Synthetic Turf Chemicals

Synthetic turf is increasingly used on playing fields and in parks. It is made in layers of synthetic materials including green plastic blades attached to a backing, small particles called "fill" that secure the blades, and underlying systems for drainage and stability. The fill, often referred to as “crumb rubber”, is of interest because it is usually made from recycled tires containing chemicals that can cause cancer, birth defects and other health problems under some exposure conditions. Many companies supply fill, and it is provided in various forms, so the chemical composition varies. Work has been ongoing to evaluate the various components of synthetic turf fields and the products used to maintain them. The information on this webpage provides an initial summary of screening chemical analyses of some fill products. Additional information will be provided in the future.

Information on fill: collection, analysis, and supporting information

Clean unused samples of fill from five synthetic turf suppliers were collected by RAMP, a Rochester-based consumer protection organization. Laboratory screening analysis was carried out by Paradigm Laboratories in Rochester New York. An information summary and health-related links were provided by Sciencecorps in Lexington Massachusetts.

The chemicals listed below were found at the range of concentrations shown. The number of samples in which the chemical was found is also listed. The screening analysis had relatively high detection limits, meaning that concentrations of interest for some chemicals (e.g., hundreds of parts per billion) could not be identified. Detection limits varied across the samples due to the sample composition. One analysis of each sample and one sample from each supplier were evaluated. The results below are informative, but further testing and evaluation is required to characterize the chemical composition of fill and of other components of synthetic turf and the products used to maintain the turf.

Chemicals Identified in the Screening Analysis of Infill (in Parts per Billion*)

EPA Analytical Method 8270C was used for the semivolatiles, including the PAHs and n-nitrosodiphenylamine. EPA Analytical Method 8260B as used for the volatiles.

Metals		
Arsenic	ND (466 -577) up to 1,010**	present in 3 out of 5 samples
Cadmium	ND (487-577) up to 621	present in 3 out of 5 samples
Chromium	ND (931 to 1,150) up to 1,520	present in 2 out of 5 samples
Cobalt	7,100 to 141,000	present in all samples
Lead	3,810 to 67,200	present in all samples
Manganese	3,460 to 7,500	present in all samples
Thallium	ND (529-693) to 1,490	present in 2 out of 5 samples
Zinc	10,600,000 to 17,000,000	present in all samples
SEMIVOLATILES		
Phthalates		
DEHP	10,800 to 203,000	present in all samples
Diethyl phthalate	ND (3,360-25,000) to 3,100	present in 1 out of 5 samples

Polycyclic Aromatic Hydrocarbons (PAHs)* **		
Chrysene	ND (2,000-25,000) to 3,820	present in 1 out of 5 samples
Fluoranthene	ND (495 to 25,000) to 15,900	present in 4 out of 5 samples
Pyrene	10,700 TO 28,300	present in all samples
Other		
n-nitrosodiphenylamine	ND (2,000-20,000) up to 7,030	present in 1 of 5 samples
VOLATILES (2 samples analyzed)		
Acetone	842 to 1,450	present in 2 of 2 samples
Carbon Disulfide	387 to 525	present in 2 of 2 samples
Chloroform	ND (167) to 732	present in 1 of 2 samples
Ethylbenzene	ND (167) to 337	present in 1 of 2 samples
Methylene Chloride	ND (147) to 286	present in 1 of 2 samples
4-methyl-2-pentanone	335 to 11,400	present in 2 of 2 samples
Tetrachloroethene	12.3 to 280	present in 2 of 2 samples
Toluene	ND (167) to 16.8	present in 1 of 2 samples
Xylene	ND (167) to 134	present in 1 of 2 samples

**** The information in this table and on this website is proprietary and cannot be duplicated without permission from RAMP. Judy Braiman, the president of RAMP, can be reached at: judybraiman@frontiernet.net Please indicate your intended use of this information if you request permission to use the data.***

***** "ND " means none detected - the chemical was not found in one or more samples, indicating the concentration could be zero or any concentration up to the detection limit. The range of detection limits reported for each chemical are shown in parenthesis following "ND". The detection limits were fairly high, exceeding measured levels in some cases (e.g., chrysene), and more problematic, exceeding some health-based reference values (e.g., methylene chloride). For this reason it is important that analyses be done to comprehensively characterize the chemical composition of fill and other components of synthetic turf.***

****** It is likely that some chemicals were present in the parts per billion range (e.g., PAHs) that could not be identified in this screening analysis.***

Additional metals were identified, but were not listed above because they were considered to have limited potential health significance at the concentrations found and in many cases are essential nutrients. These include: magnesium, potassium, sodium, selenium, barium, copper, iron, calcium, and aluminum. They may be of interest and concern with respect to ecological effects, which requires additional investigation. Zinc was listed in the table above even though it is an essential nutrient, because the concentrations found were higher than the soil reference value that was located for this metal.

