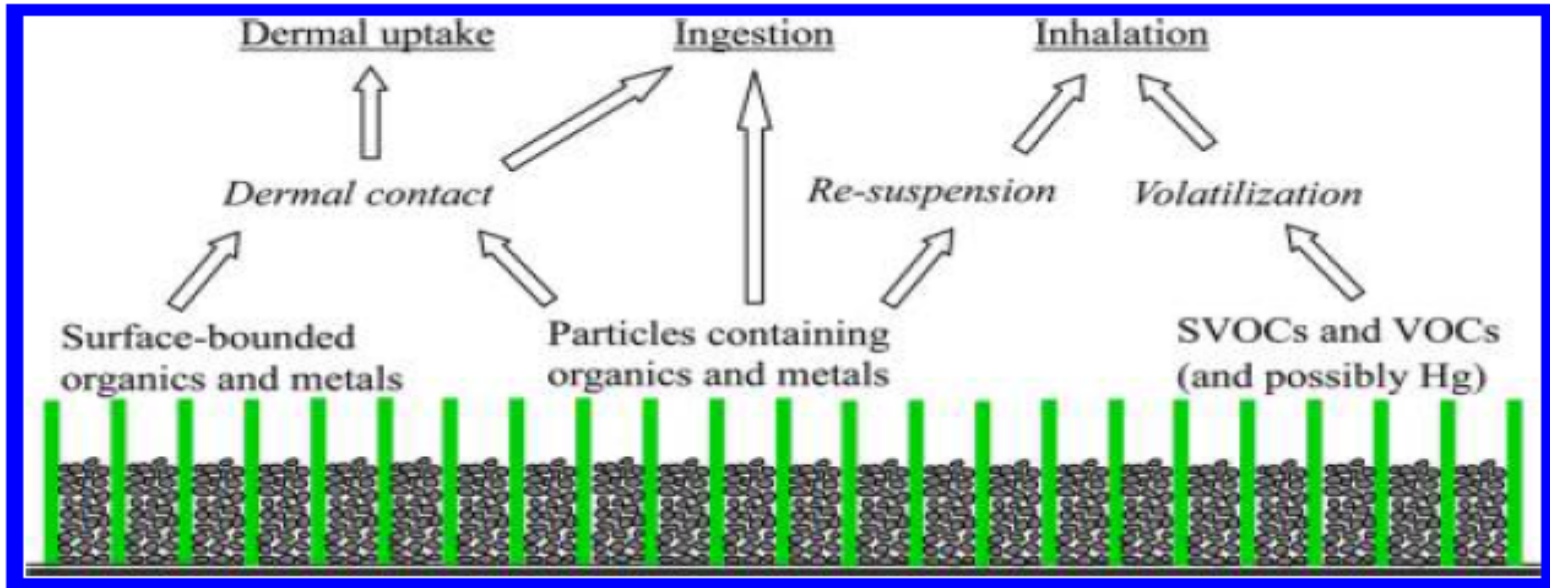


Preliminary Chemistry Testing

- Volatile organic compound (VOC) analysis by GC-MS
 - Targeted analysis (standards, VOC standard mixes, and available reference libraries)
- Solvent extraction followed by two dimensional GC/TOF MS
 - Targeted analysis (standards, standard mixes, and reference libraries)
- Untargeted analysis
- Quantitative analysis of selected identified compounds
- Particle morphology, homogeneity, elemental analysis, metals/inorganics
- Extraction with artificial biofluids and identification using appropriate techniques



Feasibility Testing of Exposure Options



- Inhalation of particulate matter
- Housing with crumb rubber
- Oral bioavailability study
- Mixing into feed



In Vivo Testing Feasibility

- Exposure options:
 - Nose-only inhalation
 - Whole body inhalation (includes dermal and ingestion of particulate as well as inhalation)
 - Ingestion via feed
 - Housing animals with crumb rubber in bedding
- Rodent models may include organ toxicity sensitivities.
- Study may assess major organ pathology, genotoxicity, and gene expression analysis.



In Vitro Testing Feasibility

- Cell cultures could be exposed via
 - Co-culture of particulate in the same media as cells
 - Chemical extraction (solvent and/or biologically relevant conditions)
 - Particulate captured on a filter that is extracted and applied to cells
- Numerous possible cell lines can be assessed for cytotoxicity, genotoxicity, or gene expression analysis
- Include chemicals with known toxicities (e.g. BTEX, styrene, formaldehyde) and individual components of tire crumb (e.g. benzothiazole)



Also Under Consideration

- Analysis of high throughput screening data in Tox21 or ToxCast for constituents of crumb rubber
- Targeted testing for areas with evidence of an effect in the first round of testing
- Additional studies with turf or aged crumb rubber/turf material
- Culture stem cells and expose to consider potential mechanisms of carcinogenesis
- Consider additional animal models



Continued Communication

Working with OEHHA and Federal Agencies

- Sharing material, strategies, and results
- Regular conference calls to update and receive input
 - Plans for pooling samples
 - Future data sharing plans
- Also engaging with interested academic researchers





- Public and BSC input
- Continued coordination with OEHHA, ATSDR, and EPA
- Project design teams
- Develop project plan for public release
<http://ntp.niehs.nih.gov/go/turf>
- Continue materials characterization and toxicology study feasibility evaluation
- Complete study designs
- Start in vivo and in vitro studies
- Analysis and release of initial results in 2017



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Questions?