Health Consultation

Exposure Investigation at Coronet Industries

CORONET INDUSTRIES
(a/k/a BORDEN FEED PHOSPHATE COMPLEX)

PLANT CITY, HILLSBOROUGH COUNTY, FLORIDA

EPA FACILITY ID: FLD00170474

DECEMBER 5, 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.

You May Contact ATSDR TOLL FREE at
1-888-42ATSDR
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

Exposure Investigation at Coronet Industries

CORONET INDUSTRIES
(a/k/a BORDEN FEED PHOSPHATE COMPLEX)

PLANT CITY, HILLSBOROUGH COUNTY, FLORIDA

EPA FACILITY ID: FLD001704741

Prepared by:

Florida Department of Health
Tallahassee, Florida
and
Exposure Investigation and Consultation Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Background

Coronet Industries is located at 4082 Coronet Road, south of the city limits of Plant City, Florida. The company processes phosphates for use in animal food supplements, primarily for the poultry industry. The facility has been operating for 91 years. In the past, the company mined phosphate deposits in the area, but no mining operations are currently being conducted.

Groundwater collected from monitoring wells at the facility is contaminated with fluoride, arsenic, cadmium, lead, and alpha radiation (1). Many residents who live near the site rely on private wells for potable water. Public health officials and residents expressed concern that water from these wells could contain chemical contaminants at concentrations of health concern. This contamination could originate from naturally-occurring minerals in the underlying phosphate deposits or from chemicals released during operations or waste management practices at the facility.

During the first two weeks of August 2003, state officials collected water samples from the private wells of residents who lived within a ¼-mile radius of the facility. The Department of Health Laboratories tested water samples from 43 homes for volatile organic chemicals, metals (including lead, cadmium, arsenic, and boron), fluoride, and gross alpha and gross beta radiation. The results indicated that water from some of the wells contained boron, arsenic, and alpha radiation at concentrations in excess of state drinking water standards. None of the water samples contained lead or cadmium at concentrations in excess of state drinking water standards.

In order to better characterize human exposure to site-related chemicals for residents who were consuming the water, the Florida Department of Health (FDOH) and the Hillsborough County Health Department (HCHD) assisted the Agency for Toxic Substances and Disease Registry (ATSDR) in conducting an Exposure Investigation (EI). We collected urine samples from residents whose wells had been sampled by the state and tested the urine samples for lead, cadmium, uranium, arsenic, fluoride, and boron.

Target Population

The participants in this EI met the following criteria: (1) they lived within a ¼-mile of the facility, (2) they were ≥ 2 years old and were capable of providing a clean-catch urine sample, and (3) their well had been tested by the State.

Test Procedures

During the week of August 12, FDOH sent potential participants a flier that alerted them to the upcoming EI. The flier informed them that urine samples would be collected the following week from eligible residents. The residents were advised not to eat any fish or shellfish for four days prior to donating a urine sample. These instructions were given because after eating fish, the urinary arsenic level could be temporarily elevated because of the high content of organic and inorganic arsenic species in fish and shellfish. Nevertheless, people who had recently eaten fish were not excluded from the investigation, since biomarkers of exposure for the other contaminants would not be affected.

On August 20, staff from the FDOH, HCHD, or ATSDR visited each home whose well had been tested and invited the residents to participate in the EI. Each adult participant completed a written informed consent form. Parents or guardians of children gave written permission to test their eligible children or wards. Children, aged 7-17 years old, gave their written assent.

A 70-ml plastic urine cup was given to each participant and he/she was instructed to provide a first morning void sample. Written instructions were given to parents of young children to instruct them in how to assist their children in collecting a urine sample. The participants were told to place the samples in zip lock bags containing adsorbent pads and store them in a refrigerator until they were collected by a representative of ATSDR.

The following day, ATSDR staff collected the samples and poured an aliquot of about 10 ml of the urine into a 20-ml screw cap, plastic collection bottle. The samples were frozen on dry ice until they were shipped to National Medical Services (NMS) in Willow Grove, Pennsylvania for fluoride analysis. NMS measured the fluoride concentration in the urine samples using an ion-specific electrode.

