



## Alternative Infills for Artificial Turf Fact Sheet

As the health and environmental concerns over the **crumb rubber infill**<sup>i</sup> used in artificial turf gain traction within the US<sup>o</sup> with increasing reports of its link to cancer, professional athletes and coaches condemning its use, municipalities and major cities across the country placing bans, politicians voicing concerns, and a federal multi-agency health study on artificial turf currently underway<sup>o</sup> manufacturers of artificial turf are responding with infill alternatives to the traditional crumb rubber infill. There are many new and emerging variations in the different products<sup>o</sup> composition and their manufacturers<sup>o</sup> claims<sup>o</sup> with some aimed at reducing the release of toxic substances, some at heat concerns, etc. Each of these materials offers their own apparent advantages, disadvantages, and questions<sup>o</sup> which are outlined below. Generally, these alternatives, their performance as turf, and their impact on human health and the environment are not yet well studied, documented, or proven. Ultimately, especially when considered in their larger context as one component of an artificial turf system, infill alternatives pose greater environmental and health risks than natural grass turf.

**Artificial turf infill:** Artificial turf infill is the material used in an artificial turf system to hold artificial grass blades upright and to cushion the surface. Crumb rubber has long been the industry standard for infill material. As a result of the increasing environmental and health concerns associated with crumb rubber, the artificial turf industry is producing infills made from alternative materials.

**Alternative infill materials:** Alternative infill products generally consist of one or more of the following components:

**Silica sand:** Sand is generally combined with other infill components listed below at various ratios (though it is also occasionally used on its own with a shock pad).

- **Toxicity:** The crystalline silica sand that is generally used in artificial turf infill contains silica dust, which can cause silicosis (hardening of the lungs through inflammation and the development of scar tissue) and cancer when inhaled. Crystalline silica is known by the state of California to cause cancer<sup>ii</sup> OSHA recently finalized stricter rules for occupational exposure to crystalline silica dust;<sup>iii</sup> and the International Agency for Research on Cancer (IARC) has classified silica as a carcinogen.<sup>iv</sup> However, there are currently no standards for non-occupational exposure and silica sand is used frequently in playgrounds and artificial turf fields.
- **Performance:** Silica sand is abrasive and relatively hard, especially under cold or frozen conditions.<sup>v</sup>

**Thermoplastic Elastomers (TPEs):**<sup>vi</sup> TPE is a generic term for extruded plastic pellets made from a rubber and plastic polymer. While TPEs are often advertised as made from "virgin" (not recycled) materials, there is wide variability amongst the quality and chemical makeup of the many TPEs on the market.<sup>vii</sup>

- **Toxicity:** While many TPEs are advertised as free of lead, zinc, and other toxic materials, some have been shown to contain heavy metals. TPEs are often composed of ethylene, butadiene, and styrene

copolymers.<sup>viii</sup> Styrene and butadiene, two of the main components in crumb rubber, are classified as carcinogens by the World Health Organization. The effects of human exposure to these substances from turf infill are not adequately studied.<sup>ix</sup> Dangerous chemical fillers, UV stabilizers, and flame retardants are often added. Very few toxicological and risk assessment studies exist, leaving insufficient data on the composition, off-gassing, leaching, and associated health effects.<sup>x</sup>

- **Temperature stability and performance:** There is no consistency amongst TPEs for these categories. Generally, TPE hardens over time.<sup>xi</sup> Many TPE fields that have been installed have had to be replaced due to the low melting point of the material resulting in a gum-like substance that sticks to cleats and sticks the [grass] fibers together.<sup>xii</sup>
- **Industry examples:** EcoGreen, Eco Max, BionPro, FutrFill

**EPDM Rubber** (Ethylene Propylene Diene Monomer): EPDM is a synthetic rubber polymer that can be made from either virgin or recycled rubber.<sup>xiii</sup> However, it is a similar material to SBR rubber, the standard crumb rubber infill. EPDM is a generic term and the source, formulation, and quality can vary greatly.<sup>xiv</sup>

