CPSC Staff[1] Analysis and Assessment of Synthetic Turf "Grass Blades"

CPSC staff identified synthetic turf products for analysis of total lead content and accessible lead. Staff obtained samples of turf that had been left over after installation or that became available when a field was dismantled. Staff also visited in-service synthetic turf fields, and used portable X-ray Fluorescence (XRF) testing equipment to detect the presence of lead in the product, as well as a portable field wiping apparatus to measure the exposure potential to the lead.

The staff considered that exposure to the lead present in some synthetic turf products could occur if some of the lead gets on children's hands, perhaps when synthetic grass blades break or become worn and release small particles of lead-containing material. The lead on the children's hands may then get transferred from their hands to their mouths through normal hand-to-mouth activity during or after playing on the field.

Analytical Methods

Lead Content

Small pieces of synthetic grass blades were dissolved in concentrated nitric acid using a microwave digestion. The digested sample solutions were then analyzed for lead content using inductively coupled plasma atomic emission spectroscopy.

Accessible Lead (Wipe Sampling)

Products found to contain lead were tested for accessibility of the lead; *i.e.*, whether children using the product could be exposed to the lead that is present.

Staff adapted the approach for estimating exposure to lead from contact with lead-containing synthetic turf fields from the approach used to assess children's exposure to arsenic from playing on playground structures built using chromated copper arsenate (CCA) pressure-treated wood (Appendix A).

The wipe testing methodology developed for testing pressure-treated wood was used to measure transfer of lead from synthetic grass blades, with one modification. Ghost Wipe™ was used in place of the polyester cloth wipe used in the wipe sampling for wood. Ghost Wipe™ is a commercially available wiping material, 15 cm x 15 cm, pre-moistened with deionized water, and sold in individually sealed packets. Company literature indicates that the Ghost Wipe™ meets all ASTM E1792-96E[2] specifications for sampling materials for lead in surface dust.

The general method involves attaching a Ghost Wipe™ to a 1.1 kg weighted disk, 8 cm in diameter, installed in a device built to provide a standardized and consistent surface wiping. The disk is dragged down a 50-cm length of turf sample for 10 back and forth strokes. The wipe is then removed for analysis.

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[1] These comments are those of the CPSC staff, have not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

[2] ASTM Standard E1792-96E, "Standard Specification for Wipe Sampling Materials for Lead in Surface Dust," ASTM International, West Conshohocken, PA, www.astm.org.

Results

Several of the products obtained by staff contained lead in the synthetic grass with concentrations ranging from 0.09 percent lead by weight to 0.96 percent. The testing showed that lead content varied between synthetic turf installations, and also within a field depending on color.

The data show that wiping of the surface of lead-containing synthetic turf with firm pressure results in transfer of some lead or lead-containing material to the wipe medium (Ghost Wipe™).

Exposure Assessment and Results

If it is assumed that transfer of lead-containing residue from the surface of synthetic turf has similar characteristics to transfer of arsenic-containing residue from wood (Appendix A) (*i.e.*, that the amount of residue collected does not increase infinitely, but plateaus at some point during play), then the amount of lead that might collect on the hands of children as they play on turf fields can be estimated from laboratory studies of synthetic turf.

As discussed in Appendix A, the experimental wipe method using polyester cloths overestimated the amount of residue that might be transferred to a person's bare skin by a factor of between five and 13 times, depending on whether a wet or dry cloth was used. Although the relationship between surface residue removal by a Ghost Wipe™ and bare skin has not been fully characterized, preliminary tests indicate that the Ghost Wipe™ overestimates to a similar degree the transfer of material from the turf surface to bare hands.

The staff believes that dividing the results obtained through use of using Ghost Wipes™ by five is a reasonable approximation of the amount of lead-containing material that may transfer to children's hands.

The exposure assessment described above concerns the accessibility of the lead. Another important point to consider is the bioavailability of the lead, which relates to the amount of lead that is absorbed by the body. The staff assumed, in this case, that the bioavailability of lead from the material that transfers to skin from contact with lead-containing synthetic turf is the same as the bioavailability of lead from food and drink in the epidemiological studies of lead exposure.

The staff's approach, based on the assessment of exposure to arsenic in pressure-treated wood, is that during play, lead-containing residue is transferred to a child's hands and then a portion of that "handload" is transferred to the mouth during the day. The staff practice for assessing whether exposure to a product would result in excessive lead exposure is to assume that about half of the residue that collects on a child's hands ends up in their mouths (*i.e.*, transfer efficiency is 50 percent).

The staff used the wipe-testing data to estimate transfer of lead to children's hands during contact with a synthetic turf surface during play. Each wipe value was divided by five to correct the overestimation of transfer using the Ghost Wipe™, and divided by two to account for the amount of lead that is transferred from the hands to the mouth.

CPSC staff recognizes a level of 10 micrograms of lead per deciliter of blood (10 µg/dL) as a level of concern with respect to lead poisoning. To prevent children from exceeding this level, the staff suggests that chronic ingestion of lead from consumer products should not exceed

15 µg lead/day[3]. This value was determined from epidemiological studies of ingestion of lead through food and drink (as discussed above with respect to bioavailability).

The results (Table 1) for this set of tested synthetic turf fields show no case in which the estimated exposure for children playing on the field would exceed 15 µg lead/day.

