Health Consultation

SMALLEY-PIPER

COLLIERVILLE, SHELBY COUNTY, TENNESSEE

EPA FACILITY ID: TNN000407378

NOVEMBER 6, 2003

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

SMALLEY-PIPER

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EPA ID NO. TNN000407378

Prepared by:

Tennessee Department of Health
Under a Cooperative Agreement with the
The Agency for Toxic Substances and Disease Registry

Background and Statement of Issues

In July 2003, Tennessee Department of Health (TDH) Environmental Epidemiology (EEP) was asked to provide a written public health consultation for the Smalley-Piper site in Collierville, Shelby County, Tennessee. Mr. Femi Akindele, US Environmental Protection Agency (EPA), contacted Mr. Robert Safay of the Agency for Toxic Substances and Disease Registry's (ATSDR) Office of Regional Operations. ATSDR referred the environmental public health question to its cooperative agreement partner, TDH. More than once, water samples from monitoring wells at the site exceeded the EPA regulated maximum contaminant level (MCL) of 100 parts per billion (ppb) of total chromium for drinking water (WSI 2002). There is concern that this chromium pollution in groundwater may cause chromium concentrations in the Town of Collierville's Department of Public Services drinking water to be a health concern.

The Smalley-Piper CERCLA site is located at 695 US Highway 72 W in a business area of Collierville, zip code 38017 (Figure 1). Presently, the site is operated by Piper Industrial Coating, which is engaged in the business of hardfacing and recycling farm equipment (Figures 2 and 3). Hardfacing applies heated iron slurry to carbon steel plows and disks to strengthen the tools in areas that are susceptible to wear and tear (WSI 2002). No hazardous materials are thought to be used in current processes. The site began making farm tools in the 1960s. Ownership and manufacturing processes both changed several times over the years. In the early 1970s, site operations moved to the manufacturing of magnesium battery casings (EPA 2002).

During the manufacturing process, the magnesium battery casings went through a treatment train consisting of ten vats each equipped with leakage (prevention) baskets. The ten-step process consisted of: 1) caustic soda, 2) rinse water, 3) rinse water, 4) acetic acid, 5) rinse water, 6) rinse water, 7) chromic acid, 8) rinse water, 9) rinse water, and 10) boiling rinse water.

The entire treatment train was surrounded by a concrete berm to contain spills. The rinse water used in the treatment process came from an on-site production well. The production well still exists, but it is no longer used. The process wastes were discharged on-site into an open, lined equalization pond. The volume of rinse water, combined with caustic soda, acetic acid, and sodium nitrate, was estimated to be 28,000 gallons per day. The chromic acid was changed after approximately 4,000 battery casings were processed; 200–300 casings were processed at a time.

In theory, mixing the caustic soda and acetic acid could yield a neutralization reaction. After being discharged into the equalization pond, the spent chromic acid was treated by injecting liquid sulfur dioxide (SO_2) from a pressure, bullet tank directly into the pond. The pond was reported to be tested twice weekly by the plant chemist. SO_2 and pH adjustments were made as necessary. The goal was to remove hexavalent chromium(VI) present in the chromic acid as a sulfide precipitate containing trivalent chromium(III). The chemical reaction would be:

$$2CrO_3 \text{ [chromium(VI)]} + 3SO_2 \rightarrow Cr_2S_3 \text{ [chromium(III)]} + 6O_2$$

In 1981–82, the magnesium casing operations, including equipment and monitoring reports, were moved to another site in New Albany, Mississippi. When the manufacturing stopped, the

Tennessee Department of Environment and Conservation (TDEC) conducted oversight during the closing of the equalization pond. Pond sediment was removed and spread on plastic sheets. The blue tarpaulin pond liner was hauled away for disposal. The pond contents were turned over, mixed with a red sand, and allowed to dry. When the State was satisfied with the analytical results from its testing activities, the contents were put back into the now-unlined equalization pond area, covered with soil, and seeded (WSI 2002).

The Smalley-Piper site is underlain by alluvial deposits of approximately 50-foot thickness. The alluvial deposits consist of sand, clay, and gravel. Underlying the alluvial deposits is Memphis Sand. The Memphis Sand is a 700–800 foot thick formation of sand with clay lenses that serves as the primary drinking water aquifer for the Memphis area east of the Mississippi River. Groundwater flow in the area is generally westward toward the river (EPA 2002).

