

Timeline of Crumb Rubber Research

10 Years of Studies Reveal Potential Hazards

2007

- **Scientific Study by OEHHA:**
[Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products.](#)
The California Office of Environmental Health Hazard Assessment (OEHHA) conducted 3 laboratory studies. One study evaluated chemical exposure that could cause harm to children. Two of the studies evaluated the risk of injury on recycled tires and wood chips. Chemical exposure study concluded that long term exposure may harm a child's health. Chrysene, a PAH and carcinogen, was higher than the risk level established by OEHHA, was found to be ingested as the result of hand-to-surface-to-mouth transfer from playground surfaces, and could possibly increase a child's chances of developing cancer. Injuries studies proved that 100% of the wood chip surfaces met the 2007 CA head impact safety standard. Fewer than 30% of rubber mulch surfaces met the head impact safety standard.
- **Scientific Report by EHHI:**
[Artificial Turf, Exposures to Ground-up Rubber Tires, Athletic Fields, Playgrounds, Gardening Mulch.](#) Environment & Human Health, Inc. (EHHI), a non-profit organization composed of doctors, public health professionals and policy experts commissioned a study from the Connecticut Agricultural Experiment Station to determine whether toxic compounds from crumb rubber could be released into air or water. The report on artificial turf describes identifying 25 chemicals, including: irritants benzothiazole and n-hexadecane; butylated hydroxyanisole, a carcinogen and suspected endocrine disruptor; and 4-(t-octyl) phenol, a corrosive that can be injurious to mucous membranes. It recognized that human exposure to the hazardous substances occurs via inhalation, skin contact, or ingestion. "The available information is sufficient and strong enough to raise plausible questions with respect to acute toxicity for susceptible persons, and for cancer risks."

2008

- **NJ Closes Fields Due to Elevated Levels of Lead (Pb):**
New Jersey officials found elevated lead levels in older artificial turf fields, and a number were closed. [Read USA Today report: "Two Cities Spurn Crumb Rubber in Artificial Turf."](#)
- **Lawsuit: California vs. Crumb Rubber Companies:**
California Attorney General Edmund "Jerry" Brown, Los Angeles City Attorney, and Solano County brought a [lawsuit](#) against AstroTurf, LLC; Beaulieu, LLC; and Field Turf, USA, for excessive lead levels after testing by Center for Environmental Health found high concentrations of lead in their products, which was later confirmed in independent tests. The lawsuit claimed the companies, "[failed to provide clear and reasonable warnings](#)" that their products contained lead, a violation of state law. The companies agreed to pay more than \$650,000 in fines and reduce the lead in their products.
- **Study by Dr. Lin Zhang, Environmental & Occupational Health Sciences Institute:**
[Hazardous Chemicals in Synthetic Turf Materials, and Their Bioaccessibility in Digestive Fluids.](#) Published in the [Journal of Exposure Science and Environmental Epidemiology.](#) Samples from rubber granules and from artificial grass fibers were taken at fields of different

ages and analyzed for polycyclic aromatic hydrocarbons (PAHs), zinc, chromium, arsenic, cadmium, and lead. These samples were then analyzed to determine their bioaccessibility in synthetic digestive fluids. The rubber granules found in artificial turf fields had PAH levels above health-based soil standards. Lead was also detected, but at relatively low concentrations. The researchers were careful to point out that “some health scientists believe that *any* Pb [lead] is harmful to children’s neurocognitive development, and that *no* new Pb should be added to their surroundings.” The study also found that “the lead in the rubber granules was highly bioaccessible in the synthetic gastric fluid.”

