Health Consultation

Public Comment
Exposure Study Protocol

Brush Wellman Elmore Plant

Elmore, Ottawa County, Ohio

EPA FACILITY ID: OHD004212999

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U. S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
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INTRODUCTION

The health effects associated with exposure to beryllium at work are well documented (1), but few investigations have considered the potential for significant environmental exposure in residential areas nearby (2, 3). In the present investigation, the pathways of interest include the past deposition of beryllium air emissions to the environment from the Brush Wellman facility in Elmore, Ohio, and, beryllium dust unintentionally brought home on beryllium workers' clothes and shoes. To clarify the current exposure situation, the Agency for Toxic Substance and Disease Registry (ATSDR) will determine beryllium concentrations in environmental samples collected from the homes and motor vehicles of a) beryllium workers, b) residents who live near the facility; and, c) residents of a comparison community.

BACKGROUND

The Brush Wellman plant is located northeast of Elmore, between the villages of Elmore and Oak Harbor. There are more than 600 current and former workers in the greater Elmore area, and approximately 4,000 persons live within 5 miles of the Brush Wellman Plant. This plant began operations in 1953 and is the primary supplier of beryllium metal, beryllium alloys, and beryllium oxide in the United States. From 1990 through 1999, Brush Wellman released between 720 and 1,105 pounds of beryllium per year into the ambient air (4). When beryllium metal extraction operations ended in 2000, the air emissions dropped to less than 200 pounds per year (4).

In 1999, the National Institute for Occupational Safety and Health (NIOSH) tested the vehicle floors (driver's side) of beryllium workers in Alabama, and (similarly) the vehicle floors of a control group (5). The geometric mean for beryllium was 19 μg/ ft^2 of surface area in beryllium worker vehicles (n=61). In control vehicles (n=10), the maximum level of beryllium was 2.1 μg/ ft^2 of surface area, and 6 samples were below the limit of detection (0.01 μg). Worker-take-home of beryllium is the most likely explanation for an approximately 10-fold difference between worker vehicles and control vehicles.

In 2001, ATSDR was asked by U.S. Senator Mike DeWine (R-OH) to determine whether beryllium from the Brush Wellman plant in Elmore was creating a health hazard for local residents. ATSDR released a health consultation in August of 2002, concluding that
a) long-term air emissions (30-day averages) from the plant were not a health hazard
and, b) there was insufficient environmental data to determine whether worker-take-home was a significant source of community exposure (6).

The Brush Wellman facility requires plant workers to remove work clothes, take off boots, take showers, and dress in uncontaminated clothing prior to leaving the plant. There are other beryllium-exposed workers in "downstream" facilities that machine beryllium alloys, including one facility, Elmore Manufacturing Company that may contract directly with Brush Wellman.

Community members have reported that the hygiene and housekeeping practices at the contract machine shops are not comparable to those at Brush-Wellman. For this reason, ATSDR will include a sampling of workers from the two contract machine shops in this exposure investigation (EI).

Literature Review

When exposed to beryllium, some individuals develop an immune sensitization to the metal. The prevalence of beryllium sensitization among occupationally exposed groups typically lies between 2 and 8 percent (1). Some sensitized individuals go on to develop chronic beryllium disease (CBD), a noncaseating granulomatous lung disease. Granulomas (scars) form in the lungs and eventually can impair lung functions. CBD can progress to severe respiratory impairment and can also be fatal (1). The early symptoms that cause a patient to seek medical evaluation frequently include cough and shortness of breath with relatively mild exertion (1).

CBD is clinically similar to sarcoidosis, a granulomatous disease of unknown etiology. An unknown number of patients with CBD have been mistakenly told that they had sarcoidosis (1). This error can be avoided by a careful exposure history and testing appropriate patients for immunologic sensitization to beryllium.

Preventing additional exposure is an important intervention, but has not been proven to arrest the disease process (8). Following exposure, beryllium-containing particles may become deposited in the lung where they can be retained for months or even years (8). Thus, primary prevention (i.e., minimizing exposure) is considered to be the most prudent approach.

During the 1940s, ten environmental (non-occupational) cases of chronic beryllium disease were attributed to ambient air pollution from a local beryllium plant in Lorain, Ohio (2). The furthest case lived 0.75 mile from the beryllium plant. More than 50 cases of chronic beryllium disease have occurred among household contacts of beryllium workers; these cases apparently resulted from contact with beryllium carried home on contaminated work clothing (7). CBD has occurred in both occupational and environmental settings where exposure was not expected.

Sources of Beryllium in the Environment

Beryllium is a naturally occurring element found in soil, air, and water. The general population is exposed to trace amounts of beryllium by inhalation of air and ingestion of drinking water and food (1). Coal-fired electricity-generating plants are the largest man-made source of beryllium air emissions in the United States (1). The EPA estimated that coal-fired power plants in the United States released 7.1 tons of beryllium in 1990 (9). Toledo Edison's Bay Shore power plant is located approximately 20 miles west of Elmore in Lucas County and is the only coal-fired power plant in Northwest Ohio. EPA estimated that in 1996 61 pounds of beryllium were released via air emissions in Lucas County from the Bay Shore Plant and 821 pounds of beryllium were released via air emissions in Elmore's Ottawa County from the Brush Wellman

Plant (10). Any contribution the coal-fired power plant made to beryllium depositions in Elmore's Ottawa County would be minor when compared to the depositions from Brush Wellman's air emissions.

Coal ash may contain trace levels of beryllium, and coal was also a common fuel for home heating in this area prior during the early 1900s. Trace levels of beryllium have been measured in lawn and garden fertilizers (11). Activities related to hobbies, such as repairing beryllium-alloy golf clubs may provide a source of exposure.

PURPOSE

The purpose of this effort is to investigate beryllium levels in the home environments of current and former beryllium workers, residents near the Brush Wellman facility, and residents in a comparison community. Results will be used to determine the possibility of higher-than-background exposures to beryllium occurring due to worker take-home or from past air emission deposition.

