Letter Health Consultation

NEW KENT WOOD PRESERVATIVES

PROVIDENCE FORGE, VIRGINIA

Prepared by
Virginia Department of Health

MARCH 2, 2016

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

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LETTER HEALTH CONSULTATION

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COMMONWEALTH of VIRGINIA

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Ruth Scharr
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Dear Ms. Scharr,

Thank you for the opportunity to review the concentrations of metals in soil at New Kent Wood Preservatives located in Providence Forge, Virginia for worker-related health implications. On December 1, 2014 you requested that the Virginia Department of Health (VDH), under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), *review arsenic, chromium, and copper concentrations in soil and determine if worker's health may be impacted*. After reviewing the data you provided and visiting the site, VDH concludes that the concentration of arsenic, chromium, and copper in soil samples collected at New Kent Wood Preservatives in 2014 and 2015 may result in a low increased cancer risk for workers with long term low soil contact, but this risk is still within EPA's acceptable risk range (10^{-4} to 10^{-6}). VDH concludes that the concentrations of arsenic, chromium, and copper found in soil in 2014 and 2015 at the New Kent Wood Preservative site are not expected to harm the health of workers with long-term low soil contact. Limitations of this analysis include the use of estimated soil contact rates and 2015 soil data that are reported as "estimates" and "biased high," which may overestimate the risk. VDH does not recommend further soil sampling unless the site use changes.

BACKGROUND AND STATEMENT OF ISSUES

The New Kent Wood Preservatives, Inc. site is located at 4101 S. Mount Castle Road, Providence Forge, Virginia in New Kent County. The site is an old wood treatment facility that operated from the 1970's to the 1990's. The wood treatment process used a chromium, copper, and arsenic solution that was applied on an unbermed concrete drip pad located near the middle of the site.

Currently, the site is occupied by two active businesses: McNeil Sales and Service Co. Inc., and Museum Resources. McNeil Sales and Service Co. specializes in refractory supplies and

services.[1] Museum Resources specializes in historic woodwork and forest product manufacture for museums and 18th century restoration work.[2] Neither of these businesses use chromated copper arsenate.[3]

On December 10, 2014, VDH met with EPA, the Virginia Department of Environmental Quality (VDEQ), and a local official at New Kent Wood Preservative to tour the site. While there, VDH had the opportunity to speak with workers and determined that typical worker contact with soil on the site is low (boot contact only). VDH noted, during this site visit, that grass, vegetation, saw dust, and gravel covered the majority of the property. There are dirt pathways between a few buildings that forklifts travel along in order to move products between buildings.

DISCUSSION

Comparison values and environmental data

The comparison of environmental data with ATSDR comparison values (CVs) is one of the first steps in the public health assessment process. The results of this screening step give health assessors an understanding of the priority contaminants at a site. When a contaminant is detected at a concentration less than its respective CVs, exposure is not expected to result in health effects and it is not considered further as part of the public health assessment process. **It should be noted that contaminants detected at concentrations that exceed their respective CVs, do not necessarily represent a health threat.** Instead, the results of the CV screening identify those contaminants that warrant a more detailed, site-specific evaluation to determine whether health effects are possible. CVs are not intended to be used as environmental clean-up levels.

VDH assumes that workers are employed for at least a year and selected exposure duration in the following order when more than one health based CV was available (chronic>intermediate>acute). VDH used the following CVs for reviewing the arsenic, chromium, and copper concentrations in soil samples:

- Environmental media evaluation guides (EMEGs) represent concentrations of substances in water, soil, and air to which humans may be exposed during a specified period of time (acute, intermediate or chronic) without experiencing non-cancerous adverse health effects. EMEGs used have been calculated using MRLs and default adult exposure assumptions.

- Cancer risk evaluation guides (CREGs) are media-specific comparison values that are used to identify concentrations of cancer-causing substances that are unlikely to result in a significant increase of cancer rates in an exposed population. ATSDR develops CREGs using EPA's cancer slope factor (CSF) or inhalation unit risk (IUR), a target risk level (10^{-6}), and default exposure assumptions. The target risk level of 10^{-6} represents an estimated risk of 1 excess cancer case in an exposed population of 1 million.