- **Toxicity:** Some studies show that newly manufactured rubber also contains levels of hazardous substances; in the case of zinc and chromium the levels of recycled and newly manufactured rubber are comparable.<sup>xv</sup> EPDM rubber can be similar in composition to crumb rubber<sup>xvi</sup> and also contains UV stabilizers, flame retardants, and other chemical additives.<sup>xvii</sup> Very little analysis has been done on EPDM as an infill.<sup>xviii</sup>
- **Temperature and Performance:** EPDM is often produced in lighter colors to reduce heat concerns.<sup>xix</sup>
- **Additional issues:** Several manufacturers in Europe have had to replace a large number of fields due to a reaction between the EPDM and the carpet fiber that causes a breakdown of the fiber.<sup>xx</sup> There are reports of premature aging and degradation of the infill due to high levels of chemical fillers.<sup>xxi</sup>

**Acrylic/Polymer Coated Sand:** Silica sand coated in acrylic or another polymer. The chemical contents of the polymer coatings vary by manufacturer.

- **Toxicity:** The polymers used to coat the silica sand vary greatly. Some contain heavy metals and other toxins.<sup>xxii</sup> Limited data is available and coatings are thought to contain additional chemicals of concern.<sup>xxiii</sup>
- **Temperature stability and performance:** Reported to stay approximately 20 degrees cooler than crumb rubber, but to get hotter than natural grass.<sup>xxiv xxv</sup> Both the acrylic coating and sand are very hard and require a shock pad and are recommended to be combined with a softer filler material. Low Resiliency and shock absorption.<sup>xxvi</sup>
- **Additional issues:** Coating is reported to dissolve in water and not last as long as manufacturers guarantee. Sand particles can gel together.<sup>xxvii xxviii</sup>

**Recycled Sneakers:** Ground athletic shoes and leftover materials from sneaker manufacturing that are marketed as safer than crumb rubber because they meet restricted substance standards set for wearable consumer goods.

- **Toxicity:** The actual composition of the rubber and other materials in the sneakers used is not actually known, but is thought to be very similar to that of crumb rubber. May contain heavy metals. Similar chemical exposures to carcinogens and neurotoxins as those from crumb rubber are suspected.<sup>xxix xxx xxxi</sup>
- **Performance:** Reported to cause contact injuries<sup>xxxii</sup> and hold static charge, sticking to clothing and equipment.<sup>xxxiii</sup> Can also cause extreme heat exposure.<sup>xxxiv</sup>

**Organic materials:** Several municipalities concerned with the health risks of crumb rubber have decided to install artificial turf fields with organic infill materials. These infills consist of any combination of one or more of the following: coconut fiber, coconut husk, coconut peat, cork, rice husks, walnut shells, etc.

- **Toxicity:** No apparent chemical toxicity in the infill materials themselves. However, other components of an artificial turf system (including polypropylene fiber carpets and SBR shock pads). Organic materials may also require treatment with pesticides, insecticides, antimicrobials or anti-static chemicals.<sup>xxxv xxxvi</sup>
- **Temperature:** Reported 20-50 degree cooler than crumb rubber, though still higher than natural grass.<sup>xxxvii</sup>
- **Performance:** Weather can impact playability as organic materials become saturated and freeze. Reports of early degradation and compaction.<sup>xxxviii</sup>
- **Other Issues:** Organic infills require irrigation and regular maintenance, including de-compaction twice a year and replacement of 10% of infill every 2-3 years.<sup>xxxix</sup> Materials harden, blow away, and float leading to migration and accumulate in waterways, reduced performance capability and higher potential for injury. There is potential for weed and mold growth and decomposition. Not recommended for flood prone areas.<sup>xl xli xlii</sup>

**Variations:** examples of variations on these materials include

- **Coated crumb rubber:** marketed as safer and more heat resistant than crumb rubber. Crumb rubber may be coated with EPDM, colorants, or other sealants. The coatings may contain additional chemicals of concern; and their effectiveness in sealing off the toxins in crumb rubber has not been well studied.<sup>xliii</sup>
- **Extruded Cork Composite (ECC):** Natural cork, polyethylene and elastomers. These composites contain many of the same harmful chemicals in other plastic and rubber alternatives.<sup>xliv</sup>