STUDY OBJECTIVES

1. Identify the occupational and community member participants for environmental sampling (Table 1).

2. Explain the EI, obtain informed consent, and administer a brief exposure questionnaire (Appendices 1-3).

3. Conduct the environmental sampling.

4. Computerize and manage the data collected.

5. Analyze and interpret the data, grouping information by potential exposure categories.

6. Identify appropriate follow-up activities.

7. Report the results and any planned follow-up activities to participants, the community, and other interested groups.

Table 1 - Proposed Exposure Group Classification for Environmental Sampling

Exposure Group	Homes (n)	Population	Selection Criteria	Rationale for sampling*
1	15	Current Brush Wellman workers	- Simple random selection from current Brush Wellman (Elmore) employed by Brush Wellman more than 5 years, - Live more than 1 km from the plant.	Determine whether homes of current Brush Wellman workers contain elevated levels of beryllium
2	15	Former Brush Wellman workers who do not live within 1 km of the plant	- Simple random selection of former Brush Wellman (Elmore) workers who were employed by Brush Wellman more than 5 years, - Have not worked at the plant or other beryllium facilities in previous 5 yrs. -Live more than 1 km from the plant.	Determine whether homes of former Brush Wellman workers contain elevated levels of beryllium
3	15	Workers in contract machine shops	- Currently work in either of two local machine shops that contract with Brush Wellman - Live more than 1 km from the plant.	Determine whether homes of current contract machine shop workers contain elevated levels of beryllium
4	25	Local residents – live within 1 km of the plant	- Live 1 km or less from the Brush Wellman plant ** - Never worked at Brush Wellman, or at the 2 contract machine shops	Determine whether the homes near the Brush Wellman plant contain elevated levels of beryllium from possible past air emissions
5	25	Comparison group	- Randomly selected from comparison community's tax records	For comparison, determine the levels of beryllium in homes of a NW Ohio community with no known industrial source of beryllium

* The term "elevated" (in Table 1) refers to the specified group's results versus the comparison group's results.

**Participation will be offered to all residents living within 1 km who are NE, SE, or SW of the plant; for the NW quadrant, 4-5 residences randomly selected.

METHODS

Environmental sampling will measure beryllium levels at the residences and in motor vehicles of current Brush Wellman employees, former Brush Wellman employees, current employees at two machine shops that contract with Brush Wellman, other local residents, and (for background levels) a comparison community with no known industrial source of beryllium.

All participants will be asked about their employment history to determine whether they work (or have worked) with beryllium-containing products. The questionnaire will verify eligibility for the various study groups and may identify other occupational sources of beryllium.

If significant beryllium contamination is identified, public health interventions could be necessary in this community. In addition to the possibility that follow-up environmental sampling could be needed, the categories of appropriate preventative actions could include health education and one or more of the following:

- primary prevention -- activities to limit or eliminate exposure pathways;
- secondary prevention -- biological monitoring to identify sensitized individuals***;***
- tertiary prevention -- ensuring that sensitized individuals are referred for further evaluation and (if appropriate) medical intervention**.**

Activities beyond primary prevention would require the development and approval of a separate protocol.

Target Populations and Comparison Population and Sample Size

ATSDR plans to collect outdoor surface soil, indoor surface dust (wipe), vacuum, and air samples for a number of identifiable exposure groups (see Table 1). Two northwestern Ohio counties, Ottawa County and Putman County, have similar demographic characteristics (12). The area of interest in Ottawa County (Elmore, Ohio) and the comparison area in Putnam County (Ottawa, Ohio) share similar geologic and soil characteristics (Hoytville-Nappanee-Paulding-Toledo)(13). Naturally occurring (back-ground) beryllium concentrations should be similar in the two areas. Beryllium emissions from Toledo Edison's Bay Shore power plant do not impact Putnam County (10).

The comparison community (Ottawa, Ohio) has a population of approximately 4000 and is 50 miles southwest of Elmore, Ohio (12). Figure 1 contains a map of northwestern Ohio. Comparison residences will be randomly selected from tax records.

Community Involvement

This protocol will be available during a 30-day public comment period. ATSDR will conduct a public meeting during the 30-day comment period to answer questions and receive comments. The protocol will be available at the Harris-Elmore Public Library. ATSDR will consider all comments received on this protocol. Prior to beginning the investigation, ATSDR will conduct another public meeting to share and discuss the final protocol with the community, representatives from Brush Wellman, and the Ohio Citizen Action group.

Consent Forms

Residents must give their consent for environmental sampling prior to participation. The consent form (Appendix 1) specifically authorizes the U.S. Environmental Protection Agency (EPA) and the Ohio EPA to access the information collected. Prior to requesting consent and collecting environmental samples, ATSDR will provide a fact sheet (Appendix 2) to the participants that outlines the purpose of the study, the methods to be used, the kinds of results that can be expected, and the time-line for the study and when to expect the results. Written consent for access, sampling, and interviewing will be obtained prior to participation.

At least one consenting adult will be interviewed at each residence included. Children (those less than 18 years of age) will not be interviewed. ATSDR investigators will ask about the work history of adults in the household, the years lived at the residence, and the primary vehicle used for transportation to work. The specific questions are in Appendix 3. If more than one adult is interviewed in the home, each adult will be asked to sign a separate consent form. Within the limits of state and federal regulations, ATSDR will make every effort to protect participants' confidentiality. Even so, there are some circumstances that would require us to release information; for example, if a judge ordered us to turn the records over. General information will be summarized without personal identifiers in the Exposure Investigation Report.

Roles

ATSDR has overall responsibility for planning and carrying out this exposure investigation. ATSDR personnel will identify the participants, obtain consent, schedule the sampling visits, administer the questionnaire, analyze and interpret the data collected, inform participants of their results, and prepare the exposure investigation report. Prior to finalizing the report, a draft ("public comment") version will be shared with the public and other stakeholders.

The United States Environmental Protection Agency's (EPA) Environmental Response Team (ERT), based in Edison, New Jersey will collect and analyze the environmental samples. ATSDR has an inter-agency agreement with EPA's ERT.

