



Artificial Turf: A Health-Based Consumer Guide

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Mount Sinai *Children's
Environmental
Health Center*

Position Statement on the use of Recycled Tires in Artificial Turf Surfaces

Position: Based upon the presence of known toxic substances in tire rubber and the lack of comprehensive safety studies, The Children's Environmental Health Center of the Icahn School of Medicine at Mount Sinai urges a moratorium on the use artificial turf generated from recycled rubber tires.

Background: Recycled rubber artificial turf products were introduced to athletic fields and playgrounds in the 1990s and have since been installed throughout the world with no prior safety testing. Tires contain heavy metals, carcinogens, and other toxic substances. Grinding them into very small crumb rubber pellets, utilized on athletic fields, or mulch, utilized on playgrounds and gardens, furthers the risk of exposure by increasing the surface area and the likelihood of accidental ingestion. Children are exposed to harmful substances when pellets touch their skin or are swallowed, and possibly from breathing chemicals released into the air from the surface. In addition to crumb rubber infill, artificial athletic turf consists of synthetic grass blades and several layers of backing materials. To date, the safety of these materials has not been proven. While manufacturers claim that a number of scientific studies indicate low risk of harm from recycled tiring playing surfaces, these studies were not conducted in a rigorous manner comprehensive enough to prove safety.

Recommendations: Although we believe that the presence of cancer causing agents and other known toxins in recycled rubber playing surfaces is sufficient reason to mandate the use of safer alternatives, we recognize the need for further scientific study. Prior to the installation of artificial turf fields of any type, studies conducted by independent, academic, or federal research institutions must prove the safety of these products. To be informative, comprehensive studies should consider, at a minimum:

- Exposure assessment under realistic playing conditions.
- All possible routes of exposure: inhalation, ingestion and dermal absorption (through skin).
- Potential health effects not only of individual chemicals, but also of mixtures of chemicals to determine their additive and synergistic effects.

In addition to the above scientific requirements, it is the responsibility of municipalities and installers to assess the opinions and address all concerns of the communities that will be utilizing the fields.

Given mounting concerns about recycled rubber surfaces, several governmental agencies have recently modified their stance on the safety of crumb rubber. On February 12, 2016, the Environmental Protection Agency (EPA), Centers for Disease Control and Prevention/Agency

for Toxic Substances and Disease Registry (CDC/ATSDR), and the Consumer Product Safety Commission (CPSC) unveiled the [Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds](#) with the aim of addressing data gaps, characterizing crumb rubber constituents, and assessing exposure pathways. According to the EPA announcement of this collaborative effort, “existing studies do not comprehensively evaluate the concerns about health risks from exposure to tire crumb”. The same conclusion was reached by the California Office of Environmental Health Hazard Assessment in 2015, resulting in a commitment to conduct extensive studies that will include exposure assessment and biomonitoring. ***Based on these recent developments we recommend a moratorium on the installation of crumb rubber playing surfaces pending results of these studies.***



Artificial Turf: A Health-Based Consumer Guide

If your school, community, or business is considering installing an artificial turf field, it's important to be an educated consumer. Many turf products are available and some are even advertised as "green" or "eco-friendly", but it can be difficult to assess their safety for use by children because adequate risk assessment studies that assess all potential routes of exposure during realistic play conditions have not been

conducted. This guide will help you dig deeper than the label on the packaging to learn what chemicals these products contain, how children may be exposed to these chemicals, and understand what the potential health risks may be.

This Guide will:

- (1) describe turf infill options and chemicals of concern*
- (2) identify how children can be exposed to these chemicals*
- (3) explain potential health risks associated with certain artificial turf products*
- (4) suggest questions to ask manufacturers (and the answers you want to hear)*
- (5) provide tips for safer play on artificial turf*

TOP 7 TIPS TO BEING AN EDUCATED TURF CONSUMER

1. Research the various infill options and turf companies.
2. Understand the long-term health concerns, both chemical and non-chemical, associated with artificial turf.
3. Ask the turf companies for detailed product information and environmental testing.
4. Request a product sample and the appropriate testing that ensures that the product does not contain dangerous chemicals.
5. Follow best practices for play on artificial turf if one is installed.
6. Consider all costs for the full life cycle of the product.
7. Determine whether natural grass is a feasible alternative.