**Summary and Recommendations:** Very few toxicological and risk assessment studies regarding the health and environmental impacts of emerging alternative infill options have been completed but from the data that is available there are many concerns to be had. While there is insufficient data on the chemical composition, off-gassing, leaching, and associated health and environmental effects that may result, the data that is available demonstrates many reasons for concern. For these reasons, the precautionary principle should be used to avoid the unnecessary and potentially devastating harms to those who would come in direct contact with the infills and the environment surrounding them.

All alternative infill options are significantly more expensive than traditional crumb rubber; with all artificial turf systems (including those with crumb rubber infill) costing more than natural turf grass.<sup>xlv</sup> There is no proven record of the durability, performance, and lifespan of these infills to warrant the cost and many anecdotal references from schools and municipalities throughout the country illustrate flaws.

While shock absorption and temperature stability of different alternative infills vary, natural grass fields are still preferable and safer playing surfaces for athletes. And while organic infill materials will likely eliminate most or all chemical exposure concerns due to the infill itself, other components of an artificial turf system are still likely sources of chemical exposure to players and surrounding ecosystems, in addition to other environmental concerns including increased stormwater due loss of pervious surface and/or evapotranspiration; toxins leaching from synthetic grass fibers and/or pads; migration of infill materials and turf fibers into waterways; leaching of algacides, pesticides, disinfectants; and an increased greenhouse gas footprint.<sup>xlvi</sup>

Overall, when considering health, the environment, and the costs natural grass turf is safer choice.