Environmental Sample Collection

Samples will be collected at selected residences in the following manner:

- One composite surface soil sample (0-10 cm in depth) will be collected from locations near two main entryways. The number and location of the sample fractions will be recorded.

- Two discrete surface dust samples will be collected from inside each residence. One from a high-use living area and the other from inside the most frequently used entryway.

One vacuum sample will be collected from a carpeted living area. A minimum of two contiguous square meters will be vacuumed for each sample. Samples will be collected using a Nilfisk GS-80 vacuum cleaner (Appendix 4). This procedure uses a 3-micrometer pore vacuum bag. All hoses will be decontaminated between samples.

One wipe sample will be collected from hard surface flooring (e.g. kitchen floors, entry ways). Samples will be collected with dissolvable "Ghost" wipes, or equivalent, using a "three pass" technique. Samples will be collected using a 30.5 cm x 30.5 cm template (930 cm^2).

- One indoor air sample will be collected in a high-use area, e.g., a family room, of each residence. The sample will be collected using a pump equipped with a closed face 37-millimeter diameter, 0.8-micrometer mixed-cellulose filter. A minimum sample volume of 1,440 liters will be collected. Residents will be asked to perform routine floor cleaning and dusting in this high use area during the air-sampling period. One or more outdoor air samples will be collected each day of the field sampling.

- One surface vacuum sample will be collected from the driver's side floor surface, for one vehicle used for work transportation. If the beryllium worker is driven to and from work the appropriate passenger side will be sampled instead. The driver's side of the primary vehicles at each residence will be sampled if the residents no longer work with beryllium or never worked with beryllium. If a floor mat is present, the entire floor mat will be vacuumed for the sample. The surface sample will be collected from the entire mat. The size of the mat will be measured and recorded.

- Global Positioning System (GPS) coordinates will be obtained for each home. Geographical Information System (GIS) maps will be developed in a manner to give general position of the residence without revealing the identity of the participants. ATSDR will obtain GPS coordinates for the Brush Wellman plant for the main smokestack.

Rationale for the Types of Environmental Sampling

Background levels of beryllium in surface soil will be determined by collecting surface soil samples in the comparison population (Table 1, group #5). This will indicate the amount of beryllium that could be tracked into residences in from outside soil in all groups. Some studies have shown that 30 to 50 percent of floor dust comes from outdoor soil (14).

Indoor vacuum samples will be used to measure the concentration of beryllium in vacuum dust and the amount (or loading) of total dust and beryllium in carpet samples reported in mass per surface area. Surface loading is a standard parameter for measuring surface contamination in residences. Surface loading is indication of the amount of dust, including beryllium, potentially

available for re-suspension (15). Total dust surface loading will be reported because it can affect beryllium dust loading measurements. For example, if beryllium dust particles are disproportionately smaller than other household dust particles, household vacuuming cleaning may remove more of the larger particles. This could reduce total dust surface loading and increase the concentration of beryllium on a mass basis.

Wipe samples will provide indication of the amount of beryllium available for re-suspension on hard surfaces.

Indoor air samples will be collected during routine cleaning activities. Inhalation is the primary exposure route of concern for beryllium dust and air sampling for beryllium is currently the best method of assessing hazard potential in the workplace. Short-term air sampling in the residences will provide only a "snapshot" comparison to the EPA 30-day standard. However, if measurable levels of beryllium in air samples approach or exceed the EPA limit, the possibility of significant beryllium contamination would prompt further investigation.

Elevated levels of beryllium in the vehicles of current and/or former beryllium workers but not in the comparison population would suggest the presence of a worker-take-home pathway.

Quality Assurance/Quality Control (QA/QC)

Split samples will be collected for 10 percent of the soil samples. Field blank samples will be collected for 10 percent of the air and wipe samples. Standard QA/QC comparisons for these environmental samples will monitor the reproducibility of laboratory results.

Sample Handling and Storage

Samples will be stored in clean containers at room temperature. Samples will be submitted to the laboratory with chain of custody forms. Laboratory selection, direction, quality assurance, quality control, and payment will be handled through the ATSDR Interagency Agreement with the EPA's Environmental Response Team (EPA ERT).

Laboratory Analysis of Samples

Laboratory analysis will be performed by the ERT laboratory in Edison, New Jersey. Soil and vacuum samples will be sieved using a 100-mesh (150)-micrometer diameter screen per ASTM D4222 procedures, as described in Appendix 4. The entire sieved fraction of the sample shall be weighed prior to analyses.

Samples shall be prepared and analyzed for beryllium per modified NIOSH Method 7300 or equivalent method. Concentrated nitric acid and hydrogen peroxide will be used for digestion instead of perchloric acid. Vacuum sample results will be reported in total surface loading as total dust loading ($\mu g/cm^2$), beryllium surface loading ($\mu g/100\ cm^2$) and beryllium concentration

(μg/g). Surface soil results will be reported in beryllium concentration (μg/g). Wipe samples will be reported in surface loading of mass per surface area (μg/100 cm^2). Air samples will be reported in mass per air volume μg/m^3.

Sample detection limits will be approximately 0.3 μg/g (based on 1-2 g dry sample and 100 mL final digestion volume) for soil and vacuum samples, 0.01 μg sample for wipe samples, and 0.007 μg/m^3 for air samples, based on a 1,440 liter air volume, and 0.01 μg sample detection limit.

Data Management

Results will be received from the laboratory in an electronic format. Questionnaire data will be collected on paper forms and entered manually into a standard computer database. Twenty percent of the entered results will be audited for accuracy. Data entry errors will be corrected. The entire database will audited and corrected if a pattern of errors are detected in the initial audit.

Data Analyses

The goal of the environmental sampling is to determine whether the residences of participants in various exposure groups contain elevated concentrations of beryllium, as compared to residences of the comparison group. This is of interest, given that the level of exposure occurring at any given residence is likely to be associated with the level of contamination.