[1]McNeil Sales and Service Co. [Accessed 2014 September 9]. Available from: http://mcneilusa.com/.
[2]Museum Resources. [Accessed 2014 September 9]. Available from: http://www.museum-resources.com/.
[3]Ruth Scharr. Personal communication. September 23, 2015.

After visiting the site and speaking with workers, VDH evaluated samples that were collected (included in Table 1) from areas where workers were likely to come into contact with soil. VDH is aware that higher concentrations of arsenic, chromium, and copper may be present at other areas of the site. The soil samples were collected from zero to three inches below ground surface in 2014.[4] In 2015, soil samples were collected from zero to six inches, six to twelve inches, and twelve to eighteen inches below ground surface. To be health protective, the highest reported concentration in 2015 from each sampling location was considered regardless of depth when calculating averages, exposure dose, and risk.

Background and perimeter results

Off-site background samples (01-03) were collected west of the site with the highest arsenic, chromium, and copper concentrations in soil reported as 2.3 milligram/kilogram (mg/kg), 4.6 mg/kg, and 6.5 mg/kg, respectively. This is consistent with off-site background sample 19 which was collected east of the site. On-site background samples (17 and 18) were higher than off-site background samples, particularly chromium and copper.

In 2015, samples were collected from just outside the perimeter of the site with the highest arsenic, chromium (VI), and copper concentrations in soil reported as 1,480 mg/kg, 12.0 mg/kg, and 131 mg/kg, respectively.

On-site soil results

Arsenic soil results

- The average arsenic soil concentration of thirteen on-site samples, eight collected in 2014, and five samples collected in 2015 averaged 121 mg/kg with 10.6 mg/kg and 449 mg/kg reported as the lowest and highest, respectively. The 95th upper confidence limit (95% UCL) for all on-site samples calculated using ProUCL was 180 mg/kg. All samples, including background samples exceeded the CREG, and only two on-site samples exceeded the chronic EMEG. Arsenic is further evaluated in the public health implications section below.

Total chromium soil results

- The average total chromium soil concentration of eight on-site samples, five collected in June and three collected in September 2014, averaged 115 mg/kg with 21.8 mg/kg and 281 mg/kg reported as the lowest and highest, respectively. None of the samples, including background samples, exceeded the chronic EMEG for chromium (VI). Total chromium is not evaluated further.

Chromium (VI) soil results

- The average chromium (VI) soil concentration of five on-site samples collected in 2015 averaged 8.5 mg/kg with 0.6 mg/kg and 23.4 mg/kg reported as the lowest and highest, respectively. None of the samples, including background samples, exceeded the chronic EMEG for chromium (VI). Chromium (VI) is not evaluated further.

[4]Sampling depth (Personal communication: Lora Werner, February 12, 2015)

Copper soil results

- The average copper soil concentration of thirteen on-site samples, eight collected in 2014, and five collected in 2015 averaged 165 mg/kg with 10.6 mg/kg and 1,040 mg/kg reported as the lowest and highest, respectively. None of the samples, including background samples, exceeded the intermediate EMEG for copper. Copper is not evaluated further.

Public health implications

After visiting the site and talking with workers, VDH has determined that worker exposure to contaminants in the soil is low (boot contact only). Because arsenic was the only contaminant found in soil above one or more CVs as noted above, it is evaluated further for public health implications.

Arsenic is a toxic naturally occurring metalloid that is found extensively distributed in the Earth's crust. Inorganic arsenic in the environment is commonly found in combination with other elements such as oxygen, chlorine, and sulfur, while arsenic bound to carbon and hydrogen is organic. About 90% of all arsenic produced is used as a preservative for wood to make it resistant to rotting and decay. Depending on the scenario (e.g. frequency, duration, concentration, route), inorganic arsenic exposures can cause a wide range of health effects, including skin lesions, stillbirth, spontaneous abortion, cardiovascular diseases, diabetes, and different types of cancers.[5] Ingestion of arsenic may directly affect the atherogenic process involving vascular endothelium, smooth muscle cells, platelets and macrophages; arsenic may exacerbate many risk factors for cardiovascular diseases.[6] Acute oral exposures can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, lung irritation and damage to blood vessels.[7] Chronic oral exposure to inorganic arsenic can lead to physical skin changes (including darkened skin and the appearance of small corns or warts on the palms, soles, and torso), as well as the development of skin cancers.[8] Arsenic is thought to be strongly genotoxic; research has shown that arsenic is able to cause DNA damage such as aneuploidy, micronuclei formation, chromosomal aberrations, deletion mutations, sister chromatid exchange and DNA-protein cross-linking.[9] The Department of Health and Human Services, the International Agency for Research on Cancer, and the EPA have all classified inorganic arsenic as a known human carcinogen.[7]

