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Project BL-08-00843

Ms. Lisa Hondros
Friends of the Riverfront
P.O. Box 580545
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Re: Summary of Document Review Comments and Opinions
Environmental, Health and Safety Issues Associated with Artificial Turf Fields
Proposed DeLaSalle Athletic Facility on Nicollet Island

Dear Ms. Hondros:

At your request, Braun Intertec Corporation (Braun Intertec) has completed our review of the documents as referenced in your e-mail correspondence dated February 22 and 23, 2008. The following provides a summary of our document review comments and opinions regarding potential environmental, health and safety issues associated with artificial turf fields.

Background Information

It is our understanding that DeLaSalle High School is proposing to construct a new athletic facility on Nicollet Island in Minneapolis, Minnesota. The facility will include the installation of a new artificial turf field comprised of recycled shredded tires ("tire crumb") as infill material. The tire crumb granules are between 0.5 to 3.0 millimeters in diameter, similar in size to that of a sand granule. The tire crumbs are typically spread 2 to 3 inches deep over the field between ribbons of plastic used to simulate grass. The tire crumb infill can account for as much as 90 percent of the overall field weight.

The tire crumbs can consist of an individual or combination of various rubbers including: natural rubber, or synthetic rubbers such as styrene butadiene rubber or ethylene propylene diene terpolymer (EPDM). In addition to the rubber itself, other substances that may be present in tires include carbon black, aromatic oils including polycyclic aromatic hydrocarbons (PAHs), and sulfur (vulcanizing agent), and various metals including some heavy metals. Although PAHs do not have high vapor pressures, many are known or suspect carcinogens.

In addition to athletic fields, tire crumb is also being used on playgrounds and as gardening mulch.

The use of tire crumbs as infill for artificial turf fields has become a controversial issue relative to various unknown health hazards and impacts on the environment. Consequently, several of the neighboring parties in proximity to the school and proposed field site have expressed concern over the risks such a field may pose to the nearby residences and overall environment.

Summary of Review Comments

Early on, the safety information relative to synthetic or artificial turf fields primarily focused on the health benefits regarding a reduction in joint injuries due to the use of the tire crumbs on such fields.

Recycled rubber has relatively high heat absorption properties. In June of 2002, a study of surface temperatures was conducted at the Brigham Young University ("Synthetic Surface Heat Studies" by Dr. Frank Williams and Dr. Gilbert Pulley). In summary, an infrared thermometer was used to measure temperatures taken at 5 feet and 6 inches above the surface and at the surface of a synthetic turf, natural turf, bare soil, asphalt, and concrete. In addition, a soil thermometer was used to measure the temperature at 2 inches below the surface of the synthetic turf. Water was used to cool the surface of the natural and synthetic turf. The surface temperature of the synthetic turf was 37 degrees Fahrenheit (°F) higher than the asphalt and 86.5 °F higher than the natural turf. Irrigation (i.e., watering) of the synthetic turf had a significant impact on cooling the surface from 174 °F to 85 °F; however, the temperature climbed back up to 120 °F after 5 minutes and 164 °F after 20 minutes, respectively. The hottest temperature recorded was 200 °F on a day when the ambient temperature was 98 °F. It should be noted that the Safety Office at Brigham Young University set 120 °F as the maximum temperature that the surface could reach to avoid injury to the skin.

Based on data available within the rubber fabrication and reclamation industries, documented chemical exposures to a variety of volatile organic compounds, semi-volatile hydrocarbons, and other contaminants exist. In addition, studies at tire reclamation sites report the leaching of similar chemical contaminants into the ground water. Although there are limited studies that identify actual levels of chemical exposures to humans with respect to tire crumbs used as infill, several of the same chemicals that rubber workers are exposed to, are likely being released from the shredded rubber tire crumbs.

In the winter of 2003, the Norwegian Building Research Institute conducted a study to assess potential environmental and health effects linked to the use of artificial turf systems. The analysis identified the recycled rubber granulates to contain lead, cadmium, copper, mercury, zinc, PAHs, phthalates, 4-t-octylphenol and iso-nonylphenol. The total concentration of zinc and PAHs exceeded the Norwegian Pollution Control Authority's normative values for most sensitive land use. The leachate from the recycled granulates contained zinc, PAHs, phthalates and phenols.