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- <sup>i</sup> "Crumb rubber" refers to Styrene-Butadiene-Rubber, or "SBR," made from recycled tires. For an overview of environmental and health concerns associated with crumb rubber infill, see DRN fact sheet: "Artificial/Synthetic Turf." *Delaware Riverkeeper Network*. Fact Sheet, September 9, 2007. Web. 18 Oct. 2016. Available at: <http://www.delawareriverkeeper.org/sites/default/files/Artificial%20Turf%20Fact%20Sheet.pdf>
- <sup>ii</sup> State of California Environmental Protection Agency Office of Environmental Health Hazard Assessment Safe Drinking Water and Toxic Enforcement Act of 1986. Chemicals known to the State to cause cancer of reproductive toxicity. May 20, 2016. Available at: <http://oehha.ca.gov/media/downloads/proposition-65/p65single05202016.pdf>
- <sup>iii</sup> "Occupational Exposure to Respirable Crystalline Silica." *Federal Register*. Occupational Safety and Health Administration, 26 Mar. 2016. Web. 18 Oct. 2016. Available at: <https://www.federalregister.gov/documents/2016/03/25/2016-04800/occupational-exposure-to-respirable-crystalline-silica#h-9>
- <sup>iv</sup> "IARC Monographs on the Evaluation of Carcinogenic Risks to Humans." *IARC Monographs*. International Agency for Research on Cancer, n.d. Web. 18 Oct. 2016. Available at: <http://monographs.iarc.fr/ENG/Monographs/vol68/>.
- <sup>v</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>
- <sup>vi</sup> Staff Work Group from Montgomery County Public Schools, Montgomery County Department of Parks, Montgomery County Council, Montgomery Department of Environmental Protection, and Montgomery County Department of Health and Human Services (2011). A Review of Benefits and Issues Associated with Natural Grass and Artificial Turf Rectangular Stadium Fields. Final Report.
- <sup>vii</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>
- <sup>viii</sup> Mount Sinai Hospital Children's Environmental Health Center. "Synthetic Turf: A Health-Based Consumer Guide." February 2016. Available at: [http://media.wix.com/ugd/fd0a19\\_f5aa0824698341499b4228ebabf90cb5.pdf](http://media.wix.com/ugd/fd0a19_f5aa0824698341499b4228ebabf90cb5.pdf)
- <sup>ix</sup> Mount Sinai Hospital Children's Environmental Health Center. "Synthetic Turf: A Health-Based Consumer Guide." February 2016. Available at: [http://media.wix.com/ugd/fd0a19\\_f5aa0824698341499b4228ebabf90cb5.pdf](http://media.wix.com/ugd/fd0a19_f5aa0824698341499b4228ebabf90cb5.pdf)
- <sup>x</sup> Ibid.
- <sup>xi</sup> Ibid.; Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>
- <sup>xii</sup> Activitas. (2014) Turf Study Memorandum prepared for the City of Marlborough, Massachusetts.
- <sup>xiii</sup> Mount Sinai Hospital Children's Environmental Health Center. "Synthetic Turf: A Health-Based Consumer Guide." February 2016. Available at: [http://media.wix.com/ugd/fd0a19\\_f5aa0824698341499b4228ebabf90cb5.pdf](http://media.wix.com/ugd/fd0a19_f5aa0824698341499b4228ebabf90cb5.pdf)
- <sup>xiv</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>
- <sup>xv</sup> Byggforsk, SINTEF Building and Infrastructure, Potential Health and Environmental Effects Associated with Synthetic Turf Systems, 2004, as referenced in KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
- <sup>xvi</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>
- <sup>xvii</sup> Mount Sinai Hospital Children's Environmental Health Center. "Synthetic Turf: A Health-Based Consumer Guide." February 2016. Available at: [http://media.wix.com/ugd/fd0a19\\_f5aa0824698341499b4228ebabf90cb5.pdf](http://media.wix.com/ugd/fd0a19_f5aa0824698341499b4228ebabf90cb5.pdf)
- <sup>xviii</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>
- <sup>xix</sup> Staff Work Group from Montgomery County Public Schools, Montgomery County Department of Parks, Montgomery County Council, Montgomery Department of Environmental Protection, and Montgomery County Department of Health and Human Services (2011). A Review of Benefits and Issues Associated with Natural Grass and Artificial Turf Rectangular Stadium Fields. Final Report.
- <sup>xx</sup> Ibid.
- <sup>xxi</sup> Synthetic Turf Infill Options. *Devotion School Building Committee*. Synthetic Turf Infill Options. October 29, 2015.
- <sup>xxii</sup> Staff Work Group from Montgomery County Public Schools, Montgomery County Department of Parks, Montgomery County Council, Montgomery Department of Environmental Protection, and Montgomery County Department of Health and Human Services (2011). A Review of Benefits and Issues Associated with Natural Grass and Artificial Turf Rectangular Stadium Fields. Final Report.
- <sup>xxiii</sup> Mount Sinai Hospital Children's Environmental Health Center. "Synthetic Turf: A Health-Based Consumer Guide." February 2016. Available at: [http://media.wix.com/ugd/fd0a19\\_f5aa0824698341499b4228ebabf90cb5.pdf](http://media.wix.com/ugd/fd0a19_f5aa0824698341499b4228ebabf90cb5.pdf)
- <sup>xxiv</sup> Staff Work Group from Montgomery County Public Schools, Montgomery County Department of Parks, Montgomery County Council, Montgomery Department of Environmental Protection, and Montgomery County Department of Health and Human

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Services (2011). A Review of Benefits and Issues Associated with Natural Grass and Artificial Turf Rectangular Stadium Fields. Final Report.

<sup>xxv</sup> Synthetic Turf Infill Options. *Devotion School Building Committee*. Synthetic Turf Infill Options. October 29, 2015.

<sup>xxvi</sup> Ibid.

<sup>xxvii</sup> Staff Work Group from Montgomery County Public Schools, Montgomery County Department of Parks, Montgomery County Council, Montgomery Department of Environmental Protection, and Montgomery County Department of Health and Human Services (2011). A Review of Benefits and Issues Associated with Natural Grass and Artificial Turf Rectangular Stadium Fields. Final Report.