The data will be analyzed as follows:

(1) for the various exposure groups, simple descriptive statistics will be developed for each measure of environmental contamination;

(2) summary measures of beryllium concentrations (and loading) in residences of the various exposure groups will be compared to summary measures for the comparison group; and,

(3) the beryllium measurements from individual residences will also be compared to the statistical distribution of the comparison group (i.e., via standard deviations) to identify residences with elevated concentrations of beryllium in environmental media. T-tests will be performed to compare the means of the exposed and comparison groups.

The questionnaire results will be used to verify the participant exposure groupings, and to identify other potential occupational sources of beryllium exposure (e.g., working in a foundry, or a dental laboratory). While the current exposure groups are defined optimally, the actual number of individuals in each category may vary slightly from estimated numbers. For example, there could be fewer workers than expected; in that case, current and past beryllium workers at Brush Wellman could be combined to produce a larger group expected to have similar exposure

characteristics. Summary statistics will be reported for each exposure group. Sample results from individual residences (and potential beryllium sources) may be reported and discussed, but only after determining that individual participants are not identifiable.

The results of the soil and vacuum samples (concentration and loading) cannot be used to make a health determination for beryllium hypersensitivity or for chronic beryllium disease; there are no surface standards for this purpose. Since concentration and surface loading are important environmental parameters that are likely to be related to exposure and risk for disease, they will be reported and compared to expected background (comparison group) levels. A health-based ambient air standard exists for beryllium, measured as a 30-day average. The proposed recommendations for follow-up public health actions are described in Table 2.

Table 2 - Proposed recommendations for individual residences and vehicles based on sampling results:

Sample Type (unit of measure)	Action level * Percentile	Recommended Action(s)
Yard Soil (µg/g)	Less than 95 percentile of the comparison group* --- Above the 95th and below the 99th percentile of the comparison group --- 99th percentile or higher of the comparison group (or more than 100 µg/g)*	None --- Evaluate exposure potential --- Recommend exposure prevention measures Evaluate exposure potential / consider additional sampling
Indoor and Vehicle Vacuum Sample (µg/g and (µg /100 cm^2)	Less than 95 percentile of the comparison group * --- Above the 95th and below the 99th percentile of the comparison group --- 99th percentile or higher of the comparison group (or more than 100 µg/g)*	None --- Evaluate exposure potential Consider additional sampling/ --- Recommend exposure prevention measures Evaluate exposure potential Consider additional sampling/
Indoor Wipe Sample (µg /100 cm^2)	Less than 95 percentile of the comparison group * --- Above the 95th and below the 99th percentile of the comparison group --- 99th percentile or higher of the comparison group	None --- Evaluate exposure potential --- Recommend exposure prevention measures Evaluate exposure potential
Indoor and Outdoor Air sample (µg/m^3)	Less than detectable levels (≈0.007 µg/m^3) --- above detectable levels but less than 0.01 µg/m^3 --- greater than or equal to 0.01 µg/m^3	None --- Evaluate exposure potential --- Recommend exposure prevention measures

Any soil or vacuum samples with 100 µg of beryllium per gram (total dust), the ATSDR Environmental Media Guide for beryllium, will be treated as equivalent 99th percentile.

The ATSDR environmental media evaluation guide (EMEG) for beryllium is based on an oral Minimal Risk Level (MRL) of 0.002 mg of beryllium per kilogram of body weight for chronic exposure. The EMEG is calculated from an oral intake of 200 mg of total dust per day by a 10 kilogram child (1). While inhalation is the most important exposure route for beryllium, exceeding the EMEG would also provide a basis for recommending exposure reduction.

ATSDR will compare the results of indoor air sampling for beryllium to the EPA National Emission Standard for Hazardous Air Pollutant's (NESHAP) Standard of 0.01 $\mu g/m^3$, based on a 30-day average (16), and the EPA's reference concentration of 0.02 $\mu g/m^3$ for chronic inhalation exposure**.** The reference concentration is an estimate of a continuous inhalation exposure that is likely to be without appreciable risk of non-cancer effects during a lifetime of exposure (17)**.**

Finally, some effects associated with beryllium are strongly associated with individual characteristics of the person exposed (8). That is, it produces immunologic hypersensitivity in some exposed individuals (but not others) (18). From a public health viewpoint, a potential outcome such as hypersensitivity makes it advisable to limit exposures that substantially exceed background levels.

The percentile measurements in Table 2 identify the relative level of a residential media measurement (compared to background levels) considered "elevated" in this investigation.

A high ranking (above 95^{th} or 99^{th} percentile) indicates that the environmental media of interest has a higher beryllium concentration than most (95 or 99 of 100) residences without an industrial exposure source. In summary, the recommendations in Table 2 are based finding beryllium levels in environmental media that are significantly above expected background (comparison group) levels, or above a standard ATSDR screening value.

A pattern of elevated results could prompt ATSDR to offer a health study to participants, or to a subgroup of participants, at higher risk. The issues, choices, and decisions associated with such a health study would be presented in a separate protocol.

Limitations of this Investigation

ATSDR considers this investigation to be primarily a public health service to the community.

The results of the investigation represent current conditions in participating residences and may not accurately reflect prior exposures. The results may be influenced by the cleaning practices of the residences.

If the concentrations of beryllium in environmental media are elevated compared to background levels, it may or may not be possible to clearly identify the source (or sources) of the excess beryllium.

Certain behavioral factors, such as, removing footwear prior to entering the residence, and other factors (e.g., track-in from visiting beryllium workers) may influence results. Attempting to evaluate the contribution of these behavioral factors to beryllium contamination in the residences is beyond the scope of this investigation.

Presentation of Results

Each participating household will be provided with its individual results prior to releasing the summary report. ATSDR will also hold a meeting with the community following the release of the summary report. The report will be completed and made available to the community for public comment without names and addresses or other information that is traceable to individual participants.

Follow-Up Activities

Elevated levels of beryllium in environmental media (as noted in Table 2) will result in specific recommendations and public health activities:

Letters will be sent to participants with elevated levels (in excess of the 99^{th} percentile) that explain their individual results and describe actions they can take to immediately reduce exposure.