The concentrations shown in the table above were compared to the New York State and New Jersey upper-limits of allowable concentrations in the soil at hazardous waste sites that have been remediated. The concentrations reported above exceeded hazardous waste site limits in some cases. In addition, approaches to evaluating hazardous waste sites typically require that the mixture of chemicals present be considered, rather than each chemical being evaluated only in isolation. When multiple chemicals have the potential to target the same systems in the body (e.g., the nervous system) or are capable of causing mutations, cancer, or birth defects, it is particularly important that protective strategies be

developed that consider the total burden of chemicals at a location or in a product. Many of the chemicals identified in fill share numerous target organs, and some are capable of causing cancer and birth defects. That adds complexity to the evaluation of fill, but is relevant when considering the safety or hazards associated with synthetic turf installations or any other consumer product.

It is very important that further research be done to fully document the concentrations present through detailed (non-screening) analyses in the near future. Conclusions cannot be drawn from screening analyses; however, such analyses can be used to strongly suggest where work is needed to evaluate potential hazards and where situations exist that require precaution from a public health perspective.

The chemicals listed above have the potential to cause serious harm under some conditions, and many are persistent in the environment. There is limited evidence regarding the potential for chemicals present in fill to move from into air, soil, and water under real world conditions. However, many are known to readily move through soil and other media when they are not bound within materials. The likelihood of their release from the fill matrix requires more evaluation under varied real-world conditions. The potential for environmental contamination, human exposures, health impacts, and ecological impacts as a result of the release of chemicals from fill is not fully characterized.

> Many questions remain unanswered regarding whether or not there are potential health or ecological hazards that can result from installations of synthetic playing fields. Due to the unresolved public health and environmental issues, it is prudent public health policy to avoid installation of new synthetic turf fields until the health and environmental issues can be fully evaluated. A bill was introduced on October 23rd 2007 to the New York State Assembly calling for a moratorium on new synthetic turf installations pending a careful review of information regarding potential human health implications and an evaluation of potential impacts.

Health Information on Chemicals Identified in Fill

There is extensive information on the health hazards of most of the chemicals listed above. Many useful links to health information are provided below. There is not complete consensus for many of the chemicals regarding the types of harm that may occur following exposure, or the level at which that harm can occur. However, in approaching the combination of chemicals that are present in synthetic turf installations, it may be useful to consider the following:

- Long-standing federal health policy regarding carcinogens states that any exposure to a genotoxic carcinogen may pose some risk of cancer, even if that risk is very small at very low doses. See: http://cfpub.epa.gov/ncea/CFM/nceaQFind.cfm?keyword=Cancer%20Guidelines and especially the special supplemental guidance document regarding cancer risks when exposures occur early in life.

- There is increasing evidence for some neurotoxic metals (e.g., lead) that developmental harm may occur even at very low doses. There may be no threshold or “safe” level of exposure that applies to all members of the public.

- In 1997, a Presidential Executive Order, *Protection of Children from Environmental Health Risks and Safety Risks* emphasized the need to address children’s unique susceptibility and numerous EPA risk assessment guidelines relevant to children’s health issues have been published subsequently (1998 2002, 2005) as summarized in documents available at: http://cfpub.epa.gov/ncea/CFM/recordisplay.cfm?deid=160003

- There is substantial variation in susceptibility to disease and other types of harm in the human

population, as evidenced by the variations we see in people's health following exposures to hazards such as smoking, radiation, and air pollution. While studies are ongoing to understand these variations, and to provide information that will someday enable people to make more informed decisions regarding their own health, there is very limited information now that would allow prediction of who might be harmed and who would be safe under various conditions of exposure to chemicals. It is essential that the public become better informed regarding the potential hazards that exist in their environment, so that they can make informed choices regarding the health of themselves, their families and communities.