- **Banned in NYC:**

New York City Parks Department banned the installation of new crumb rubber fields in city parks and schools. After testing crumb rubber fields for lead levels, the city replaced a field in Harlem that had the highest lead content. Since then, the city has been replacing crumb rubber fields as part of 10-year renovation cycle. [New York Daily News reports, “City Yields Ground on Crumb Rubber in Turf Wars.”](#) [USA Today reports: “Two Cities Spurn Crumb Rubber in Artificial Turf.”](#)

2009

- **Research Study by the EPA:**

[A Scoping-Level Field Monitoring Study of Synthetic Turf Fields and Playgrounds.](#)

The EPA did a limited study from August to October 2008 and published its findings in November 2009. Samples were taken from 6 turf fields and 2 playgrounds. The study had limitations and did not measure concentrations of organic chemicals (SVOCs, including PAHs) that vaporize in the heat. The report states that the concentrations of materials present in recycled waste tire products were below levels considered harmful. EPA did recommend continued study in this area.

- **Banned in Los Angeles Unified School District:**

Los Angeles Unified School District [banned tire crumb rubber](#) on playing fields after lead was discovered at some of the preschool playgrounds. The school district removed crumb rubber from 54 preschools. They opted to use alternatives like cork.

2010

- **Research Study by OEHHA:**

[Safety Study of Artificial Turf Containing Crumb Rubber Infill Made from Recycled Tires: Measurements of Chemicals and Particulates in the Air, Bacteria in the Turf, and Skin Abrasions Caused by Contact with the Surface.](#) This California OEHHA study on used tire crumb rubber in artificial turf fields reviewed the chemical concentrations in the air above the fields found 8 chemicals that appear on the [California Proposition 65 list](#) of cancer-causing agents. The study also calculated that exposure via inhalation to 5 of these chemicals (benzene, formaldehyde, naphthalene, nitromethane, and styrene) results in increased lifetime cancer risks that exceed one in one million. The highest risk was from nitromethane, which could cause 9 cancer cases per one million soccer players. The OEHHA study also found that 2 other chemicals (toluene and benzene) on the California Proposition 65 list, identified as developmental and reproductive poisons. Data gaps identified in this study will be focused on during the current study that OEHHA is conducting.

2011

- **Scientific Study by Stuart L. Shalat, Sc.D.:**
[An Evaluation of Potential Exposures to Lead and Other Metals as the Result of Aerosolized Particulate Matter from Artificial Turf Playing Fields](#). This study, overseen by the New Jersey Department of Environmental Protection, detected arsenic, cadmium, chromium and lead, all metals with known human toxicity, in the air samples above artificial turf during various levels of activity. It concluded that artificial turf can deteriorate to form dust containing lead at levels exceeding EPA standards, which can be inhaled, posing a potential hazard to children. These results "raise some concerns with regard to the potential hazards that may exist for individuals and in particular children."

2012

- **Scientific Study by Sunduk Kim et al.:**
[Health Risk Assessment of Lead Ingestion Exposure by Particle Sizes in Crumb Rubber on Artificial Turf Considering Bioavailability](#). Published in [Environmental Health and Technology](#). Researches considered the risks for lead exposure from children ingesting rubber powder resulting from exposure to crumb rubber infill artificial turf and found that elementary school students had a hazard index that exceeded 0.1, a level that is considered a "potential for hazard," with middle and high school students also suffering exposure levels.

2013

- **EPA Retracts Prior Safety Claims:**
The [EPA issues a disclaimer](#) to statements made regarding the EPA crumb rubber study published in 2009. The disclaimer inserted into its original [press release](#) accompanying the study noted that it is "outdated," and redirects visitors to another website that more accurately reflects the state of the science on tire crumb.

The EPA website now emphasizes its very "limited nature." It states: "In 2008, EPA conducted a limited Scoping-Level Field Monitoring Study of Synthetic Turf Fields and Playgrounds. The purpose of the limited study was to test a method for measuring possible emissions from using synthetic turf on playgrounds and ball fields, **not to determine the potential health risks of recycled tire crumb in playgrounds or in synthetic turf athletic fields.**" The EPA website also emphasizes the need for additional studies because "the existing studies do not comprehensively evaluate the concerns about health risks from exposure to tire crumb."