In March 2001, surface water flowing onto a potential subdivision site northeast of Smalley-Piper was discovered to contain 153 parts of total chromium per billion parts of water (ppb). In April 2001, the previously mentioned on-site production well and the surface water drainage ditch were sampled. Concentrations of total chromium of 141 ppb and 139 ppb, respectively, were measured. Until this discovery, the Smalley-Piper site was believed to have been successfully remediated. These results led to testing 11 groundwater wells in July 2002. The 11 wells supply all five of the Town of Collierville's Department of Public Services public drinking water plants. Together the five plants service approximately 12,000 connections (EPA 2002).

From the July 2002 testing, two groundwater wells, located west of Smalley-Piper (WSI 2002), were reported to have detectable total chromium levels. These wells, 201 and 202, are used by the Town of Collierville Water Plant #2. During the same time period, the Smalley-Piper on-site production well and the surface water drainage ditch were sampled again. Total chromium concentrations reported were 93 ppb and 89 ppb, respectively. With the increasing evidence of chromium pollution, periodic chromium testing at Collierville Water Plant #2 was mandated.

Chromium has frequently been detected in Town of Collierville source water wells numbered 201 and 202, total chromium levels ranged from non-detect to 74 ppb in these wells. The chromium levels have always been below the EPA maximum contaminant level (MCL) of 100 ppb. Furthermore, water from well 201 is mixed with water from well 202 prior to public distribution. This action dilutes the chromium concentration in the water supply. Total chromium concentrations in drinking water distributed to the public ranged from non-detect to 43 ppb between July 20, 2001 and October 7, 2003. Once again, these levels were below the EPA MCL of 100 ppb. As of November 2003, both wells 201 and 202 were in operation at Water Plant #2. Water Plant #2 draws 1.5 million gallons of groundwater per day (MGD), which is 8.0% of Collierville's total demand.

The land use of the area surrounding the Smalley-Piper site has changed since the manufacturing of the magnesium battery casings in the 1970s ended. Figures 2, 3, and 4 depict new businesses, including stores and restaurants now present in the area.

Discussion

Environmental Sampling

Chromium pollution discovered in March 2001 near the Smalley-Piper site led to sampling groundwater in the on-site production well and surface water drainage ditch in April and July 2001. Table 1 provides the results of the sampling.

TABLE 1. On-site chromium in water analysis (ppb) conducted April and July 2001 for Smalley-Piper, Collierville, Shelby County, Tennessee.

	on-site production well		**surface water drainage ditch**	
	April 2001	July 2001	April 2001	July 2001
chromium(VI)	not measured	76	not measured	75
Total chromium	141	93	139	89

An EPA site investigation (SI) was conducted at Smalley-Piper the week of July 8, 2002. Three groundwater monitoring wells were installed during the SI. The on-site production well was also sampled in duplicate. The wells were sampled for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides/PCBs, metals, and cyanide. Various compounds were identified and measured in small quantities (EPA 2002). Table 2 shows that one of the four wells contained an elevated concentration of total chromium. The 250 ppb total chromium measured in well SP02GW is markedly greater than the 100 ppb MCL. A potable water sample (i.e., a blank) was collected to facilitate further evaluation in case contamination was introduced by the use of the municipally supplied water as drilling fluid (EPA 2002).

TABLE 2. Total chromium values (ppb) measured in groundwater monitoring wells during the July 2002 EPA SI at the Smalley-Piper site, Collierville, Shelby County, Tennessee.

SP01GW	SP02GW	SP03GW	SP04GW on-site well	SP04GW duplicate	SP05PW potable blank
13	250	14	20	16	not detected

As a precaution, the Town of Collierville's Department of Public Services was required to perform periodic monitoring of the chromium concentration in its municipal water sources and finished drinking water supply. Results of samples collected from two groundwater wells and finished drinking water are presented in Table 3 (TOC 2003).

TABLE 3. Total chromium and hexavalent chromium(VI) concentrations (ppb) measured in the Town of Collierville's Department of Public Services Plant #2 source water wells and finished drinking water, July 20, 2001 to October 7, 2003, Shelby County, Tennessee (TOC 2003).