What is artificial turf?

Synthetic or artificial turf is a multi-layer product used as a surface on athletic playing fields, playgrounds, golf courses, and residential lawns. It typically consists of:

- a top layer of **fibers** usually made from usually nylon, polypropylene, polyethylene designed to mimic natural grass blades
- **infill** to provide cushioning and serve as a base for the blades
- a **backing layer** to which the blades are sewn
- a **drainage layer**
- additional **padding layers** in some applications

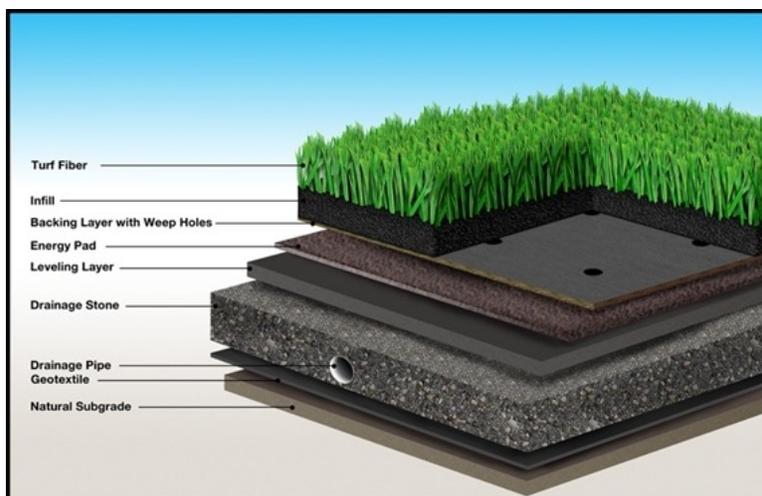


Figure 1. Anatomy of Artificial Turf
Source: Synthetic Turf Council

What health risks are associated with play on artificial turf?

(1) Chemical Exposures

Chemicals that are known or suspected to be carcinogenic or toxic to the nervous or reproductive systems have been detected in turf infill and the surrounding air (Table 1). Exposures to chemicals from turf occurs through:

- **Inhalation** of Volatile Organic Compounds (VOCs) and small particulates

- **Dermal contact and absorption** through the skin or open wounds: Many of the components of turf may contain chemicals and even leach out of the product, increasing potential for dermal exposure upon contact.
- **Ingestion:** Turf infill particles are very small and can be ingested as can chemicals that leach from turf and accumulate on hands.
- Exposure levels are affected by weather conditions, temperature, and type of activity (i.e. physical impact on the turf itself and ventilation rate of the individual)
- **Tire rubber composition is highly variable** across manufacturers, and test results have identified numerous chemicals of concern in turf containing crumb rubber infill.

(2) Non-chemical Exposures

- **Heat:** Because synthetic turf is typically dark and does not vaporize water, surface temperatures can get up to 60 degrees higher than natural grass and have been measured as high as 160 degrees on a summer day.
- **Latex allergy:** synthetic rubber contains latex in relatively low concentration; individuals with latex allergy should be warned about possible allergic reactions.
- **Contact injuries:**
 - Athletes playing on turf fields have been shown to have more abrasions or “turf burns,” which in turn can harbor infection.
 - Artificial turf may increase the rate of contact injuries such as knee injuries and concussions, however data is conflicting.

What Chemicals Should I Be Concerned About?

