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Health Questions about Artificial Turf Fields

Background

Cities and towns across Connecticut have increasingly opted for replacement of grass fields with a form of artificial turf that uses recycled rubber tires. The tires are processed into crumb rubber and used as an infill material to cushion the playing surface. Purported advantages over natural grass fields are reduced watering and maintenance, avoiding the need for pesticides, reduced injuries, and ability to play on the fields in a wider variety of weather conditions. However, the fields may not be maintenance-free and involve some grooming. Also, there are sources that recommend anti-static and antimicrobial treatments.

Questions have been raised regarding health, safety and environmental aspects of the rubber infill material (Brown, 2007). Rubber contains a variety of industrial chemicals that, in small quantities, can be released into the air during playing and which may run off into the environment in rainwater. This fact sheet focuses upon the potential health effects to athletes and spectators using these fields, many of who are school-age children.

What Chemicals Can Be Released By The Rubber Infill Material?

A mixture of particles and volatile chemicals can be released.

Rubber is a complex mixture of chemicals, some of which readily vaporize to form a gas (volatile organic chemicals or VOCs), while others remain in the solid-phase (e.g., metals, polycyclic aromatic hydrocarbons or PAHs). Given the variety and types of chemicals involved,

it is not surprising that some have toxic or carcinogenic activity when tested in laboratory animals. Studies at indoor soccer fields in Norway under active use conditions have shown that artificial turf can release numerous chemicals into the air, some as gases and others as particles. The VOCs included benzothiozole and toluene, while PAHs and phthalates were in the particles (Dye, et al., 2006). A laboratory study of vapor release from crumb rubber at the Connecticut Agricultural Experiment Station identified 3 additional chemicals (butylated hydroxanisole, hexadecane, octylphenol) and traces of other unidentified constituents (CAES, 2007). California EPA evaluated the potential for chemicals to be absorbed into the body if the rubber were swallowed by children (CalEPA/OEHHA, 2007). They found that 22 chemicals leached out of the rubber when subjected to a gastric acid solution intended to simulate the human stomach. Thirteen different metals were leached with zinc and copper the most abundant. Organic chemicals were also extracted from the rubber with aniline and benzothiazole the most common. Benzene, toluene and PAHs were not found in the extract.

VOC release from crumb rubber infill would be expected to be greatest under sunny, hot weather conditions and the surface of artificial fields is known to become hotter than the ambient air. Temperatures of 150F or higher have been found under these conditions (McNitt, 2007). Particle release is expected to be affected by the number of athletes using the field at any given time, their body weight and the intensity of their exercise. Weather conditions such as temperature gradients and wind will affect gas and particle concentrations in the breathing zone of athletes; in general this is 3-6 feet above the surface. Temperature studies done by Pennsylvania State University indicate the rapid dispersal of heat with height above the fields with measurements 3 feet above the surface 40-60F less than the surface temperature (McNitt, 2007). This rapid atmospheric mixing suggests that VOCs emanating from the surface will also rapidly dilute and that the main potential for exposure is during brief periods where athletes are lying flat on the ground. Indoor fields will have less dilution effect (less wind and temperature gradient) and measurements at indoor soccer fields in Norway (height above field not specified) found a variety of rubber-related VOCs (Dye, et al., 2006).

How Can People Be Exposed To Rubber Chemicals At Artificial Turf Fields?

Inhalation and ingestion exposures are possible.

Athletes using the fields can be exposed to VOCs and particles released from the rubber infill. Because their play may create airborne particles and because of their high ventilation rate, athletes are expected to receive the greatest exposure. As shown in the Norway indoor field study (Dye, et al. 2006), these particles can be in the respirable dust (<10 micron) range and can exist at concentrations of 1-10 microgram per cubic meter (ug/m³), which is somewhat higher than the urban background estimated for Los Angeles rubber dust (1-2 ug/m³) (Miguel, et al., 1996). Athletes may also inadvertently ingest dust particles that cling to the hands and clothing.

Those watching from the sidelines or grandstands will receive lower exposures to the particles and VOCs released by the rubber. It is also possible that if young children accompany parents to these fields, they may swallow the infill material itself, although the ingestion of whole granules is not likely to be a frequent occurrence. This possibility may increase if artificial turf fields are placed at elementary schools and playgrounds that have playscapes.

Since the particles cling to shoes and clothing, it is also possible for the infill material to be tracked into cars and homes after leaving the field. This can lead to some ongoing exposure to the athlete and other household members, as the particles become part of house dust. This is expected to be much less exposure than from the fields themselves.

Are People Exposed To These Chemicals In Other Ways?

Yes.

Most of the chemicals emitted from the rubber granules are quite common in urban and suburban air. Part of the reason is that car and truck tires are constantly being worn down and release a similar array of gases and particles as can be released from crumb rubber. These chemicals are not just near roadways but spread around and become part of the background air. For example,

roughly 1-2% of the respirable dust in Los Angeles is estimated to come from the wearing of tires (Miguel, et al., 1996).