	East Well #201		West Well #202		Plant #2 – finished drinking water	
Date	**Total Cr**	**hexavalent**	**total Cr**	**hexavalent**	**total Cr**	**hexavalent**
7/20/01	15	15			<9	<10
8/02/01	19	21	8	10	15	12
10/22/01		20		20		
1/16/02		20		26		
4/10/02		14		26		
7/16/02		<10		42		
8/07/02			41	41	26	28
8/26/02		<10		46		30
10/29/02		10		50		20
1/27/03	<9	15	10	73	21	46
1/30/03	<9	<10	65	56	27	23
2/06/03	7	<10	66	63	18	13
3/04/03	6	<10	70	60	26	30
4/28/03	<10	<10	<10	<10	<10	<10
5/05/03	8	<50	9	<50	8	<50
5/19/03	10		58		34	
5/27/03	11	<10	60	43	38	32
5/27/03		<9		53		31
6/26/03	13		73		42	
7/31/03	16		74		43	
8/29/03	12		74		40	
9/17/03	13		70		40	
10/07/03	12		73		40	

Although the chromium concentrations measured in the groundwater wells and the finished drinking water are below the EPA MCL of 100 ppb, both total chromium and hexavalent chromium(VI) concentrations have increased over time. Currently, the West Well #202 has the highest levels of chromium. Controls are already in place to ensure that both wells are drawn from at the same time in order to mix the source waters and thus dilute the total chromium concentration. If either well shuts down or if there is a loss in amperage, then the entire water plant is designed to shut down to prevent the west well from operating alone. Town of Collierville Water Plant #2 draws 1.5 million gallons of groundwater per day, with a pump rate of 550 gallons per minute (WSI 2002). Of the five water plants operated by the Town of Collierville, Water Plant #2 is by far the smallest volume plant. A voluntary total chromium level of 50 ppb in finished drinking water, more conservative than the EPA enforceable MCL of 100 ppb, was established by the Department of Public Services as a shutdown level. This level is based on the state of California's total chromium MCL of 50 ppb.

Private Drinking Water Wells

According to the EPA site investigation, 83 private wells exist within 1 mile of the Smalley-Piper site (WSI 2002). It is unlikely that these private wells have been tested for chromium. According to the Memphis-Shelby County Health Department, it is unlikely that these wells serve as residential drinking water wells. The area of Collierville in question was reported to have had municipal drinking water available for 10–15 years. Homeowners were given 1 year to connect to municipal water once available. Therefore, no residents are thought to be drinking water from a private well. No private well data were reviewed in preparing this document.

Chromium

A naturally occurring element, chromium is found in rocks, animals, plants, soil, and volcanic dust and gases. Chromium can be found in different forms in the environment. The three most common forms of chromium are elemental chromium(0), trivalent chromium(III), and hexavalent chromium(VI). The metal chromium(0) does not occur naturally and, thus, is uncommon. Chromium(III) is an essential nutrient that helps the human body use sugar, protein, and fat. Hexavalent chromium(VI) is produced by industrial processes (ATSDR 2000).

Chromium compounds have no known odor or taste. Elemental chromium(0) is a grey solid metal with a high melting point. It is used in making steel and other metal alloys. The naturally occurring mineral chromite in the chromium(III) form is used as lining in high-temperature industrial furnaces, in other chemical compounds, and in metal alloys. Chromium(III) and chromium(VI) are used to make chrome metal plating. In addition, chromium(III) and chromium(VI) are used in the manufacture of dyes and pigments, in the tanning of leather, and in wood preserving products (ATSDR 2000).

Drinking chromium-polluted water was the pathway into the human body focused on in preparation of this health consultation. Chromium(0) is not currently believed to cause a serious health risk to humans. Ingestion of hexavalent chromium(VI) at levels greater than those found thus far in Collierville has been shown to damage the kidneys in several studies. A 1965 study in the People's Republic of China where villagers drank water with 20,000 ppb chromium(VI) resulted in oral ulcers, diarrhea, abdominal pain, indigestion, and vomiting. Medical and laboratory studies suggest that hexavalent chromium(VI) has the greatest potential to cause adverse health effects in people and laboratory animals. The public water supply from the Town of Collierville Water Plant #2 was periodically measured for both total chromium and hexavalent chromium(VI) concentrations. Typically, the amount of hexavalent chromium(VI) dominated the total chromium concentration measurement.

According to the International Agency for Research on Cancer (IARC), chromium(0) and chromium(III) are not classifiable as to their carcinogenicity. EPA has insufficient evidence that chromium(VI) in food or water causes cancer. For the oral exposure route, chromium(VI) is classified as Group D, not classifiable as to human carcinogenicity (ATSDR 2000). No reliable information exists that suggests chromium in any form has harmful effects on reproduction or

causes birth defects in humans. However, birth defects have been observed in laboratory animals exposed to chromium(VI) (ATSDR 2000).