In October of 2005, the Norwegian Institute for Air Research measured the concentration of airborne dust and gas phase compounds (volatile organic compounds and PAHs) in three different indoor artificial turf pitches. The airborne dust contained PAHs, phthalates, semi-volatile organic compounds, benzothiazoles and aromatic amines. The proportion of organic material in the dust was reported as considerable.

In 2006, Rutgers University conducted a study of tire crumbs taken from synthetic turf fields in New York City. The study identified six PAHs, all likely human carcinogens, at levels that exceeded the regulatory levels in New York. However, the researchers did note that a solvent extraction was used to release the PAHs from the tire crumbs.

In June of 2007, Environment and Human Health, Inc. (EHHI) conducted a tire crumb study in conjunction with the Department of Analytical Chemistry at the Connecticut Agricultural Experiment Station (CAES) to evaluate the chemicals released to the air and water under ambient conditions. One set of experiments tested the leaching potential of the metals from samples of tire crumbs and one sample from commercial rubber mulch. The second set of experiments tested the chemicals released from the tire crumbs and commercial rubber mulch. In summary, the lab results identified the following metals leached into water from the tire crumbs: zinc, selenium, lead and cadmium. Secondly, at a temperature of 60 degrees Celsius (°C), several chemical compounds were detected although the four primary compounds detected included: benzothiazole, butylated hydroxyanisole, n-hexadecane, and 4-(t-octyl) phenol. As noted in the CAES document, when the black tire crumbs were placed in direct sunlight at an exterior temperature of 88 °F, the temperature measured within the tire crumbs was 131 °F, which is equal to 55 °C. Thus, the temperature of 60 °C used in the lab study is considered to

be representative of actual ambient conditions on the field. EHHI concluded that the chemicals found in the air at tire-shredding facilities should also be considered to be potential contaminants at sites that use tire crumb infill. Note: the above-referenced information is contained in the following documents.

- Examination of Crumb Rubber Produced from Recycled Tires; CAES, 8/07
- Exposures to Recycled Tire Rubber Crumbs Used on Synthetic Turf Fields, Playgrounds and as Gardening Mulch; EHHI, August 29, 2007.

In the State of New York, a recent bill (No. A09503) provides for a public health study on the use of crumb rubber in synthetic turf, a six-month moratorium on its use and installation pending the health department's report, and site specific environmental impact statement whenever synthetic turf use is proposed.

Remarks

In summary, based on our review of the various documents and the specified studies, it is our opinion that the tire crumb infill can be a potential health hazard to the users and other individuals in the immediate vicinity of the field, as well as to pose a risk to the neighboring environment. However, as outlined in the EHHI report, there is a need for more data and further testing to assess the actual exposure conditions during normal use/activities on the field.

With respect to potential impacts to the environment, there are several variables that will influence the degree of impact. These include but are not limited to the following:

- Seasonal weather conditions including temperature, relative humidity, wind direction/speeds, precipitation (rain)
- Actual field design relative to irrigation systems, field drainage runoff/systems in place
- Frequency of field use or overall loading impacts relative to individuals carrying loose infill with them on their shoes and clothing
- Field maintenance activities such as replenishment of infill and cleanup of loose debris
- The actual composition or type(s) of rubber contained in the infill material

In addition to the above-referenced variables, other conditions that may influence potential health hazards to users, spectators, and other nearby individuals include, but are not limited to include:

- Physical activities or other disturbance factors that decrease the size or diameter of the tire crumbs; whereby, a percentage of the airborne dust becomes respirable within the lower lung region. Again, it is important to keep in mind that the dust associated with the tire crumbs may contain a variety of other organic contaminants.
- The primary exposure pathway of concern for individuals, particularly those playing on the field involves inhalation of contaminants. The actual degree of exposure will depend on the actual airborne concentrations, duration of time on the field at any given time, and the frequency of use in terms of acute or short-term effects versus chronic or long-term effects. Exposures by way of ingestion or direct skin contact are less likely to contribute to the overall exposure.
- Elevated surface temperatures will increase the potential for chemical off-gassing and exposure to organic compounds.

In closing, Braun Intertec recommends a thorough environmental impact study should be conducted to assess the current site conditions and what if any impacts the proposed artificial turf field would have on the environment and any associated health risks to individuals on or near the site.

This report is issued in accordance with our General Conditions (6-15-06). If you have any questions or require further assistance, please call me at 952.995.2482.

Sincerely,

BRAUN INTERTEC CORPORATION



Gregory G. Olson, CIH
Senior Industrial Hygienist
Associate Principal