Other sources for these chemicals are also quite common. For example, outdoor air contains PAHs from car exhaust and home furnaces, while indoor air and consumer products can be a source of chemicals found in rubber: benzothiozoles (carpet padding, rubber-based flooring, wine, food flavorings – Bellavia, et al., 2000), latex allergens (rubber bands and latex gloves), phthalates (cosmetics, flooring), toluene (solvent in glues and other consumer products), butylated hydroxyanisole (food preservative), hexadecane (food packaging), and PAHs (wood smoke, char-broiled meat). A California study found that benzothiazole off gases from rubberized flooring that is commonly used in schools and estimated indoor air concentrations up to several hundred ug/m³ (California Integrated Waste Management Board, 2003).

Rubber matting is commonly used beneath play equipment so that children have played on rubber surfaces for many years. However, the shredded nature of the tire crumbs causes a greater potential for exposure than is likely from intact rubber surfaces.

Thus background sources of exposure to the chemicals present in rubber infill are common and expected to be more continuous and at times greater than what is possible from playing on artificial turf fields. Possible exceptions to this are: 1) the ingestion of the infill material itself by small children, although this would be expected to be a one-time or sporadic event; 2) the contamination of the home environment with rubber granules and dust, which could lead to an ongoing, low-level exposure.

Is There A Health Risk?

Based upon the current evidence, a public health risk appears unlikely. DPH does not believe there is a unique or significant exposure from chemicals that can be inhaled or ingested at these fields. However, there is still uncertainty and additional investigation is warranted.

Any risk assessment on chemical exposures from artificial turf fields will be limited by the fact that exposure pathways are still not well characterized and that for some chemicals, the

toxicology database is incomplete. A potential concern is the possibility of respiratory irritation and instigation of an asthma attack. Asthma is already a concern in youth sports, especially in hot weather. One of the main chemicals that can off gas from the rubber, benzothiazole, is an irritant and particulate matter and latex allergens are potential asthma triggers. Concerns have also been raised regarding cancer risks given that rubber contains PAHs, certain of which are carcinogenic. However, when judged within the context of background exposures to these chemicals as well as risk assessments conducted by other regulatory bodies, artificial turf fields do not appear to be a significant risk factor for asthma or cancer.

Several governmental bodies have reviewed the potential exposures and risks from the chemicals that can be released from artificial turf. The Norwegian government conducted a quantitative risk assessment based upon the data described above from several indoor turf fields and a review of the available toxicology data (Norwegian Inst Public Health, 2006). They used reasonably conservative assumptions for contact rates via inhalation and ingestion of pellets by athletes. Their analysis found no elevated health risks. They cautioned that their assessment was incomplete in several areas, particularly due to incomplete toxicology data and regarding the potential exposure to latex allergens. The Swedish government issued a qualitative review of health risks and leaching potential to the environment and also determined that the risk to public health was not a concern (KEMI, 2006). However, from a pollution prevention perspective, they recommended against new installations of artificial turf. Risk evaluations by the French government and by the State of NJ similarly did not find threats to public health with the NJ white paper concluding that there was no obvious toxicological concern raised by crumb rubber in its intended outdoor use (Moretto, 2007; LeDoux, 2007). The California EPA/OEHHA risk assessment of children ingesting 10 grams of rubber pellets on a one time acute basis did not find an elevated health risk (CalEPA/OEHHA, 2007). Other groups have done their own assessment and found concerns due to the types of exposure possible (Brown, 2007).

It is also important to consider possible exposures in relation to background sources of the chemicals that can be released from the rubber infill. While this type of comparison is still limited, we do know that there is frequent and considerable background exposure to particulate matter, PAHs, latex allergens and phthalates in outdoor air, consumer products, food and the

indoor home environment. Some of this exposure comes from rubber itself as the wearing of tires is a significant contributor to air pollution.

Exposures to benzothiazole and other VOCs at artificial turf fields are expected to be low as off-gassing in cool weather may not be great and off-gassing in hot weather will be more significant but may be readily diluted with height above the field due to wind and as the heat from the field disperses. However, careful measurements of this have not been made.

While DPH does not believe there is a unique or significant health threat from chemical releases that can be inhaled or ingested, the uncertainties warrant further investigation.

Should Towns Continue To Install This Type Of Artificial Turf Field?

DPH's review does not find any reason to stop installation of these fields.

Currently there are no federal or state limits on the installation of crumb rubber-based turf fields. Therefore, it is up to towns to make a case-by-case decision on whether artificial turf is the right choice for a particular setting. DPH's review of the existing literature does not find any reason to stop installation of these fields, but acknowledges that much of this information is very recent and this area is rapidly evolving. Additionally, the potential exposures and risks have not been fully characterized. DPH recommends that towns consider these uncertainties as part of the array of issues evaluated when deciding whether to install artificial turf fields (e.g., cost, maintenance, public acceptability).

Where Can I Get More Information?

Health Questions? Contact the Environmental and Occupational Health Assessment unit at CTDPH at 860- 509-7740

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