Online Sources of Information

The following sources provide technical information that is freely accessible. Most websites listed below have a search engine that allows you to type in the name of a chemical to locate information. The summaries on most websites don't cover the range of hazards or address the susceptibilities of some members of the population. In addition, few websites include all available information. Therefore, it is useful to review a number of websites to gain a good understanding of the potential health and environmental issues associated with any chemical.

It is also important to note the date when the information was assembled because some information may be out of date. For the most comprehensive, but highly technical, information available, the last entry below can be used: the National Library of Medicine (NLM). NLM provides access to the listings of all studies published in the peer reviewed literature (primarily journals) across the globe on topics related to health.

CDC's Toxicological Profiles for many chemicals: http://www.atsdr.cdc.gov/toxpro2.html

Toxnet (National Library of Medicine's compilation of many databases): http://toxnet.nlm.nih.gov/index.html

California's list of chemicals known to cause cancer or reproductive damage: http://www.oehha.ca.gov/prop65/prop65_list/Newlist.html

California's toxicity criteria database: http://www.oehha.ca.gov/risk/ChemicalDB/index.asp

Scorecard Chemical Profile Search: http://www.scorecard.org/chemical-profiles/

Hazardous Substances Data Bank: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB

NLM - PubMed is the journal article access portal at: http://www.ncbi.nlm.nih.gov/sites/entrez This website provides a listing of journal articles on specific topics. While abstracts (summaries) of the studies are available for most studies, the full text of the journal articles is usually not available without paying a fee to the publisher. However, the journal articles may be available at a medical library in your area.

Comparative Information from Soil Concentration Limits

A reasonable comparison for fill composition is soil, considering the interest in runoff, offgassing, and other characteristics. There are limited standards for chemical contamination in soil and the information regarding naturally occurring background levels of metals in soil shows wide geographic variations. While the State of New York promulgated soil clean up objectives for Brownfields (hazardous waste sites undergoing cleanup) in recent years, these objectives are controversial and litigation to address

health and safety concerns is ongoing. Both New Jersey and California are in the process of releasing final soil chemical contamination limits. USEPA has values that vary by location and are also controversial in their applications, in part because of the variations that are accepted at different hazardous waste sites.

All of these limits can be used as “reference values” for purposes of comparing the levels of chemicals in artificial turf components and the concentrations in soil that result from the artificial turf installations, if soil contamination occurs. The underlying documentation regarding health, chemical releases into air, groundwater contamination, vapor intrusion into homes and other buildings, environmental degradation, and other issues with respect to soil contamination will be informative and useful when considering chemicals present in the components of artificial turf. We will be posting links to the website that contain the New York, New Jersey, and California reference values. Additional state, federal, and international values may also be identified and will be provided if links to the appropriate websites are identified.

The modeling that is incorporated into the development of reference values is extensive and in many cases theoretical rather than empirical (based on real-world observations. The modeling relies on dozens of assumptions regarding the behavior of chemicals in the environment, the behavior of the human population (e.g., how much water they drink), and the natural world (levels of rainfall, composition of soil, etc). Consequently, there is considerable uncertainty incorporated into reference values and they do not necessarily fully protect all people. For example, when “normative” (average) values are used in models to develop reference values, they may not protect all people because by definition many have exposures that are higher than average.

For many chemicals there is limited or no information regarding the impacts of chemicals on children, or on long-term consequences of low level exposures, leading to serious data gaps that limit the reliability of reference values. It is also clear that lists of chemical ingredients do not identify all chemicals present - they itemize only those that were looked for, and only those present at levels sufficiently high to be detected by the laboratory methods used. As a result of the many sources of uncertainty regarding chemical composition and the hazards that chemicals may pose, it is recommended that a protective and precautionary approach be taken when determining the best way to proceed regarding the use of all consumer products. Synthetic turf is no exception, and merits careful review due in part to the very large amount of material that is used in each installation (e.g., tons of fill are applied to the land).

Future information

This website will contain additional information and links to other resources in the future. If you have information that you would like referenced on this website via links to your website or that of other agencies, companies, or organizations, please send the link with a short description of the information to: info [at] sciencecorps.org