Not So Sweet Sixteen
Less is More Trouble for Aging Artificial Turf Fields

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Since the discovery of lead in artificial turf yarn fibers in a sports field in New Jersey last year, the looming concern has turned to potential lead exposure to those playing on the existing, aging; often, poorly maintained; artificial turf fields.

Some existing artificial turf fields yarn fibers have been found to contain lead levels from less than 1 mg/Kg to a reported excess of over 6,000 mg/Kg. Until the early part of 2008 – no one in the artificial turf industry even suspected lead (Pb) content to be of concern. Of course, once found, the industry as a whole has raced to reformulate and remove excess amounts of lead content – however – there may be several thousand of the more than 3500 installed artificial turf fields that exceed safe standards.

The EPA/HUD limit is 400mg/kg, based on soil in playground areas.

The assumption is a particle containing lead is the same whether it is a soil particle or a fiber particle. The concentrations have depended somewhat on type of fiber, manufacturer, fiber color, production variability, and method of analysis.

The lead can come directly from the fiber and from oxidation of the outer surface of the fiber to form lead dust. Exposure to the lead is by inhalation of the dust and ingestion of the dust and fiber. (Asked by the CPSC – ASTM is taking measures to evaluate and publish protocols to standardize the analysis methods to EPA standard methods SW846 3050B for sample preparation and SW846 6010B for analysis of total lead in artificial turf samples.)

The fibers and dust can enter the mouth by quarterbacks licking their fingers before having the ball hiked, players taking their mouth guards in and out of their mouths between plays, dropping their mouth guards, simply swallowing small airborne particles that are gulped down with air during intensity of play, and many other possibilities.

Studies by the New Jersey Department of Public Health and Junfeng et al show that between 15% to 50% of the lead in the fibers is digested and bioaccessible , and between 50% to 90% of the lead in the dust is bioaccessible and can enter the blood stream.

It only takes ingestion of one gram of dust and fibers to meet the EPA/HUD blood level threshold of 10 ug/dl and the CDC 10 ug/dl level of concern for children if the fibers contain 5,000 mg/Kg lead and the body assimilates only 10% of the lead in the fibers ingested.

Sixteen fibers weigh approximately one gram. **One gram is the weight of a dollar bill.**

It takes 20 days for the body to excrete half the lead in the blood. Some of the lead in the blood is absorbed into bone tissue where it takes 20 years for the body to expel half of this lead.

An argument may be made that there is no way that a person will ingest 16 fibers or 1 gram of fibers and dust during a field event, however it is very feasible that a person could ingest that much during a week, 2 weeks, or 3 weeks of field activity.

Continued exposure would gradually increase the lead blood level.

A player on the field for 5 days in a week would only need to ingest 0.2 grams of fiber and dust or approximately 3 fibers a day to equal the EPA/HUD/CDC 10 ug/dl lead limit.

The EPA/HUD limit for playground soil is 400 mg/Kg lead which can be extended to artificial turf since they are both particles containing bound lead.

There is pressure for the limit to be reduced to 300 mg/Kg or lower for artificial turf. Based on the EPA limit of 400 mg/Kg and assuming only 10% of the ingested fiber is assimilated, then an adult would only have to ingest approximately 13 grams of fiber and dust or approximately 200 fibers to equal the 10 ug lead/dl blood limit.

It would be difficult to ingest this much fiber in one event; however, it is feasible that it could be done over a longer period of time, after repeated exposure, causing blood lead **accumulation**.

The lower the total lead content in the artificial turf, the lower the possible lead exposure.

It is possible that future US Federal or State regulations, rules, bans or restriction of lead (Pb) inhalation/ingestion limits may be reduced to 0.5 micro grams per day (0.5 ug/day) based on recent research on the effects of lead on learning and reproduction for children.

As in the case of California's Prop 65 Maximum Allowable Dose Level (MADL) of 0.5 ug/day, (instead of 10 ug/dl), for a 5000 mg/Kg total lead content fiber it would take approximately 800 times less fiber to be inhaled/ingested by a child, to reach the MADL for reproductive harm of 0.5 ug/day exposure.

Assuming only 10% assimilation of the lead in the fibers, a child would need to ingest only 0.001 grams of dust/fiber that contained 5,000 mg/Kg lead or **approximately 1/200th of a single fiber** for the child to have a potential exposure of the Prop 65 MADL exposure of 0.5 ug/day.

If the fibers contained 400 mg/Kg lead, then the child would need to ingest 0.013 grams of dust/fiber or only 2/10ths of a fiber for the child to have a blood lead level of 0.5 ug/day.

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Supportive Information regarding the calculations and a representative chart

Calculations – you can also refer to the Layman's Guide presentation included
Following are example calculations for the above data.
Given: the weight of <u>16 fibers is 1 gram</u>
      10 ug of lead/dl blood equals 100 ug/L
      there is approximately 5 liters of blood per person
      the concentration of lead in the fibers is <u>5,000 mg/Kg</u>
Assume: <u>10% (0.10) of the lead is assimilated</u>

16 fibers/g = 0.0625 fibers/g
(0.0625 fibers/g)(1/1000 g/Kg) = 0.0000625 Kg/fiber
(5,000mg lead/Kg fiber)(0.0000625 Kg/fiber) = 0.3125 mg lead/fiber
(0.10)(0.3125 mg lead/fiber) = 0.03125 mg lead/fiber
(0.03125 mg lead/fiber)(1,000ug/mg) = 31.25 ug lead/fiber
(500ug lead/person)(1/31.25 ug lead/fiber) = <u>16 fibers/person</u>
(16 fibers/person)(1/16 fibers/g) = <u>1 g/person</u>

<u>Assuming 10% of the lead ingested is assimilated, a person ingesting 16 fibers or 1 gram of fibers/dust containing 5,000 mg/Kg lead would have a blood lead concentration equal to the EPA/HUD/CDC limit of 10 ug/dl.</u>

Total Lead In Fibers (mg/kg)	EPA/HUD Amount for 10ug/dl Lead in Blood				CPCS Amount for 15ug/Day Lead in Blood			
	Weight of Fibers/Dust Ingested (g)		Equivalent Number of Whole Fibers Ingested		Weight of Fibers/Dust Ingested (g)		Equivalent Number of Whole Fibers Ingested	
	10%*	50%**	10%*	50%**	10%*	50%**	10%*	50%**
5,000	1	0.2	16	3	0.03	0.006	0.5	0.1
1,000	5	1	80	16	0.15	0.03	2.5	0.5
600 (CPSC 2008)	8	2	128	32	0.25	0.05	4	0.8
400 (EPA Limit)	13	3	200	40	0.4	0.08	6	1
300 (CPSC 2009)	17	4	267	53	0.5	0.1	8	2
100 (CPSC 2011)	50	10	800	160	1.5	0.3	25	5
10	500	100	8,000	1,600	15	3	250	50
1	5,000	1,000	80,000	16,000	150	30	2,500	500

*Assuming 10% of the lead ingested is assimilated
**Assuming 50% of the lead ingested is assimilated