Of all the turf components, the greatest concern for harmful exposures comes from the infill. There are currently several types of infill available, but to date we know the most about “crumb rubber” infill. Crumb rubber is made from recycled tires. The eco-friendly term sometimes used to advertise crumb rubber turf fields refers to the fact that by repurposing the tires into turf fields, hazardous tire waste is not going to landfills. However, because the lifespan of a turf field averages 10 years, the hazardous tire materials will eventually need to be safely disposed of.

Tire rubber composition is highly variable across manufacturers, making it difficult to know concentrations of individual chemicals. Below is a partial list of chemicals of concern known to present in artificial turf made from recycled rubber. Some of these chemicals may also present in artificial turf products that do not contain recycled crumb rubber, however manufacturers are not required by law to disclose the

chemical content of their turf products, so this information is not publicly available. We will continue to update this guide as more information becomes available.

Table 1. Partial list of chemicals of concern present in crumb rubber artificial turf infill*

Chemical	Potential Health Effect
Benzene	Known human carcinogen
Arsenic	Known human carcinogen ⁱ
Styrene	Reasonably anticipated to be a human carcinogen
Polycyclic aromatic hydrocarbons (PAHs)	Reasonably anticipated to be a human carcinogen ⁱⁱ
Lead	Neurotoxicant
Zinc	Neurotoxicant
Cadmium	Known human carcinogen ⁱ
Chromium	Known human carcinogen ⁱ Respiratory irritant
VOCs and SVOCs (e.g. benzothiazole, hexane, toluene, formaldehyde)	Respiratory irritants or asthma triggers Neurotoxicants Some are known human carcinogens ⁱ
Phthalates	Reproductive toxicant
Crystalline Silica	Known human carcinogen ⁱ Respiratory irritant
Latex	Allergen
Particulate matter	Respiratory irritant or asthma trigger

*For a more extensive list of chemicals of concern identified in turf see https://www1.nyc.gov/assets/doh/downloads/pdf/eode/turf_report_05-08.pdf

Digging Deeper

As concerns about hazardous exposures from crumb rubber infill have mounted, several alternative fills have been developed. Below is a table of some of the options currently available. To date we know very little about the composition and consequences of playing on the newer generations of crumb rubber infill alternatives.

Table 2. Available Infill Types

Type of Infill	Infill Details	Health Concerns
Crumb Rubber	<ul style="list-style-type: none"> • Most common type of infill, particularly on athletic fields • Made from shredded recycled tires (“Ambient” or Cryogenic” refers to the temperature at which the tires are shredded) • Crumbs are less than 3mm in diameter • 200,000lbs of crumbs per average playing field (2-3lb per square foot, 2-3 inches deep) • May be mixed with silica sand 	<ul style="list-style-type: none"> • Extreme heat • Contact injuries • Chemical exposures to carcinogens and neurotoxins (See Table 1) • Exposure can occur by inhaling the off-gases, by absorbing chemicals through skin contact and, possibly, by ingesting particles that are airborne or transported into children’s mouths by hand contact.
Coated Crumb Rubber	<ul style="list-style-type: none"> • Crumb rubber may be coated with colorants, sealers, or anti-microbial substances for aesthetics, hygienic purposes, and to reduce dust generated during manufacturing 	<ul style="list-style-type: none"> • Same as crumb rubber but possible reduction in heat and dust • Coating may contain additional chemicals of concern
Rubber or Foam Padding	<ul style="list-style-type: none"> • Made from recycled tires • Often used as an alternative to crumb rubber on playgrounds and residential lawns 	<p>Similar to crumb rubber but possible reduction in exposure by ingestion in absence of tire crumbs</p>
Sand (Silica)	<ul style="list-style-type: none"> • One of the original infilling materials utilized in synthetic turf • Natural product • Often used in conjunction with other infills such as crumb rubber or coated with elastomer or acrylic • Acts as a shock absorber when coated 	<p>Possible respiratory irritation if inhaled</p>