The remaining urine in the urine cups was stored frozen on dry ice until ATSDR delivered them to the National Center for Environmental Health Laboratory (NCEH) in Atlanta for analysis. The NCEH analyzed the samples for lead, cadmium, uranium, and arsenic using inductively coupled plasma-mass spectroscopy (ICP-MS). Creatinine concentrations were measured using an automated spectrophotometric technique.

At the time that the protocol for this EI was developed, the results of the private well testing were not yet available. The State later reported that water from eight of the wells they tested had a boron concentration in excess of their drinking water advisory level. Therefore, we later offered to test the urine samples that had already been collected for boron. Of the original 106 participants, 101 requested that their urine samples also be tested for boron. These urine samples were tested for boron by National Medical Services using inductively coupled plasma-atomic emissions spectroscopy (ICP-AES).

Results and Discussion

106 residents of 35 homes completed a consent/assent form and provided a urine sample. The test population consisted of 78 adults and 28 children, aged 3 to 17 years old. It was not possible to analyze three of the urine samples for all chemicals because of the small volume of urine that was provided.

Data summaries for the concentrations of lead, cadmium, and uranium that were detected in the urine samples are presented in Tables 1-3. For statistical analyses, chemical concentrations below the analytical detection level were assigned a value equal to the detection level divided by the square root of 2.

The individual test results for these chemicals were compared to the 95th percentile value for the civilian United States population as reported in the Center for Disease Control's (CDC) *Second National Report on Human Exposure to Environmental Chemicals* (2). The comparisons were made using creatinine-normalized values to correct for urinary dilution. Since the percentile values may vary by age, individual comparisons were made using an age specific percentile value. For adults, gender specific comparison values were used. Most of the individual urine test results were within the 95th percentile of the national population, but a few individual test results did exceed the 95th percentile. This finding is expected since, in a normal population, about 5 percent of samples would exceed the 95th percentile of the national comparison population.

Lead

A statistical summary of the concentrations of lead that were detected in urine samples in this EI is presented in Table 1. None of the well water samples tested by the state laboratory had a lead concentration in excess of the state drinking water standard of 15 µg/L.

Table Urine lead concentrations in EI participants

	µg/L	µg/g creatinine
mean	0.881	0.711
median	0.715	0.607
range	ND – 4.04	ND – 3.78

ND not detected

Most of the EI participants had urine lead concentrations within the national reference range (95th percentile = 2.37 µg/g creatinine). However, the urine concentration of lead was elevated above the 95th percentile comparison value in three participants. There is no health based standard for urine lead concentrations. Only a few studies have simultaneously measured blood lead and urine lead concentrations in populations with low-level exposure (3, 4). In a recent study, Gulson et al. examined the correlation between blood lead and urine lead concentrations (3). This study indicated that there is a statistically significant correlation between urine and blood lead levels, although there is considerable scatter in the data, particularly at blood lead levels below 10 µg/dL. These findings suggest that the blood lead levels in the three people in this EI with an elevated urine lead level would be below 10 µg/dL. The CDC recommends that blood lead levels in children, less than 6 years old, should be below 10 µg/dL. In adults with occupational exposure to lead, the Occupational Safety and Health Administration recommends that blood lead levels should be below 40 µg/dL. Therefore, the estimated blood lead levels in the participants of this investigation would not be expected to exceed a level of health concern.

Cadmium

A statistical summary of the concentrations of cadmium that were detected in the urine samples in this EI is presented in Table 2. None of the well water samples tested by the state laboratory had a cadmium concentration in excess of the state drinking water standard of 5 µg/L.

Table 2: Urine cadmium concentrations in EI participants

	µg/L	µg/g creatinine
mean	0.414	0.378
median	0.31	0.302
range	ND – 1.58	ND – 1.76

ND not detected

Most of the EI participants had urine cadmium concentrations within the national reference range (95th percentile = 1.03 µg/g creatinine). However, the urine concentration of cadmium was elevated above the 95th percentile comparison value in five participants. For workers with occupational exposure to cadmium, the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that urine cadmium concentrations should be below 5 µg/g creatinine (5). The maximum urine concentration of cadmium detected in this investigation (1.76 µg/g creatinine) was well below this health-based level.