Children's Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances. Children have lower body weights than adults. Yet, children drink a larger volume of water per mass of body weight than adults. Therefore, a child's lower body weight and higher intake rate results in a greater dose of chromium per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

The most important difference in the evaluation of the threat to children and adults who might consume chromium-polluted drinking water resides in the use of the EPA maximum contaminant level versus ATSDR comparison values. The EPA MCL of 100 ppb total chromium is the regulatory standard. This standard assumes a greater ratio of chromium(III) to chromium(VI) in the drinking water than what has been measured at Water Plant #2. Table 3 shows that most of the chromium measured in Water Plant #2 is hexavalent chromium(VI). ATSDR hexavalent chromium(VI) screening levels for intermediate exposure, 15 to 364 days, for increased non-cancer adverse health effects are different for adults and for children. The reference dose media evaluation guide (RMEG) for adults exposed to an intermediate duration of hexavalent chromium(VI) in drinking water is 100 ppb. This value is similar to the EPA MCL for total chromium. For children, ATSDR has set the intermediate RMEG for chromium(VI) in drinking water at 30 ppb. The finished product drinking water data in Table 3 shows that the screening level of 30 ppb hexavalent chromium(VI) has been slightly exceeded each month since May 2003. The 30 ppb RMEG for children is a screening value only. Exceedances of this RMEG do not imply health affects are occurring, especially since these levels have been detected for a short time frame and because the water from Plant # 2 is blended with other water throughout the municipal water system.

ATSDR's RMEG is based on EPA's reference dose (RfD) for chromium(VI) of 0.003 mg/kg-day. This RfD has a combination of uncertainty and modifying factors totaling 900. EPA's overall confidence in the RfD is low. The Town of Collierville has voluntarily decided to stop using Water Plant #2 if the finished drinking water has 50 ppb total chromium. Given the low confidence in EPA's RfD and large safety factor (900) used in establishing the RfD, 50 ppb total chromium, used by the State of California, is likely to be as protective as ATSDR's RMEG.

Conclusions

1. No apparent public health hazard exists for consumption of water supplied by the Town of Collierville's Department of Public Services Water Plant #2, Shelby County, Tennessee.

2. An indeterminate future public health hazard exists. If the chromium concentration in finished drinking water continues to increase, the result could be a public health hazard.

3. Private groundwater wells are no longer used for drinking water in Collierville.

Recommendations

1. Continue to monitor the total chromium and hexavalent chromium(VI) concentrations in well numbers 201 and 202 and the finished drinking water product at Water Plant #2.

2. If the hexavalent chromium(VI) concentration remains consistently over 30 ppb in finished drinking water, then additional chromium-reduction procedures should be implemented to protect children's health.

3. If the total chromium concentration in finished drinking water exceeds the voluntary contaminant level of 50 ppb, then the Department of Public Services should stop using Water Plant #2 to protect public health.

Public Health Action Plan

1. TDH EEP is available to review additional data and conduct a site visit.

2. TDH EEP will provide copies of this health consultation to the environmental regulatory agencies and concerned local residents.

3. TDH EEP will continue to provide health education to environmental regulatory agencies and community members concerned about the site.

4. TDH EEP will maintain dialogue with TDEC, EPA, and ATSDR until evidence exists that chromium pollution detected in the Town of Collierville, Shelby County, Tennessee, is not a potential environmental public health threat.

References

[ATSDR] Agency for Toxic Substances and Disease Registry. 2003. Water comparison values. Atlanta: US Department of Health and Human Services.

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[EPA] US Environmental Protection Agency. 2002. Memorandum: Well installation at Smalley-Piper Site, Collierville, Tennessee, SESD Project No. 02-0796. Nov. 19, 2002. Athens, GA: Region 4, Science and Ecosystem Support Division.

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[WSI] Weston Solutions, Inc. 2002. Engineering evaluation/cost analysis Smalley-Piper, Collierville, Shelby County, Tennessee – revision 1. Atlanta, GA: US Environmental Protection Agency.