- **Scientific Study by Chemosphere:**
[Hazardous Organic Chemicals in Rubber Recycled Tire Playgrounds and Pavers](#). This peer-reviewed Llompart study found hazardous substances including PAHs, phthalates, antioxidants (eg, BHT, phenols), benzothiazole and derivatives, among other chemicals. It showed high amounts of toxic chemicals in recycled materials and the vapor phase above the samples confirmed volatilization of many organic compounds demonstrating that these chemicals can enter the body through inhalation. "Uses of recycled rubber tires, especially those targeting play areas and other facilities for children, should be a matter of regulatory concern."

- **Playground Closed in Greenbelt, MD:**

The City of Greenbelt, MD closed a brand new playground due to toxic rubber tire mulch concerns. In a [report by NBC news](#), Diana Zuckerman with the Cancer Prevention and Treatment Fund said, "Rubber mulch contains phthalates, which are chemicals that affect hormones, and other chemicals that are known to be harmful to our health."

2014

- **NBC News Report:**

In response to escalating nationwide debate, [NBC News takes an in-depth look](#) at the crumb rubber controversy. The story covers the heated debate over the possible health hazards of exposing children to shredded tires on playgrounds and athletic fields. Soccer coach Amy Griffin began a crusade after hundreds of athletes became ill with cancer.

NBC has continued its coverage with least [15 different news articles](#) related to the crumb rubber debate.

- **Scientific Case Study and Report:**

[Investigation of PAH and other hazardous contaminant occurrence in recycled tyre rubber surfaces](#). Published in the [International Journal of Environment Analytical Chemistry](#). The study found 14 out of 16 EPA priority PAHs were identified and quantified in the rubber playground surface. The study confirmed the presence of other harmful compounds including phthalates, adipates, antioxidants, and benzothiazole, in some cases at high concentrations. The study concluded chemicals could reach surrounding air, and thus, PAHs are a likely inhalation risk, especially for children. "The presence and the high concentration of these chemical compounds in playgrounds should be a matter of concern owing to their high toxicity."

- **Bill to Ban Crumb Rubber in CA:**

California State Senate introduced [bill](#) to ban synthetic rubber materials in turfs and playgrounds.

2015

- **Scientific Research by the University of Siena, Italy:**

[Release of Polycyclic Aromatic Hydrocarbons and Heavy Metals from Rubber Crumb in Synthetic Turf Fields: Preliminary Hazard Assessment for Athletes](#).

From the Abstract and Conclusion: "We evaluated in nine samples of rubber crumb the total content of some heavy metals (zinc, cadmium, lead, copper, chromium, nickel, iron) normally found in tires. The results showed high levels of PAHs and zinc in all rubber crumb samples compared to rubber granulate limits set by Italian National Amateur League."

"Most of all, evaporation at high temperatures may expose users of sports grounds, who are often children between 5 and 13 years of age, in a very sensitive phase of growth, to many of these toxic compounds. The results of the present study demonstrate that PAHs are continuously released from rubber crumb through evaporation. Athletes frequenting grounds with synthetic turf are therefore exposed to chronic toxicity from PAHs. The main conclusion we can draw from this preliminary study, which will be validated by further field and laboratory research, is that although synthetic turf offers various advantages over natural grass, the quantity of toxic substances it releases when heated does not make it safe for

public health.”