[5]Smith AH, Steinmaus CM. 2009. Health effects of arsenic and chromium in drinking water: Recent human findings. Annu. Rev. Public Health. 2009;30:107–122.
[6]Chen CJ, Hsueh YM, Lai MS, Shyu MP, Chen SY, Wu MM, Kuo TL, Tai TY. 1995. Increased prevalence of hypertension and long-term arsenic exposure. Hypertension. 25:53–60.
[7]Agency for Toxic Substances and Disease Registry (ATSDR) 2007a. Toxicological Profile for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.
[8]Agency for Toxic Substances and Disease Registry (ATSDR) 2007b. Public Health Statement for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. [Last updated 2007 August, Accessed 2014 September 9]. Available from: http://www.atsdr.cdc.gov/phs/phs.asp?id=18&tid=3.
[9]Faita F, Cori L, Bianchi F, Andreassi MG. 2013. Arsenic-Induced Genotoxicity and Genetic Susceptibility to Arsenic-Related Pathologies**.** Int J Environ Res Public Health. 10(4): 1527–1546

Table 1. Arsenic, chromium, and copper concentrations in soil collected in the 2014 and 2015, and comparison values.

	Sample Location	Soil Depth (inches)	Arsenic (mg/kg)	Chromium‡ (mg/kg)	Copper (mg/kg)
Sample date June 20, 2014					
Background (to the west)	01	0-3	**1.8**	4.3	2.9
	02	0-3	**1.8**	4.3	3.3
	03	0-3	**2.3**	4.6	6.5
On-site Samples	067	0-3	**229**	143	332
	080	0-3	**53**	51.8	29
	097	0-3	**177**	171	123
	098	0-3	**449**	281	1,040
	100	0-3	**51**	77.7	47.8
Sample date September 10, 2014					
Background	17*	0-3	**3.6**	19.5	22.9
	18*	0-3	**5.3**	23.4	14.2
	19†	0-3	**2.9**	8.1	4.1
On-site Samples	08	0-3	**82.2**	108	77.9
	11	0-3	**36.2**	64.2	16.4
	12	0-3	**10.6**	21.8	10.6
Sample date February 2015 (shaded samples are reported as biased high or estimates)					
Off-site sample (perimeter)	311	0-6	**218**	1.61	167
		6-12	**14.9**	2.84	20.3
	314	0-6	**295**	2.75	75.7
	341(duplicate)	0-6	**335**	12.0	84.2
	315	0-6	**1,480**	9.78	131
On-site Samples	317	0-6	**5.62**	2.15	4.54
		6-12	**37.9**	2.16	16.8
		12-18	**1.53**	2.13	1.84
On-site Samples	318	0-6	**49.8**	4.24	39
		6-12	**39.4**	2.14	30
		12-18	**33.0**	5.37	23.5
On-site Samples	319	0-6	**156**	8.22	175
		6-12	**102**	4.67	85.8
		12-18	**46.9**	2.9	37
On-site Samples	320	0-6	**46.5**	3.47	34.7
		6-12	**64.8**	0.643	44.4
		12-18	**57.5**	3.26	49.2
On-site Samples	321	0-6	**174**	23.4	160
		6-12	**157**	3.12	186
		12-18	**121**	6.20	106
Comparison value, type, and length of exposure					
Environmental media evaluation guide			210 (Chronic)	630 (Chronic)‡‡	7,000 (Intermediate)
Cancer risk evaluation guide			0.47	N/A	N/A

(*Source:* EPA) **mg/kg** – milligrams/kilograms. *On-site background samples. †Off-site background sample collected east of the site. ‡Total chromium reported in 2014 and chromium (VI) reported in 2015. ‡‡Chromium (VI) comparison value used. **Bold face** = concentrations exceeds one or more comparison values. **N/A** = not applicable.