Uranium

A statistical summary of the concentrations of uranium that were detected in the urine samples in this EI is presented in Table 3. None of the well water samples tested by the state laboratory had a uranium concentration in excess of the state drinking water.

Table 3: Urine uranium concentrations in EI participants

	µg/L	µg/g creatinine
mean	0.0125	0.0100
median	0.0085	0.0070
range	ND – 0.127	ND – 0.076

ND = not detected

Most of the EI participants had urine uranium concentrations within the national reference range (95th percentile = 0.034 µg/g creatinine). However, the urine concentration of uranium was elevated above the 95th percentile comparison value in three participants. The Nuclear Regulatory Commission has recommended that corrective actions be taken when urine uranium concentrations in uranium mill workers exceed 15 µg/L [16]. The maximum urine concentration of uranium detected in this investigation (0.127 µg/L) was well below this level.

Fluoride

A statistical summary of the concentrations of fluoride that were detected in the urine samples in this EI is presented in Table 4. None of the well water samples tested by the state laboratory had a fluoride concentration in excess of the state drinking water standard of 4 mg/L or the federal Secondary Maximum Concentration Level of 2 mg/L.

Table 4: Urine fluoride concentrations in EI participants

	mg/L	mg/g creatinine
mean	0.96	0.84
median	0.82	0.70
range	0.21-3.8	0.17-2.3

There is no national reference range for fluoride concentrations in urine. Fluoride concentrations in urine increase as the concentration of fluoride in a person's drinking water increases. In order to prevent dental caries, the U.S. Public Health Service (USPHS) recommends that public water supplies be fluoridated at a concentration of 0.7 to 1.2 ppm, depending on the average maximum daily temperature of the area (6). People who drink water that contains fluoride in this recommended concentration range typically have urine fluoride concentrations of about 1.0 mg/L (7, 8). The mean fluoride concentration in urine samples from the participants of this investigation was 0.96 mg/L. Therefore, the average fluoride concentration in the urine samples from the participants was similar to that in people who drink fluoridated water at the USPHS recommended levels.

Exposure to high doses of fluoride, particularly in young children, can cause dental fluorosis. As the concentration of fluoride in drinking water increases above the recommended level, the risk and severity of dental fluorosis increases. The U.S. Environmental Protection Agency set a secondary drinking water maximum contaminant level (MCL) of 2.0 ppm fluoride in drinking water to protect against the cosmetic effect of dental fluorosis. All of the water concentrations of fluoride in the participants' wells were less than 1.0 ppm. People may also be exposed to fluoride from food, beverages, and fluoride-containing dental products. In the diet, high concentrations of fluoride are found in tea, fish, and shellfish.

At higher concentrations of fluorine in drinking water (greater than 4.0 ppm), there is a risk of skeletal fluorosis. In a study of workers with occupational exposure to fluoride, skeletal fluorosis was observed in workers who had an average urine fluoride level of 9.0 mg/L (9). The American Conference of Governmental Industrial Hygienists (ACGIH) concluded that changes in bone structure are unlikely to be seen if fluoride concentrations in 24-hour urine specimens are below 5 mg/L (5). To protect workers who are exposed to fluoride in the workplace, the American Conference of Governmental Industrial Hygienists has recommended a Biological Exposure

Index (BEI) of 3 mg/g creatinine prior to the start of the work shift and 10 mg/g creatinine at the end of the work shift (5).

The highest urine fluoride concentration detected in a participant of this investigation was 3.8 mg/L or 2.3 mg/g creatinine. Therefore, fluoride exposures in the participants in this EI were not at levels that would be expected to cause skeletal fluorosis.