- **Legislative Bill in Minnesota:**
In the spring of 2015, Minnesota State Legislature introduced [bill](#) to halt installation of tire rubber mulch and crumb rubber.
- **Banned in Montgomery County, MD:**
Unanimous council voted to ban publicly funded crumb rubber athletic fields. Roger Berliner, a member of Montgomery's county council, stated: "We have turned the page on crumb rubber. Let's put that behind us, and move forward into a totally safe and concussion-free, and heat island-free, environment for our children. So we can have great playability, and none of those worries." "All we could do is take a look at the literature that exists," Berliner said. "And that literature comes back and says it's not conclusive." Read the [NBC news report](#).
- **Retraction by the Consumer Product Safety Commission:**
On May 19, 2015, Chair of U.S. Consumer Product Safety Commission (CPSC), Elliot Kaye, [testified before U.S. Congress](#) that he no longer stands behind a 2008 statement from the CPSC that crumb rubber is safe to play on. His testimony described new federal studies underway. The CPSC also ordered an enforcement review of marketing of artificial turf products for children because CPSC found lead levels in artificial sports fields above statutory limits in children's products.
- **Scientific Study by EHHI at Yale University:**
Environmental and Human Health, Inc. (EHHI), a non-profit organization of physicians and public health professionals, commissioned a crumb rubber study performed by Yale University ("Yale Study"). The Yale Study that found that crumb rubber infill from used tires contains at least [96 chemicals](#) and [heavy metals](#), including carcinogens and other chemicals (arsenic, acetone, benzene, mercury, lead, styrene-butadiene, and polycyclic aromatic hydrocarbons, to name a few). Of the 96 chemicals detected, a little under one-half had no toxicity assessments done on them for their health effects. Of the one-half that had toxicity assessments (and were toxic), 20% are known or probable carcinogens, and 40% of chemicals were irritants. Of the irritants found, 24 percent were respiratory irritants, some causing asthma symptoms, 37 percent were skin irritants, and 27 percent were eye irritants.

EHHI issued a press release with the Yale Study: [The Cancer List Keeps Growing among Athletes on Synthetic Turf](#). EHHI states, "There are now 153 cancer cases reported, and of those, 124 are soccer players with 85 being soccer goalies. Many of them are student athletes."

[David Brown](#), Sc.D. Public Health Toxicologist explained, "Chemicals are usually assessed for their toxicity one chemical at a time. Synergistic effects of being exposed to numerous chemicals at the same time are not known. From the data in this new study, it is reasonable to assume that persons playing on synthetic turf fields with rubber tire infill or toddler playgrounds surfaced with rubber tire mulch are being exposed concurrently to multiple chemicals and multiple carcinogens."

[Dr. Gaboury Benoit](#), a Yale University professor of environmental chemistry and engineering, was the study's lead investigator. Benoit said, "The shredded tires contain a

veritable witches' brew of toxic substances. It seems irresponsible to market a hazardous waste as a consumer product."

During a conversation with a member of the mulch committee, Dr. Benoit confirmed that the Yale Study passed peer review and will be published December 2016 or January 2017.

- **New Study Underway by OEHHA:**

The California Office of Environmental Health Hazard Assessment (OEHHA) and the Department of Resources Recycling and Recovery [announced a new 3-year crumb rubber study](#), expected to be complete by mid-2019. The 3 million dollar project aims to assess potential health effects associated with recycled tires in synthetic turf fields and playground products. It is the most in-depth crumb rubber study to date. Researchers aim to:

- Extract and identify as many chemicals as possible from crumb rubber samples
- Utilize more suitable artificial bio-fluids to evaluate the chemicals that enter the body
- Measure crumb rubber particle size to understand if inhalation of small particles occurs
- Assess the risks of chemical exposures resulting from skin contact, breathing, ingesting

- **Alternatives Used in Los Angeles:**

Los Angeles replacing 100 grass soccer fields with artificial turf that does not use "crumb rubber." [Read article in L.A. Weekly.](#)

- **Toxicology Study in Minnesota:**

Parents in Duluth, Minnesota initiated a battle over the use of rubber mulch at an elementary school playground in 2015. They formed a grassroots entity, "[Duluth Parents for Healthy Playgrounds](#)," and hired a toxicology firm to test crumb rubber samples from the playground.