Individual participants with elevated levels of beryllium in environmental media may be offered additional environmental evaluation, as described in this protocol.

Appropriate health-related follow-up activities, such as health education for the community and for healthcare providers, will be identified and outlined in a final report.

If ATSDR determines that this community, or some part of the community, would benefit from biomedical testing, a separate protocol will be prepared by ATSDR and presented to the community.

INVESTIGATORS AND ACKNOWLEDGMENTS

INVESTIGATORS

Peter Kowalski, CIH, Division of Health Assessment and Consultation (DHAC), is the principal investigator; Lynn Wilder, CIH (DHAC) and Dr. Dan Middleton, Division of Health Studies, are the co-investigators.

ATSDR ADVISORS

The following ATSDR employees reviewed and commented on the draft and provided thoughtful input: Amanda Gonzalez, Dr. Susan Metcalf, and Susan Moore, Dr. Ken Orloff, Dr. Allan Susten (all from DHAC), Dr. Robert Johnson (Division of Health Education and Promotion), Dr. Robin Wagner, Office of the Associate Administrator, and Dr. Lucy Peipins, formerly with the Division of Health Studies.

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Appendix 1 – *Adult* Consent Form

Agency for Toxic Substances and Disease Registry
U.S. Department of Health and Human Services
Atlanta, Georgia 30333

Interview and Environmental Testing
Brush Wellman (Elmore) Exposure Investigation
(Flesch-Kincaid Scale = 9.2)

Sponsors

The Agency for Toxic Substances and Disease Registry (ATSDR) is offering to test homes that may contain beryllium from the beryllium industries in northwestern Ohio. The U.S. Environmental Protection Agency (EPA) is assisting ATSDR in this investigation.

The homes of current and former beryllium workers and homes located near the Elmore facility are the focus of this study (focus homes). Others homes in a similar area will be tested to find the typical amount of beryllium that occurs in the environment.

Purpose

The purpose is to compare beryllium levels at homes near, or associated with, beryllium industries, to beryllium levels in northwestern Ohio where there are no major beryllium industries.

Procedures

We have checked a box below to show why you were invited to take part in this study.

- 9 You are a current or former beryllium worker, or you share a residence with someone who is.
- 9 Your home is near the Brush Wellman facility.
- 9 Your home is in the comparison community (Putman County). The comparison community has no known major sources of beryllium nearby.

You can decide to take part in this study, or not to take part. If you do take part, you will be asked about current and past homes and jobs. You may be asked similar questions about other adults in the home. Answers to these questions will help us explain the meaning of the results. We will take soil samples from your yard. We will take air samples inside and outside your home. We will take dust samples from floors in your home and car. These samples will be tested for beryllium. Our questions should take less than 20 minutes, but taking the samples may take up to 3 hours.

Benefits

You will help figure out whether homes near beryllium plants and homes of beryllium workers have more beryllium than those homes of a comparison community.

Additionally you will find out whether the dust and air at your home has more beryllium than typical levels found in the environment. You will find out whether the dust in your car floor and soil in your yard has more beryllium than typical levels found in the environment. Additionally, if elevated levels of beryllium are found you will find out how to reduce the beryllium levels in you home and vehicle.

Risks

We do not know the level of beryllium in soil or dust that would be unsafe. We will find out if there is more beryllium at your home and in your car than background levels. If there is more beryllium than background levels, you might have to tell prospective buyers if you sell your home.

Follow-up

Depending on what we find in your soil, indoor dust and air, and car dust, we may offer health study in the future. If we offer this study, more information will be provided before the study is started.

Participation

Taking part in this project is voluntary. If you do not wish to take part, there is no penalty. You will not lose any benefits that you are entitled to receive.

If you sign the consent form and then change your mind, you can stop at any time. If you stop, there is no penalty. You will not lose any benefits that you are entitled to receive.

Results

ATSDR will send a letter to explain your test results. After these results have been mailed to you, ATSDR will come back to Elmore for a public meeting to explain the findings. We will answer any questions and discuss any concerns you have. You can call Peter Kowalski of ATSDR at any time. His number is 1- 888-422-8737 (toll free), or 1-404-498-0492.

Confidentiality

After this study is over, ATSDR will write a report about the findings. The report will be available to the public, but it will not identify you or anyone else. We will not include your name, address, or phone number. Your confidentiality will be protected to extent allowed by federal and state laws. Your name, address, answers to questions, and individual environmental results will be stored in a password-protected computer or in a locked file cabinet at ATSDR.

Federal, state, or local agencies may ask us for access to your results. If you agree to let us share your results with them, they will also be required to protect your confidentiality.

Contact

If you have any questions, or if you feel you have been harmed by this investigation, you may contact: Peter Kowalski of ATSDR at 888-422-8737 (toll free) or 404-498-0492.

Participant Consent

I have read the description of this exposure study. My questions have been satisfactorily answered. I know that I can ask more questions at any time. I know that I can stop being part of this project at any time, even if I sign this consent form. If I drop out, there will be no penalty.

Please check one:

☐ *I give my consent to allow ATSDR to test: the soil in my yard, air inside my home, and dust in my home and in my car, and also I give my consent to answer questions about my work history and the place I live.*

☐ ***I DO NOT** give my consent to allow ATSDR to test: the soil in my yard, air inside my home, and dust in my home and in my car, and also I give my consent to answer questions about my work history and the place I live.*

***Please Check One*:**

☐ *I give my consent to allow ATSDR to share my test results with the United States Environmental Protection Agency and the Ohio Environmental Protection Agency.*

☐ ***I DO NOT** give my consent to allow ATSDR to share my test results with the United States Environmental Protection Agency and the Ohio Environmental Protection Agency.*

Signature _____ Date _____

Witness _____

Name (print) _____
First **M.I.** **Last**

Address _____
Street

_____
City **State** **Zip code**

Telephone number _____ - _____
(Area Code)

Appendix – 2 – Brush Wellman Exposure Investigation Fact Sheet

Appendix 3 - Brush Wellman Exposure Investigation Questionnaire

Date _____

Hello, my name is _____, I am an environmental health scientist with the Agency for Toxic Substance and Disease Registry (ATSDR). ATSDR, with help from the Environmental Protection Agency (EPA), is doing an exposure investigation (EI) in the Elmore area. We would like you to answer these questions to provide us with more information about possible exposure sources to beryllium. First, I will ask you how many adults live at this home. Then, I will also ask you about the work history of each adult in your house. Then I will ask you about the motor vehicles you use to drive to work. Your answers to these questions will help us decide where to sample and how to interpret the results. Thank you for your help.