Workers with low exposure to soil

To evaluate the potential for non-cancer adverse health effects VDH first calculates daily doses using the following equations and assumptions[10] for *low exposure*:

$$D = \frac{C * IR * EF * CF}{BW}$$

Where:

D = exposure dose (mg/kg/day)

C = contaminant concentration (the mean is 121 mg/kg and the 95% Student's t-distribution upper confidence limit (UCL) is 180 mg/kg)

IR = adult ingestion rate of contaminated soil (100 mg/day)

EF = exposure factor (5 work days/7 days a week x 50 work weeks per year/52 weeks per year): 0.687) unit less

CF = conversion factor (10^{-6} kg/mg)

BW = adult body weight (80 kg)

Using 180 mg/kg of arsenic in soil, the daily dose is calculated to be

$$D = \frac{180 \text{ mg/kg} * 100 \text{ mg/kg} * 0.687 * 10^{-6} \text{ kg/mg}}{80 \text{ kg}} = 0.00015 \text{ mg/kg/day}$$

This daily dose is compared to the chronic MRL (0.0003 mg/kg/day) for ingestion of arsenic to determine if harmful effects are possible. MRLs are an estimate of daily human exposure to a substance that is not likely to harm a person's health over a specified duration of exposure. The calculated dose (0.00015 mg/kg/day) is less than the chronic MRL. The actual exposure may be lower because conservative assumptions were used in the dose calculation such as the use of the 95% UCL instead of average arsenic concentration and the use of the highest results (regardless of sample depth) of the 2015 samples. Additionally, the 2015 arsenic sample results were reported by EPA as being laboratory estimates and biased high.

The additional cancer to workers from low worker exposure to arsenic in soil is calculated by multiplying the dose by the cancer slope factor for arsenic $(1.5 \text{ mg/kg/day})^{-1}$ and then adjusting the exposure for a lifetime exposure. To adjust for a lifetime exposure VDH assumes that a worker lives for 78 years and works at the site for 25 years. This gives the following additional cancer risk.

[10] Agency for Toxic Substances and Disease Registry (ATSDR). 2014. Exposure Dose Guidance for Soil and Sediment Ingestion. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. November.

$$\text{Cancer risk} = 0.00015\ \text{mg/kg/day} * 1.5\ (\text{mg/kg/day})^{-1} * 25\ \text{years}/78\ \text{years} = 7 \times 10^{-5}$$

Therefore, if 100,000 workers were exposed to arsenic in soil at the 95% UCL for 25 years there would be a risk of 7 additional cancer cases. This low additional cancer risk is within EPA's target risk range (1 in 10,000 to 1 in 1,000,000).

Workers with high exposure to soil

If the current workers increase exposure to the soil from low to high contact, then the calculated cancer risk would increase.

LIMITATIONS

Limitations of this analysis include the use of estimated soil contact rates and 2015 soil data that is reported as "estimates" and "biased high," which may overestimate the risk.

CONCLUSIONS

VDH concludes that the concentrations of arsenic, chromium, and copper found in soil in 2014 and 2015 at the New Kent Wood Preservative site are not expected to harm the health of workers with long-term low soil contact.

RECOMMENDATION

VDH does not recommend further soil sampling unless site use changes.

I trust that the above information will be of help to you. Should you have any additional questions please contact Dwight Flammia by phone at (804)-864-8127 or by email: Dwight.flammia@vdh.virginia.gov

Greetings,

You are receiving a document from the Agency for Toxic Substances and Disease Registry (ATSDR). We are very interested in your opinions about the document you received. We ask that you please take a moment now to complete the following ten question survey. You can access the survey by clicking on the link below.

Completing the survey should take less than 5 minutes of your time. If possible, please provide your responses within the next two weeks. All information that you provide will remain confidential.

The responses to the survey will help ATSDR determine if we are providing useful and meaningful information to you. ATSDR greatly appreciates your assistance as it is vital to our ability to provide optimal public health information.

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