Toxicology Results: [Scrap Tire Mulch on Duluth Public Schools' Playgrounds, A Summary of Children's Environmental Concerns](#). This report includes a summary of literature review, testing performed, and alternatives to toxic rubber mulch. According to [local media coverage](#), "The test found 12 chemicals listed by the Minnesota Department of Health as "chemicals of high concern."

- **Legislators Request CPSC Study:**

Senators Richard Blumenthal and Bill Nelson [wrote a letter of request to CPSC](#) Chairman Elliot Kaye to conduct comprehensive studies to verify the safety of rubber for use in areas where children play, including playgrounds.

- **Banned in Edmonds, WA:**

In Washington state, [Edmonds City Council](#) approved an 18 month moratorium on the instillation of crumb rubber turf fields until July 2017.

- **2015 CPSC Public Playground Safety Handbook Disclaimer:**

The Consumer Product Safety Commission updates the playground handbook. The first page includes a disclaimer that "Section 2.4 of the Handbook identifies shredded/recycled rubber mulch as an "appropriate surfacing" product, given that this product can meet the impact attenuation requirements of ASTM F1292, as long as minimum depths of the material are maintained, as specified in table 2 of Section 2.5. **This notation is solely focused on the impact attenuation to minimize serious head injuries, and not on other aspects that may pose other risks, such as chemical exposure or ingestion.**

- **2015 Empire State Consumer Project (ESCP) Report:**
The ESCP 2015 Children's Products Safety Report includes a [rubber mulch chemical analysis](#) found arsenic, cadmium, and zinc at "higher than current acceptable limits." This testing turned up levels of toxics that exceed the New York State Department of Environmental Conservation for Brownfields, which are former hazardous waste sites.

2016

- **Senators Request Action by Obama Administration:**
[In a written request to President Obama](#), Senator Richard Blumenthal and Bill Nelson asked for comprehensive studies to assess the safety of crumb rubber for use in synthetic turf and playground surfacing products.
- **Federal Research Plan Announced:**
Three weeks later, the EPA, CDC/ATSDR, and CPSC announced a new [Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields](#) to answer environmental and human health questions. The study is examining 225 chemicals and how players on synthetic fields and children on playgrounds might be exposed through skin contact, inhalation, and accidental ingestion. Agencies will provide a status report by end of 2016, but the CPSC study on rubber mulch is not starting in earnest until 2017 after the EPA identifies the chemicals in crumb rubber.
- **Banned in Hartford, CT:**
Hartford, Connecticut bans crumb rubber and petroleum-based artificial turf in the first update of its zoning regulations in 50 years. Local article, "[A Shifting Ground for Artificial Turf in Connecticut](#)," quotes Sara Bronin, a zoning board commissioner and director of the Center for Energy and Environmental Law at UConn Law School. Bronin states, "In a dense urban environment like Hartford, any negative environmental and public health effects of synthetic infill could be magnified. So the uncertainties about these effects weighed heavily on our decision."
- **Expert Data Analysis from Mount Sinai:**
At the Children's Environmental Health Center of the Icahn School of Medicine at Mount Sinai, pediatricians, epidemiologists, and laboratory scientists conducted a review of the risks and benefits of artificial playing surfaces, finding significant gaps in the evidence supporting the safety of recycled rubber turf products. The findings are summarized in [Artificial Turf: A Health-Based Consumer Guide and Position Statement on the use of Recycled Tires in Artificial Turf Surfaces](#).
Noted dangers include: (1) extreme heat, (2) inhalation and ingestion of toxic and carcinogenic chemicals, (3) transportation home of rubber pellets, and (4) escape of chemical hazards from rubber surfaces to the environment.
Mount Sinai also issued [Written Testimony before the Connecticut General Assembly Committee on Children](#) that included a "Position Statement on the use of Recycled Tires in Artificial Turf Surfaces." The same experts answer FAQs online, "[What to Know about Artificial Turf Fields](#)."