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Certification

This Health Consultation: Smalley-Piper, Collierville, Shelby County, Tennessee, was prepared by the Tennessee Department of Health Environmental Epidemiology under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

Roberta Erlwein

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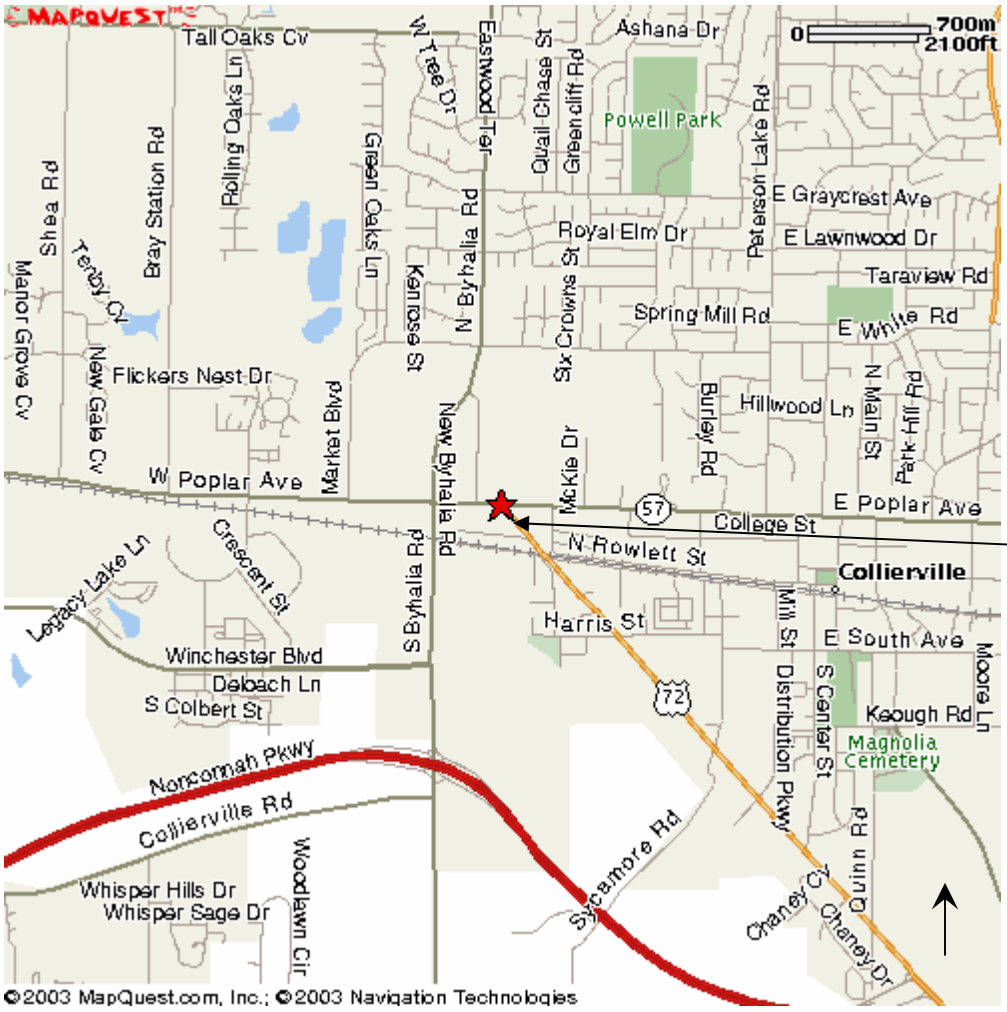
Chief, State Program Section, SSAB, DHAC, ATSDR

Electronic Document

FIGURE 1

Map detailing area around the Smalley-Piper site (695 US Highway 72 W).
Collierville, Shelby County, Tennessee, 38017 (Map credit: MapQuest.com 7/31/03)



Smalley-Piper

FIGURE 2
Photo of Piper Farm Products (a/k/a Smalley-Piper site).
Collierville, Sparta County, Tennessee (Photo credit: Robert E. Safay, ATSDR, 6/19/03)

FIGURE 3
Photo of Smalley-Piper detailing businesses now operating in the former industrial area.
Collierville, Shelby County, Tennessee (Photo credit: Robert E. Safay, ATSDR, 6/19/03)

FIGURE 4
Photo of Raleigh Tire garage bays and storage.
Collierville, Shelby County, Tennessee (Photo credit: Robert E. Safay, ATSDR, 6/19/03)

FIGURE 5
Photo of Raleigh Tire.
Collierville, Shelby County, Tennessee (Photo credit: Robert E. Safay, ATSDR, 6/19/03)