

**From:** Christi Davis  
**Sent:** Friday, March 10, 2017 3:59 PM  
**To:** Turf, Synthetic@OEHHA  
**Subject:** Exposure measurement

Great presentation. The exposure measurement for PM 2.5 uses kicking machine with the monitors located off the field. Does this mimic the exposure received by a goalkeeper engaged in functional training where she may dive into the turf 100 times over the course of 10-15 minutes? Or does this mimic the exposure of a player dribbling the ball down the field? How has the validity of this method been validated?

Christi Davis Ph.D.

**From:** Christi Davis  
**Sent:** Monday, March 13, 2017 1:27 AM  
**To:** Turf, Synthetic@OEHHA  
**Subject:** Comments on presentation

I would like to compliment everyone on both the quality of the planned study and also on the insightfulness of the questions asked of the investigators. I particularly appreciate that the advisory panel recognizes that the overarching goal is to estimate the health risk posed by artificial turf fields. I have a few comments based on the released materials and the presentation on Friday.

Fields near point source pollution.

A question was raised as to whether fields near point sources of pollution should be used in the study. Pollution from point sources or roadways may interact differently with artificial turf fields than it does with natural grass fields. A study by Dr. David Brown found elevated benzene exposures for children playing soccer on an artificial turf field. Benzene from vehicle exhaust from an adjacent parking lot was adsorbing onto crumb rubber in the turf field and re-emitting when the field warmed. Thus, while toxic chemicals may not originate in an artificial turf field, the field may concentrate or perpetuate exposures from other sources. On the other hand, grasses and other plants are well known for filtering toxic chemicals from the air. Because the endpoint of concern is human health risk, the way artificial and natural fields interact with ambient pollution is relevant and should be part of the study. The difference in toxic exposures between artificial turf fields and grass fields is of interest, regardless of the original source of the chemicals.

Biofluid Extraction

The time periods for biofluid extractions need to be biologically relevant. PM 2.5 that is deposited in the alveoli is not necessarily cleared within 4 hours. It can remain for weeks to months. Testing needs to reflect the potential for extended exposure.

Particle sizes in ingestion and dermal exposure need to include dust and fine particulate matter. Most of the crumb rubber that sticks to the skin will be in the form of dust and PM. Much of the ingested crumb rubber will be from incidental hand to mouth contact. Crumb rubber on the hands will tend to be in the form of particulate matter. Even when players get crumbs in their mouths after slides or dives into the turf, they can easily spit out the larger crumbs. It's the dust and tiny crumbs that end up getting swallowed. Additionally, larger respirable particulates will be trapped in mucus in the upper airway and make their way down the back of the throat into the digestive tract. A child with pica may consume 10g of crumbs in one day. However, an elite goalkeeper may ingest 0.1g of dust and particulate matter 250 days a year for 10 years, or 250g of crumb dust over a lifetime. (The risk assessment by the Norwegian Institute of Public Health and the Radium Hospital assumed that players ingested up to 1g of crumb rubber per match or training session. However goalkeepers have estimated swallowing only about 1/4 teaspoon per match, so 0.1g may be a more conservative estimate.)

Field Exposure Measurement

Why is field exposure measurement being conducted at the same time as the exposure pathways study? Shouldn't the exposure pathways study be completed first? Then, you would know what activities to model and you would also know what compounds you should expect to detect, in what proportions. For example, initial data from the exposure pathways study indicated that benzothiazole and naphthalene were minimally present in undisturbed crumb but present at high levels in crumb that had been agitated. While this result is not unexpected, it has not been explicitly reported in studies on crumb rubber before this. Additionally,

researchers may want to reexamine the findings of previous studies, such as “Artificial Turf Field Investigation in Connecticut: Final Report,” by Simcox et.al. in light of this new data. The findings from the Simcox study may not be fully consistent with the findings presented at the meeting Friday.

Understanding the conditions under which SVOCs like benzothiazole are off-gassed, and how atmospheric mixing of these chemicals is affected by activity is critical to accurately measuring real-world exposures.

Additionally, in the field weathering studies, it was unclear whether the crumb rubber was continually simultaneously exposed to sun, ozone, elevated temperature and mechanical grinding, as would be the case on a field. All of these conditions can influence the degradation of crumb rubber into smaller particles, thus influencing the rate off-gassing

#### Safety Warnings

On page 126, why do OEHHA personnel need a warning about heat stress, heat exhaustion, and dehydration, and exposure hazards from chemicals on turf fields, before entering the fields? If the risks are significant, why didn't OEHHA highlight them before this? If OEHHA staff need these warnings, don't parents and children need these warnings before they enter the field? The disparity here makes it appear as if OEHHA cares more about the health of its workers than about the health of children. This is particularly concerning since children's bodies are less able to deal with exposures to toxic chemicals than adults'.

*Before entering the field, the LBNL and OEHHA field leads will hold a tailgate meeting to go over the safety protocol. OEHHA field lead will present the emergency facility information and discuss potential physical (e.g., trips and falls, slip hazards, **heat exhaustion and heat stress, dehydration**, proper lifting techniques, use of personal protective equipment including eye protection, **potential exposure hazards from chemicals applied to or that are on the turf**, hygiene techniques and first aid) and biological hazards (e.g. bug bites).*

Thank you for your time and service.

Christi Davis, Ph.D.