<sup>xxviii</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>

<sup>xxix</sup> Mount Sinai Hospital Children's Environmental Health Center. "Synthetic Turf: A Health-Based Consumer Guide." February 2016. Available at: [http://media.wix.com/ugd/fd0a19\\_f5aa0824698341499b4228ebabf90cb5.pdf](http://media.wix.com/ugd/fd0a19_f5aa0824698341499b4228ebabf90cb5.pdf)

<sup>xxx</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>

<sup>xxxi</sup> Mount Sinai Hospital Children's Environmental Health Center. "Synthetic Turf: A Health-Based Consumer Guide." February 2016. Available at: [http://media.wix.com/ugd/fd0a19\\_f5aa0824698341499b4228ebabf90cb5.pdf](http://media.wix.com/ugd/fd0a19_f5aa0824698341499b4228ebabf90cb5.pdf)

<sup>xxxii</sup> Ibid.

<sup>xxxiii</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>

<sup>xxxiv</sup> Mount Sinai Hospital Children's Environmental Health Center. "Synthetic Turf: A Health-Based Consumer Guide." February 2016. Available at: [http://media.wix.com/ugd/fd0a19\\_f5aa0824698341499b4228ebabf90cb5.pdf](http://media.wix.com/ugd/fd0a19_f5aa0824698341499b4228ebabf90cb5.pdf)

<sup>xxxv</sup> Staff Work Group from Montgomery County Public Schools, Montgomery County Department of Parks, Montgomery County Council, Montgomery Department of Environmental Protection, and Montgomery County Department of Health and Human Services (2011). A Review of Benefits and Issues Associated with Natural Grass and Artificial Turf Rectangular Stadium Fields. Final Report.

<sup>xxxvi</sup> Synthetic Turf Infill Options. *Devotion School Building Committee*. Synthetic Turf Infill Options. October 29, 2015.

<sup>xxxvii</sup> Ibid.

<sup>xxxviii</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>

<sup>xxxix</sup> Synthetic Turf Infill Options. *Devotion School Building Committee*. Synthetic Turf Infill Options. October 29, 2015.

<sup>xl</sup> Ibid.

<sup>xli</sup> Gale Associates Inc. (2015). Alternative Infills for Synthetic Turf. Available at: <http://www.galeassociates.org/wp-content/uploads/2015/03/Alternative-Infills-for-Synthetic-Turf.pdf>

<sup>xlii</sup> Staff Work Group from Montgomery County Public Schools, Montgomery County Department of Parks, Montgomery County Council, Montgomery Department of Environmental Protection, and Montgomery County Department of Health and Human Services (2011). A Review of Benefits and Issues Associated with Natural Grass and Artificial Turf Rectangular Stadium Fields. Final Report.

<sup>xliiii</sup> Mount Sinai Hospital Children's Environmental Health Center. "Synthetic Turf: A Health-Based Consumer Guide." February 2016. Available at: [http://media.wix.com/ugd/fd0a19\\_f5aa0824698341499b4228ebabf90cb5.pdf](http://media.wix.com/ugd/fd0a19_f5aa0824698341499b4228ebabf90cb5.pdf)

<sup>xliiv</sup> Synthetic Turf Infill Options. *Devotion School Building Committee*. Synthetic Turf Infill Options. October 29, 2015.

<sup>xli v</sup> "Artificial/Synthetic Turf." *Delaware Riverkeeper Network*. Fact Sheet, September 9, 2007. Web. 18 Oct. 2016. Available at: <http://www.delawareriverkeeper.org/sites/default/files/Artificial%20Turf%20Fact%20Sheet.pdf>

<sup>xli vi</sup> In reviewing available literature on Artificial Turf, The Staff Work Group from Montgomery County Public Schools, Montgomery County Department of Parks, Montgomery County Council, Montgomery Department of Environmental Protection, and Montgomery County Department of Health and Human Services found that "the impacts of material transportation, construction, maintenance, and loss of carbon sequestration result in artificial turf fields adding GHG to the atmosphere when compared to natural grass fields."