- **Bill to Ban Crumb Rubber in WA:**
Spring 2016, Washington State Legislature introduced [bill](#) to ban synthetic rubber materials in turfs and playgrounds.
- **Bill to Ban Crumb Rubber in CT:**
Spring 2016, Connecticut State Legislature introduced [bill](#) to prevent use of rubber in playgrounds.
- **A Link between Crumb Rubber and Cancer Cases:**
[The Huffington Post reports](#) on Coach Amy Griffin, who created “[Amy’s list](#)” to collect cancer stats related to crumb rubber. The News Tribune also reports, as of April 2016, [220 athletes have related cancers](#), mostly lymphoma and leukemia. Of the 220, 166 of them are soccer players, 102 are goalkeepers.
- **Banned in Concord, MA:**
In Concord, Massachusetts voters approved a [3-year moratorium](#) on artificial turf. Article 47 prevents placement of turf with crumb rubber on any town owned land.
- **Banned in Littleton, MA:**
The town of Littleton, Massachusetts enacts a [3-year moratorium](#) on tire crumb rubber infill.
- **Rubber Turf Replaced in Seattle, WA:**
Seattle, Washington Parks & Recreation Department plans to [replace a crumb rubber turf](#) field at Cal Anderson Park with alternative material that uses cork and sand instead of crumb rubber given nationwide health concerns over crumb rubber.
- **Duluth School Board Removes Rubber Mulch from Playgrounds:**
In response to the grassroots-funded toxicology test, Duluth, Minnesota School Board voted to [replace rubber mulch used on 10 playgrounds](#). The estimated cost: \$300K-400K.
- **Chapel Hill Town Council Converting Crumb Rubber Field:**
The crumb rubber turf debate heats up in Chapel Hill where the Chapel Hill Town Council [voted to convert Homestead Park soccer fields](#) due to concerns of crumb rubber and fill the artificial turf with EPDM, a purer form of rubber.
- **Rubber Mulch Removal in Long Island, NY:**
The North Shore School District on Long Island, NY is [funding the removal of rubber mulch](#) from all of its school playgrounds and replacing it with wood chip.
- **Rubber Mulch Removal in VT:**
In Vermont, the Hartland [School Board releases \\$25,000 from reserve funds](#) to replace tire rubber mulch with wood chips.
- **Rubber Mulch Removal in MN:**
In Chanhassen, Minnesota Principal allowed the removal of rubber mulch from the school playground. [See Facebook Page, Bank Rubber Mulch on Playgrounds.](#)
- **Rubber Mulch Removal in CA:**
In Arcata, California a school is allowing the PTO to remove rubber mulch. [See Facebook Page, Bank Rubber Mulch on Playgrounds.](#)

- **Organic Turf in Sylva, NC:**
In July 2016, Sylva, NC chose to install a \$900K organic field for Smoky Mountain High School, due to health and environmental concerns over crumb rubber. [See WLOS report.](#)
- **Alternative Turf Fill in Pittsburg, PA:**
Chartiers Valley School District [chose to pay extra to install virgin rubber](#) and Shaler School Board [chose to pay extra to install a cryogenic rubber](#) fill field instead of potentially hazardous crumb rubber.
- **Crumb Rubber Replaced in Amsterdam:**
In October 2016, Amsterdam football club Ajax [replacing 4 artificial turf pitches](#) (soccer fields) because of [safety concerns](#) over crumb rubber granules.
- **Texas School District Removes Rubber Mulch:**
Hays Consolidated School District in Texas is replacing rubber mulch on its 5 playgrounds due issues with displacement of rubber mulch (pieces blow away and is difficult to maintain) and fall safety, as well as questions about exposing children to chemicals in tires. [Watch the KVUCabc news report](#), beginning at 3:03 minutes.
- **Banned in Sweden and Norway:**
European countries, including [Sweden and Norway have total bans on crumb rubber.](#)