Demographic Information

1. What is your name?_____
First Middle Last

a. How many persons 18 or older live in this house [ ]

b. What are their names? .

Name(i)

Name 1. _____
First Middle Last

Name 2. _____
First Middle Last

Name 3. _____
First Middle Last

Name 4. _____
First Middle Last

2. What is your current (this) address?

Current Street Address _____

City _____ State _____ Zip code _____

Occupational History (one for each adult resident)

Note: < > are used in indicate where interviewer would identify the person for whom the questions are about. If the participant is answering questions about themselves use appropriate personal pronouns ("you" or "your"), otherwise refer to the household member by their name: labeled $NAME_{(i)}$, where i = 1 to "n" adults in the household. Use additional sheets as needed.

Questions	***Fill in blank spaces and check boxes [ ].***
LENGTH OF RESIDENCE	
3. Name of Adult resident (subject of interview): Note: **$NAME_{(i)}$** , "i" goes from "1" to "n" adults. *4 How long have <you / NAMEi >lived at this (current) address?*	_____ First Middle Last _____ years _____ months
SELECTING PERSON TO INTERVIEW *If questions refer to person interviewed, GO TO Q7. If not, CONTINUE.*	
5. Is < $NAME_{(i)}$ >available to answer some work-related questions?	Yes [ ] No [ ] *If yes, GO TO Q8.* . *If no, CONTINUE.*
6. If < $NAME_{(i)}$ > is not available, can I ask you some questions about < $NAME_{(i)}$ > 's work? 7. What is the name of the person responding for the subject?	Yes [ ] No [ ] *If yes, go to Q7.* *If no, STOP.* _____ First Middle Last
CURRENT EMPLOYMENT *If the participant is answering questions about themselves use appropriate personal pronouns (e.g., "you" or "your"), otherwise refer to the household member by their name ($NAME_{(i)}$)*	
8. Which best describes < YOUR/$NAME_{(i)}$ > current employment status?	Work outside the home: [ ] CONTINUE. Work at home: [ ] GO TO Q12 Unemployed: [ ] GO TO Q12 Retired: [ ] GO TO Q12
9. What is the name of < YOUR/$NAME_{(i)}$ > current employer?	
10. When did < YOU/$NAME_{(i)}$ > start work for your current employer?	Year began:
9. Is beryllium in any form processed or machined at the facility where < YOU/$NAME_{(i)}$ > currently work?	Yes[ ] No [ ] Don't Know [ ]
10. What is < YOUR/$NAME_{(i)}$ > current job title ?	
11. Before leaving work.... a ..do < YOU/$NAME_{(i)}$ >shower? b. do < YOU/$NAME_{(i)}$ > change from work clothes? c. ....do < YOU/$NAME_{(i)}$ > remove work shoes?	always [ ] sometimes [ ] never [ ] always [ ] sometimes [ ] never [ ] always [ ] sometimes [ ] never [ ]

PAST EMPLOYER(S) (j) Note: j = "1" to "m" past employers that processed or machined beryllium.	
12. Have < YOU/NAME$_{(i)}$ > worked in any (other) facilities in the past that processed or machined beryllium?	Yes [ ] No [ ] Don't Know [ ] If Yes, continue. If "No" or "Don't Know", GO TO STOP.
13. What was the name of the most recent (previous) beryllium-related company? < PAST EMPLOYER $_{(j)}$ >	
14.What was < YOUR/NAME$_{(i)}$ > job title at < PAST EMPLOYER $_{(j)}$ >:	
15. What were < YOUR/NAME$_{(i)}$ > dates of employment < PAST EMPLOYER $_{(j)}$ >:	Year began: _____ Year left: _____
16. At < EMPLOYER (j) >, before leaving work.... a .....did < YOU/NAME$_{(i)}$ > shower? b. ....did < YOU/NAME$_{(i)}$ > change from work clothes ? c. ....did < YOU/NAME$_{(i)}$ > remove work shoes?	always [ ] sometimes [ ] never [ ] always [ ] sometimes [ ] never [ ] always [ ] sometimes [ ] never [ ]
Go back to 12.	

STOP

Motor Vehicle Transportation

17. How many motor vehicles are located at your home? _____vehicles

I am going to ask a few questions about these vehicles and about how they are used.

Characteristics	Vehicle 1	Vehicle 2	Vehicle 3	Vehicle 4
Make				
Model				
Year				
Years owned				
When were the vehicle's floors last cleaned?...	Months (mos) 3 mos or less[ ] >3 to 6 mos [ ] >6 to 12 mos [ ] > 12 mos [ ] Don't Know [ ]	Months (mos) 3 mos or less[ ] >3 to 6 mos [ ] >6 to 12 mos [ ] > 12 mos [ ] Don't Know [ ]	Months (mos) 3 mos or less[ ] >3 to 6 mos [ ] >6 to 12 mos [ ] > 12 mos [ ] Don't Know [ ]	Months (mos) 3 mos or less[ ] >3 to 6 mos [ ] >6 to 12 mos [ ] > 12 mos [ ] Don't Know [ ]
Is this car used for commuting to work? *IF "Never," GO TO THE NEXT VEHICLE*	Routinely [ ] Sometimes [ ] Never [ ]	Routinely [ ] Sometimes [ ] Never [ ]	Routinely [ ] Sometimes [ ] Never [ ]	Routinely [ ] Sometimes [ ] Never [ ]
What is the name of the person who uses this vehicle the most for commuting?	____________	____________	____________	____________
Where does < YOU/NAME$_{(i)}$ > sit while commuting?	Driver's Seat [ ] Right Front [ ] Other [ ]	Driver's Seat [ ] Right Front [ ] Other [ ]	Driver's Seat [ ] Right Front [ ] Other [ ]	Driver's Seat [ ] Right Front [ ] Other [ ]
Has this vehicle been used to commute to a facility that processes or machines beryllium? .... *IF "No" or "Don't Know," GO TO THE NEXT VEHICLE*	Yes [ ] No [ ] Don't Know [ ]	Yes [ ] No [ ] Don't Know [ ]	Yes [ ] No [ ] Don't Know [ ]	Yes [ ] No [ ] Don't Know [ ]
Name this beryllium processing or machining facility..................... *GO TO THE NEXT VEHICLE UNTIL FINISHED*	______________	______________	______________	______________