Boron

The summary statistics for the concentrations of boron detected in urine samples from the participants of this EI are shown in Table 5. There is no state or federal drinking water standard for boron. However, nine of the well water samples exceed the state health advisory level of 0.6 mg/L.

Table 5: Urine boron concentrations in EI participants

	mg/L	mg/g creatinine
mean	1.32	1.17
median	0.98	0.90
range	0.29-15.8	0.14-12.3

There is no national reference range for the concentration of boron in urine. In the published literature, several studies reported urine concentrations of boron in populations with background exposures to boron. The results of these studies are summarized in Table 6.

Table 6: Urine concentrations of boron (mg/L) in populations with no unusual exposure to boron.

Author	Country	Mean	Median	Range
Minoia [10]	Italy	1.89	-	0.47-7.80
Imbus [11]	United States	0.919	0.715	0.040-6.60
Usuda [12]	Japan	-	0.798 (GM*)	-
Abou-Shakra [13]	United Kingdom	-	0.753	0.155-2.888

GM = geometric mean

The average boron concentration in the urine samples from the participants in this EI was 1.32 mg/L, and the median concentration was 0.98 mg/L. Therefore, as compared to the data in Table 6, the average/median urine concentration of boron in the urine samples from the participants was similar to or slightly higher than those in populations with no unusual exposure to boron.

Imbus et al. reported that the 95th percentile urine concentration of boron in adult men in the United States was 2.46 mg/L [11]. For the participants in this EI, urine concentrations of boron that exceed this 95th percentile concentration were considered to be elevated. By this definition, seven of the EI participants had an elevated urine boron concentration. The maximum detected concentration of boron in urine was 15.8 mg/L or 12.3 mg/g creatinine.

Even though several of the participants had elevated urine boron concentrations, the concentrations were not at levels that have been associated with adverse health effects in humans or animals. In a borax mining area in Turkey, local residents were exposed to elevated concentrations of boron in their well water, as well as through food [14]. In this population, urine boron concentrations ranged from 0.04 to 50.70 mg/L, and the average concentration was 8.3 mg/L. In spite of these elevated boron exposures, no adverse health effects were reported.

In borax workers in the United States, the end-of-shift average urine concentrations of boron in healthy workers ranged from 3.16 to 10.72 mg/g creatinine [15]. By comparison, in this EI, the average urine concentration of boron was 1.17 mg/g creatinine, and the maximum detected concentration was 12.3 mg/g creatinine. In experimental studies, adverse health effects were not observed in animals that were exposed to boron at doses that greatly exceeded occupational exposures. For example, no adverse health effects were observed in dogs that had been fed a diet containing boron that resulted in a urine boron concentration of 180 mg/L [15].

Therefore, although several participants in this investigation had urine boron concentrations that were elevated as compared to normal populations, the concentrations were not at levels that have been associated with adverse health effects.

Arsenic

At the time that this report was written, the NCEH laboratory had not yet analyzed the urine samples for speciated arsenic. When these results become available, ATSDR will prepare an addendum to this report that discusses the arsenic test results and their significance.

Limitations of this Investigation

The participants in this investigation varied considerably in their use of well water. Some reported using well water for drinking, cooking, and non-potable purposes in their household. Others used well water only for non-potable purposes and used bottled water for drinking. Some of the participants reported using water treatment devices such as water softeners, particulate filters, carbon filters, and reverse osmosis units. Furthermore, several of the participants reported that they stopped drinking the water when they received their water test results from the State, which was a day or two before this EI was conducted. In addition, whenever possible, the State collected water samples prior to its passage through treatment devices. Therefore, the concentrations of chemicals in the raw water could differ from what the participants were drinking from the tap.

Because of these multiple sources of variability, it is difficult to estimate exposures to drinking water contaminants. Furthermore, this investigation was offered as a public health service, so we did not exclude any residents whose wells had been tested, regardless of their water consumption history or use of water treatment devices. Several of the chemicals in this investigation (uranium, fluoride, and boron) are rapidly excreted from the body after ingestion, so the urine concentrations of these chemicals are strongly influenced by recent consumption. Some of the participants in this investigation had stopped drinking the water a day or two before they donated a urine sample. The urine levels of contaminants that were measured in residents who were not drinking the water at the time of the investigation may not be representative of their past exposures.