EPDM (Ethylene Propylene Diene Monomer)	<ul style="list-style-type: none"> • A synthetic vulcanized rubber polymer elastomer resistant to abrasion and wear • May be generated from recycled or new (“virgin”) material • Also contains UV stabilizers, anti-oxidants, chalk, pigments, flame retardants, and vulcanizing agents such as zinc oxide • Purportedly free of heavy metals • Few toxicological and risk assessment studies exist 	<p>Insufficient data on chemical exposures due to limited studies that assess composition, off gassing, leaching, and associated potential health effects</p>
TPE (Thermoplastic Elastomer)	<ul style="list-style-type: none"> • Polymer of rubber and plastic resistant to abrasion and wear • Composed of ethylene, butadiene and styrene copolymers or polyurethane elastomers generated utilizing isocyanides • May also contain UV stabilizers, anti-oxidants, chalk, pigments, and flame retardants • “Virgin” material, not made from recycled materials • Purportedly free of heavy metals • Can be reused or recycled • Few toxicological and risk assessment studies exist 	<ul style="list-style-type: none"> • Insufficient data on chemical exposures due to limited studies that assess composition, off-gassing, leaching, and associated potential health effects • Styrene and butadiene are classified as carcinogens by the World Health Organization. The effects of human exposure to these substances from turf infill are not yet known as specific studies have not yet been conducted.
Nike Grind or Eco Grind	<ul style="list-style-type: none"> • Rubber infill generated from recycled athletic shoes and leftover materials from Nike manufacturing • May be mixed with sand • May contain heavy metals 	<p>Similar to crumb rubber from recycled tires:</p> <ul style="list-style-type: none"> • Extreme heat exposure • Contact injuries • Chemical exposures to carcinogens and neurotoxins (See Table 1)

“Organic” Infill	<ul style="list-style-type: none"> • Natural cork and/or ground fibers from the outside shell of the coconut (sometimes referred to as “corkonut,” or rice husks) • Can be recycled directly into the environment • Purported to absorb less heat and more humidity than crumb rubber infill 	<ul style="list-style-type: none"> • Possible reduced heat exposure compared with rubber surfaces • Insufficient data on chemical exposures due to limited studies that assess composition, off-gassing, leaching, and associated potential health effects
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Be An Educated Artificial Turf Consumer

- o Beware of **greenwashing**: the use of terms like “organic”, “green”, and “Eco” do not guarantee safety. In fact, those terms are not regulated for turf products, so their meaning in this context is at best ambiguous.
- o Choose companies that are transparent and disclose all materials¹. Note that an MSDS sheet does NOT disclose all chemicals used in the product. To obtain complete disclosure, ask manufacturers to list all components in writing.
- o Contact the CEHC to discuss testing options and results.
- o Consider the possibility of maintaining a grass field with an underground drainage system
- o **ASK the turf company:**
 - **Are the infill materials new (“virgin”) or recycled?**

It’s possible to obtain a full ingredients list for new materials, versus recycled which vary from lot to lot.

¹Toxicological profiles of potential chemicals of concern can be found at: <http://www.atsdr.cdc.gov/substances/indexAZ.asp>: The Agency for Toxic Substances and Disease Registry, a federal public health agency of the U.S. Department of Health and Human Services, maintains a Toxic Substances Portal, a searchable database of chemicals that includes exposure risks and health effects.

<http://www.epa.gov/iris/> EPA’s Integrated Risk Information System (IRIS) is a human health assessment program that evaluates information on health effects that may result from exposure to environmental contaminants. The searchable IRIS database contains information on more than 550 chemicals.

- **What additives and coatings are used on the blades and infill such as colorants, sealants, antimicrobials, and flame retardants?**

Many of these may be chemicals of concern and can leach from the product.

- **What is the composition of each layer including fiber blades, infill, and backing?**

Although much of the focus is on infill, all components of a turf field contain potential chemicals of concern.