18. How many entrances are there into your home? _____ entrances

Entrance Locations for the home

	Description of Location of each Entrance
Entrance 1	
Entrance 2	
Entrance 3	
Entrance 4	

19. Which room in your home gets the most use by your family during waking hours?

[_____]

20. Which answer best describes how often the carpeting/floors in this room cleaned by sweeping, vacuuming or other methods?

More than once a week [ ]

About once a week [ ]

About once every 2 weeks [ ]

Less than once every 2 weeks [ ]

Thank you for your helping with this survey. Your responses are an important part of our investigation.

Appendix 4 - Indoor Dust Collection Procedure

Collection of Indoor Dust Samples from Carpeted Surfaces for Chemical Analysis
Using a Nilfisk GS-80 Vacuum Cleaner

TABLE OF CONTENTS

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to define the procedures for collection of carpet-embedded dust samples that can then be analyzed for lead, pesticides, or other chemical compounds and elements. This procedure is applicable for the collection of samples on a variety of surfaces.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Sample collection is performed utilizing the Nilfisk GS-80 vacuum cleaner equipped with a high efficiency particulate air (HEPA) filter. A diagram of the Nilfisk GS-80 vacuum cleaner is presented in Figure 1. Soil and other particulate matter with aerodynamic diameters of approximately 5-micrometers (μm) and larger, embedded within the carpet, are collected and returned to the laboratory for sieving and analysis.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

Following collection of the sample into a dedicated collection bag, the bag is removed from the vacuum cleaner and placed into a 32-ounce glass jar. Storage of the samples at ambient temperature is appropriate for samples that will be analyzed only for metals.

Note: Samples for organic analysis should be maintained at approximately 4^0C.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are no known interferences with this method.

5.0 EQUIPMENT/APPARATUS

5.1 Equipment List

-Nilfisk Model GS-80 vacuum cleaner
-Two meter folding ruler or similar device
-Masking tape
-Clean aluminum foil
-Shaker sieve, as specified in ASTM D4222, with 100-mesh screen
-Analytical balance[sensitive to a minimum 0.1 milligram (mg) and weighing range of 0.1mg - 1000 grams(g)].

-Distilled water
-Methanol
-Kimwipes ™ or other laboratory tissue
-Vacuum collection bags
-Polyliners
-32-ounce glass jars

6.0 REAGENTS

Methanol and distilled water are required for sampling train cleaning and decontamination.

7.0 PROCEDURES

7.1 Preparation

The overall sampling strategy should be designed to address the goals of the study. Users should consider factors such as foot traffic volume, types of activities, and proximity to potential sources. The sampling strategy should be described in the Quality Assurance Work Plan (QAWP) prepared prior to the sampling event. The ideal sampling locations are those areas that conform with the overall sampling strategy. For example, protocol may require the selection of a carpeted area for sampling where small children play or are likely to play.

1. Determine the extent of the sampling effort, the sampling methods to be employed, the amount of dust needed to reach the desired detection limit and the types and amounts of equipment and supplies needed.

2. Obtain and organize the necessary sampling and monitoring equipment.

3. Decontaminate or pre-clean equipment, as specified in Section 7.5, and ensure that it is in working order.

4. Prepare schedule and coordinate with staff, client, and regulatory agency, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan.

6. Measure the area to be sampled and outline it using masking tape or other appropriate methods. Draw a diagram of the room(s) where the sample(s) were taken, locating the sampled area(s).

7.2 Calibration Procedures

The Nilfisk GS-80 vacuum cleaner has no flow devices that need calibration prior to sampling. The sampling train shall be thoroughly inspected to ensure that it has been cleaned, properly assembled, and complete.

7.3 Field Operations

1. Prior to sample collection at the house to be sampled, complete a sample data sheet, recording all requested information and sketch the area to be sampled. A sample data sheet is provided in Figure 2.

2. Select a sampling area according to the established protocol defined in the QAWP. In most cases, three locations are selected for sampling in each house. Each sample is collected with a dedicated sampling train that has been properly assembled, cleaned, and decontaminated to ensure sample integrity. The size/weight of each sample is dependent on the goals and objectives of the sampling event, the analyses requested, and the desired method detection levels (MDLs). A 100-gram sample is highly desirable if multiple analyses (metals, pesticides, etc.) are requested. A minimum 5-10-gram sample is required for metal analysis.

3. Utilizing the 2-meter folding ruler or any other measuring device, outline and mark the recommended 1-m^2 portion of the carpet to be sampled.

4. Begin the sample collection at one corner of the delineated sample area, moving the sampler back and forth four times over a strip running in a straight line between the defined sampling area edges. The width of the strip is defined by the width of the sampling nozzle. After completing the first strip, angle over to the second strip gradually on the next pass, again completing four double passes.

5. Continue sampling the area delineated until an adequate sample is collected. To determine if adequate sample weight will be collected, one must use visual judgement or perform the finger judgment test on the carpet to judge the dust loading of the carpet and make a decision on whether to sample the recommended 1-m^2 area or a larger area. If sampling a larger area, measure the area accurately and document.