Reporting Results

In December 2003, individual test results and an explanation of their significance were provided to the participants of this investigation.

Conclusions

At the time of this investigation, lead, cadmium, uranium, fluoride, and boron were not detected in urine samples from the participants at concentrations that are associated with adverse health effects. Therefore, the measured exposures to these chemicals pose no apparent public health hazard. This conclusion may not apply to exposures that occurred in the past or to other residents of the area.

Recommendations

Blood lead concentrations are a better indicator of potential health effects than are urine lead concentrations. Therefore, as a prudent public health policy, it is recommended that a blood lead measurement be conducted on the participants who had a urine lead concentration in excess of the 95th percentile comparison range.

Public Health Action Plan

(1) The Hillsborough County Health Department will offer blood lead testing to participants who had a urine lead concentration in excess of the 95th percentile comparison range.

(2) The Florida Department of Health will prepare several health consultations for the Coronet Industries site. These reports will assess all available data and information for the site and determine if environmental contamination poses a public health hazard.

Report prepared by:

Kenneth Orloff, PhD, DABT
Research Toxicologist
Agency for Toxic Substances and Disease Registry

Michael L. Patterson, MD
Environmental Health Scientist
Agency for Toxic Substances and Disease Registry

Susan A. Bland
Biological Scientist
Florida Department of Health
Bureau of Environmental Community Health

References

(1) Florida Department of Health; Brief Petition Scoping Report: Coronet Industries; Plant City, Florida; June 18, 2003.

National Center for Environmental Health; Second National Report on Human Exposure to Environmental Chemicals. http://www.cdc.gov/exposurereport/pdf/SecondNER.pdf

BL Gulson et al. Blood lead-urine lead relationships in adults and children. Environmental Research, Section A 78 152-160 (1998).

A Brockhaus et al. Exposure to lead and cadmium of children living in different areas of North-west Germany: results of biological monitoring studies 1982-1986. Int Arch Occup Environ Health 60 211-222 (1988).

American Conference of Governmental Industrial Hygienists; Documentation of the Biological Exposure Indices; Cincinnati, Ohio.

Centers for Disease Control, Recommendations for using fluoride to prevent and control dental caries in the United States. MMWR August 17, 2002/50(RR14); 1-452.

Agency for Toxic Substances and Disease Registry, Draft Toxicological Profile for Fluorine, Hydrogen Fluoride, and Fluorides; September 2002.

(8) I. Zipkin et al. Urinary fluoride levels associated with use of fluoridated waters, Public Health Reports 71(8) 767-772 (1956).

(9) NL Kaltreider et al.; Health survey of aluminum workers with special reference to fluoride exposure. J Occup Med 14:531-541 (1972).

C Minoia et al.; Trace element reference values from tissues from inhabitants of the European community. I. A study of 46 elements in urine, blood, and serum of Italian subjects. Sci Total Environ 95 89-105 (1990).

HR Imbus et al. Boron, cadmium, chromium, and nickel in blood and urine. Archives of Environmental Health 6 286-295 (1963).

K Usuda et al. Study on urine boron reference values of Japanese men: Use of confidence intervals as an indictor of exposure to boron compounds. Science Total Environment 220 45-53 (1998).

(13) FR Abu-Shakra et al. Lithium and boron in biological tissues and fluids. Trace Elements

in Medicine 6 142-146 (1989).

M Col and C Col. Environmental boron contamination in waters of Hisarick area in the Kutahya province of Turkey. Food Chemical Toxicology 41 1417-1420 (2003).

BD Culver et al. The relationship of blood- and urine-boron to boron exposure in borax workers and the usefulness of urine-boron as an exposure marker. Environmental Health Perspectives 102(Suppl 7) 133-137 (1994).

US Nuclear Regulatory Commission; NRC Regulatory Guide 8.22 - Bioassay at Uranium Mills; 1988.