Study Limitations

This assessment is subject to a number of limitations including the accuracy of the wipe sampling method for estimating exposure to lead-containing residue from touching or other contact with the synthetic turf surface; the accuracy of the assumptions about the capacity of bare skin to collect surface residues during a typical play event at a field; and the accuracy of the assumptions related to hand-to-mouth transfer of lead-containing residues. Further, the staff did not make adjustments in its assessment to account for the non-uniformity of lead content of synthetic turf fields; *i.e.*, some fields had striped areas that contained lead that constitute only a small part of the total playing surface of the field that otherwise had no detectable lead levels. Children playing on such fields might have some contact with the lead-containing striped areas, but most of their contact with the surface would be expected to be with the other parts of the turf (not lead-containing). Finally, the bioavailability of lead from synthetic turf may not be the same as it is for the food and drink exposures that were the basis of the dose-response assessment used to determine the staff's recommended 15 µg/day exposure limit for lead.

[3] 16 C.F.R. § 1500.230. Codified Guidance Policy for Lead in Consumer Products (63 FR 70648; December 22, 1998).

Appendix A

The staff's previous assessment[4] of children's exposure to arsenic from playing on playground structures built using chromated copper arsenate (CCA) pressure-treated wood informed the current approach to analysis of synthetic turf surfaces and the assessment of potential exposure to the lead contained in the turf "grass" fibers. Lessons learned from the CCA studies include:

1) Development of a treated wood sampling method: A saline-wetted polyester cloth wipe was attached to a 1.1 kg weighted disk, 8 cm in diameter. The disk was dragged down a 50-cm length of wood for 10 back and forth strokes. When compared to results of residue transfer using volunteers with bare hands, the polyester cloths picked up approximately 13 times more residue; the experimental values were multiplied by a conversion factor of 0.076 to get human skin equivalent handloadings. When the polyester cloths were used dry, they picked up, on average, about 5 times more residue than the volunteer's bare hands did.

2) Understanding of some of the characteristics of treated wood surface residues: Removal of surface residue arsenic correlated with several experimental design features including the material used to wipe the surface, whether the material was wetted or dry, the amount of force applied during wiping, and the area wiped. A key observation was that the amount of dislodged residue did not necessarily simply increase with changes in method that would likely remove more residue. Rather, the amount of dislodged residue approached a plateau, *i.e.*, it appeared that the transfer of material depended on the capacity of the transfer medium (whether the skin of hands of volunteers or wipes made of cloth or other materials) to collect residue, which was not infinite.

3) Understanding of the nature of children's contact with playground structures and potential exposure to surface residues: The data, in conjunction with activity analysis of children playing on playgrounds, led to the conclusion that despite the large variability in children's playground activities and time spent at a playground, their hands would likely collect surface residues from the wood structures they happened to touch fairly quickly in a play session—what the staff termed "maximum handloading". For the exposure and risk analysis, then, the staff assumed that a child's hands would become contaminated with an amount of arsenic as determined by the experimental study of residue transfer. Data from cloth wipes were adjusted for the finding that the cloth wipes always picked up more residue from the wood surfaces than the bare skin of volunteers.

[4] Briefing Package, Petition to Ban Chromated Copper Arsenate (CCA)-Treated Wood in Playground Equipment (Petition HP 01-3), February 4, 2003.

Table 1. Turf Sample Exposure Results and Health Hazard Evaluation

Firm	Description	Subsample	Lead content (%)	Wipe Sampling Result (µg) *	Estimated daily ingestion of lead (µg) †‡
1	Green, installed 1999; removed 2008	1	0.54	65.8	6.6
		2	0.56	98.7	9.9
		3	0.55	39.9	4.0
		Average		68.1	6.8
1	Green, indoor field; installed 2000; in use		0.88	14.3	1.4
1	Green; new, 2008	1	0.1	1.2	0.12
		2	0.09	1.2	0.12
		3		0.9	0.09
		Average		1.1	0.11
1	Green; new, 2008	1	0.42	1.3	0.13
		2	0.47	0.4	0.04
		3		0.4	0.04
		Average		0.7	0.07
2	Green and other colors; installed 2005; in use		nd	nt	neg
2	Green; unused sample sent to lab for analysis		nd	nt	neg
2	Green; unused sample sent to lab for analysis		nd	nt	neg
2	Green; unused sample sent to lab for analysis		nd	nt	neg
2	Green; unused sample sent to lab for analysis		trace	nt	neg
2	Green; unused sample sent to lab for analysis		nd	nt	neg
2	Red; unused sample sent to lab for analysis		nd	nt	neg
2	Yellow stripes; field in use	Sideline,1	0.53	0.9	0.09
		Sideline,2		0.5	0.05
		Midfield		2.4	0.24
3	Green with yellow stripes; installed 2007; in use	Green	nd	nt	neg
		Yellow,18	0.96	0.7	0.07
		Yellow,19		1.4	0.14
		Yellow,20		0.8	0.08
		Yellow, Average		1.0	0.1
4	Green; white stripes; installed 2004; in use		nd	nt	neg

Note: nd = none detected; nt = not tested; neg = negligible

* Amount of lead collected on Ghost Wipe™ during wipe testing; if multiple wipes were conducted on a sample, the result of the first wipe is shown; all values are total lead removed during wipe.

† Laboratory wipe results divided by 5 to account for differences in lead residue removal efficiency of the Ghost Wipe™ and bare skin. The factor of 5 was taken from the staff's CCA studies; a similar trend was found in limited hand sampling of synthetic grass blades. Staff assumes that half of the residue that collects on a child's hands will be transferred to the mouth and ingested. Thus, the estimated daily ingestion of lead is the Ghost Wipe™ result divided by 5 divided by 2.

‡ The estimated daily ingestion of lead is an estimate of exposure for children playing on a synthetic turf field. Each estimate in this analysis may be compared to the 15 µg/day level that CPSC staff suggests not be exceeded in order to prevent young children from exceeding the 10 µg/dL blood lead level of concern.