6. Wearing surgical gloves, make sure to tap with your hand on the nozzle inlet to dislodge any dust remaining in the nozzle or the hose. This procedure will ensure complete sample recovery. Turn off the vacuum

cleaner and allow to sit undisturbed for at least 30 seconds. Unsnap the two vacuum container clips to access the inside of the container. Remove the polyliner and the vacuum collection bag within it. Then seal off the polyliner with the vacuum collection bag inside, and transfer to a properly labeled 32-oz. glass jar. Document the sample and store for shipping to the laboratory.

7.4 Laboratory Operations

Upon arrival at the laboratory, recovery of the dust samples from the GS-80 dedicated collection bags is accomplished by the following procedure:

1. Select a clean working area in the laboratory where recovery of the samples is to be performed (a 4-foot by 4-foot area will be sufficient). Make sure that the following equipment/apparatus is available, assembled, and in good working condition:

   -Shaker sieve (No. 100), as specified in ASTM D-422 with particle size separation of 150 micrometers (Φm). A complete set consists of three components: the cover, the screen, and the receiver pan. The receiver pan must be pre-weighed and its weight recorded.

   -Sieve shaker for mechanical sieving. Models readily available are CSC Scientific Company, Inc. Catalog No. 18480 and Thomas Scientific Catalog No. 8324-A10 (Tel 800 345-2100).

   -Analytical balance sensitive to a minimum 0.1 milligrams (mg) and weighing range of 0.1 mg to 1000 grams (g).

   -Surgical gloves. Thomas Scientific Catalog No. 5761-W14.

   -Disposable dust mask. Thomas Scientific Catalog No. 8055-M20.

   -Camel's Hair Brush. Fisher Scientific Catalog No. 03-655.

   -Clean aluminum foil.

   -Kimwipes™ or other laboratory tissue.

1. Wearing clean surgical gloves to handle the bags and a dust mask for dust protection, retrieve the vacuum collection bags from the 32-ounce glass jars used to transport the bags from the field to the laboratory.

3. Empty the contents of the bag into the No. 100-mesh sieve screen through the bag opening. Complete this operation by removing the plastic adaptor from the collection bag inlet. Shake the bag as necessary to ensure all the contents have been transferred through the screen to the receiver pan.

4. Place the cover on the sieve screen and manually or mechanically shake the sieve for a minimum of 5 minutes and a maximum of 10 minutes until all the fine dust particles are collected in the bottom receiver pan. If manual shaking is performed, the directions in D-422 of ASTM must be followed: "*Conduct the sieving operation by means of a lateral and vertical motion of the sieve, accompanied by a jarring action in order to keep the sample moving continuously over the surface of the sieve. Continue sieving until not more than 1 mass percent of the residue on a sieve passes that sieve during 1 minute of sieving".*

   If mechanical shaking is performed, set up the recommended sieve shaker on an even and stable surface. Proceed with the sieving operation following directions in the manufacturer's manual.

5. Re-weigh the receiving pan utilizing the analytical balance. The difference in weight is the weight of the sieved sample. If total weight of material is desired, the coarse material remaining on top of the sieve must be collected on a pre-weighed sheet of aluminum foil, re-weighed and the weight added to the weight of the sieved sample.

6. Transfer the sieved sample from the receiving pan to an 8-ounce wide mouth glass jar. Use the camel's hair brush to ensure complete transfer of the sample. Cap glass jar and secure sample.

7. Document each sample. Each sample must be provided with the following information: identification number, date of sampling, location, analysis requested. Each sample must be recorded into a chain-of-custody form before delivery to the analytical laboratory.

8. Before processing the next sample, thoroughly wipe clean the shaker sieve set with a Kimwipe™ . Wait until dry. Repeat steps 1 through 7.

7.5 Sampling Train Decontamination

To decontaminate the sampling trains, move them to a well ventilated area and perform the following:

1 Assemble one of the sampling trains to be used as the decontamination unit for decontaminating the nozzles, hoses, and wands. This unit must be provided with a clean polyliner and dust bag.

a. With the vacuum cleaner turned on and wearing clean surgical gloves, the nozzles, wands, and hoses are decontaminated using a bottle brush to remove any accumulated dust. Make sure to tap with your hand on the nozzle to remove any visible dirt that have accumulated on the brush. When the nozzle is considered to be clean, remove and spray with reagent grade methanol and allowed to air dry on a clean surface. The wand and hose are then cleaned with the bottle brush. Make sure to tap with your hand on the wand inlet while cleaning with the bottle brush to remove any visible dirt. Repeat this procedure to decontaminate the other nozzles, wands, and hoses.

b. Pull out the dirty dust bag from the decontamination unit and wipe clean the inside of the container with distilled water. Do the same to the other containers. Spray the inside of the containers with methanol and allow to air dry. If decontaminating in between homes, wipe cleaning the inside of the containers with distilled water is sufficient.

8.0 CALCULATIONS

The dust weight calculations for the final sieved dust fraction is performed in accordance with ASTM Method D 422. Dividing the final dust weight by the area sampled (expressed in m^2) provides dust loading per square meter, in g/m^2. When the analysis results are received, the loading of analyte per square meter of carpet area (ug/m^2) can be calculated in the same way. Analysis will also provide mg/kg concentration. If total (gross) dust loading of the sampled area needs to be calculated, the total dust weight before sieving must be obtained. The total dust weight is divided by the area sampled to obtain total dust loading per square meter.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instruments must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

10.0 DATA VALIDATION

Results of the quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potential hazardous materials, follow U.S. EPA, OSHA and corporate health and safety procedures.

12.0 REFERENCES

American Society For Testing And Materials, *Standard Practice for Collection of Dust from Carpeted Floor for Chemical Analysis, Designation D 5438-93,* Reprinted from the Annual Book of ASTM Standards, Philadelphia, PA.

American Society For Testing And Materials, *Standard Test Method for Particle Size Analysis of Soils,Designation D 422-63,* Reprinted from the Annual Book of ASTM Standards, Philadelphia, PA.

Instructions for Use-Nilfisk Model GS 80, Nilfisk of America, Inc.,Malvern, PA (1987).

FIGURE 1. GS–80 Dust Sampling Apparatus