- **Are Safety Data Sheets (SDS or MSDS) available that discuss each component?**

SDS or MSDS sheets are documents that contain information on potential hazards (health, fire, reactivity, and environmental) of a chemical product as well as safe handling procedures. Because manufacturers are not required to disclose all ingredients on an MSDS sheet, only those they deem to be potentially hazardous, these forms cannot be relied on as “ingredient lists.” However any turf company that you choose should be able to provide a complete list of chemical components for their product.

- **Has the turf been tested under realistic play conditions for heat generation, off-gassing, and particulate matter generation?**

Ideally this testing has been conducted by a third party that is not a paid consultant to the turf company. At a minimum the company should be able to provide you with their own test results or those of a consultant they have hired.

- **What products are required to sanitize (i.e. fungicides and antimicrobials) and clean the field and how often must they be applied?**

These products not only increase the likelihood of chemical exposures, they may increase maintenance costs. It's important that manufacturers are upfront about all maintenance requirements. In addition, antimicrobials and fungicides may pose health risks for children chronically exposed to them.

Other Considerations

- The lifespan of various turf options - how soon will it need to be replaced?
- Are there hidden costs such as those required for disposal of crumb rubber?
- Will the turf be indoors or outdoors? Inhalational exposures are likely to be higher indoors without proper ventilation.
- Ecotoxicity - Chemicals from artificial turf may be toxic to wildlife. Some studies have shown that new generations of turf such as EPDM are more toxic to aquatic life than crumb rubber
- Siting of the field - is it in close proximity to water sources that may be contaminated by runoff?

Tips for Safer Play on artificial turf surfaces

- If you select a turf field that does contain chemicals of concern, post a safety warning on your field to keep players and spectators safe
- Avoid use on very hot days
- Avoid use for passive activities (i.e. sitting, lounging, picnicking)
- Ensure good ventilation of indoor fields by opening doors and windows and utilizing fans
- Monitor young children to prevent accidental ingestion
- Always wear shoes on artificial turf
- Wash hands before eating, drinking, or adjusting mouth guard
- Clean cuts and abrasions immediately
- Brush hair thoroughly after play
- Remove and clean shoes and gear outside before getting in car
- At home, take off shoes and shake out your children's equipment and clothes outside or over the garbage
- Shower immediately after playing on artificial turf
- Vacuum any infill that comes into your home

Additional Resources

<https://www.epa.gov/chemical-research/federal-research-recycled-tire-crumb-used-playing-fields>

http://www.ct.gov/deep/cwp/view.asp?a=2690&Q=463624&depNav_GID=1511

https://www1.nyc.gov/assets/doh/downloads/pdf/eode/turf_report_05-08.pdf

<http://www.calrecycle.ca.gov/publications/Documents/Tires/2010009.pdf> 2010 CA report

<http://www.nbcnews.com/news/investigations/how-safe-artificial-turf-your-child-plays-n220166>

<http://www.ehhi.org/artificial-turf.php>

[http://www.wellesleyma.gov/pages/WellesleyMA_SpragueResources/TPE vs EPDM vs SBR and quality.pdf](http://www.wellesleyma.gov/pages/WellesleyMA_SpragueResources/TPE%20vs%20EPDM%20vs%20SBR%20and%20quality.pdf)

https://www.health.ny.gov/environmental/outdoors/synthetic_turf/crumb-rubber_infilled/docs/fact_sheet.pdf

<http://www.syntheticurfCouncil.org/?page=FAQs>

<http://www.forbes.com/sites/mikeozanian/2014/09/28/how-taxpayers-get-fooled-on-the-cost-of-an-artificial-turf-field/>

Ginsberg G, Toal B, Kurland T.M. (2011) Benzothiazole toxicity assessment in support of synthetic turf field human health risk assessment. *J Toxicol Environ Health A*. 74(17):1175-83. doi: 10.1080/15287394.2011.586943.

Cheng H, Hu Y, Reinhard M. (2014) Environmental and health impacts of artificial turf: a review. *Environ Sci Technol*. Feb 18;48(4):2114-29. doi: 10.1021/es4044193.