February 10, 2014

This factsheet was developed for health professionals serving residents living in, or those working in, Kanawha, Cabell (Culloden area only), Boone, Putnam, Lincoln, Logan, Clay, Roane, and Jackson who were affected by the Freedom Industries, Elk River chemical spill. It was developed and reviewed in collaboration with medical and clinical toxicology experts at the West Virginia Poison Center and the MidAtlantic Center for Children's Health and the Environment.

What chemicals were spilled into the Elk River on January 9, 2014?

The tank at Freedom Industries was storing a mixture of crude **M**ethyl**C**yclo**H**exane **M**ethanol (**MCHM**) and various **P**ropylene glycol **Ph**enyl ethers (**PPH**). Crude MCHM is a chemical mixture used to process coal. The primary constituent of crude MCHM is 4-methylcyclohexanemethanol. 4-MCHM is an organic alcohol.

Crude MCHM has an obvious odor that smells like licorice. Even though the MSDS sheet for MCHM states that the odor information is "unknown", the chemists who have been working since January 9th with pure MCHM have verified that this chemical smells like licorice. The odor is not due to an additive. Chemists working with the pure material have also verified that pure MCHM does not have an oily feel and it is colorless.

On January 21, 2014, Freedom Industries reported that PPH was also part of the release into the Elk River. PPH products are primarily used as building blocks for the production of other chemicals, and have a slight or nonexistent odor. It is colorless.

Currently, the facility estimates that crude MCHM represented approximately 88.5% by weight of the total volume that was spilled into the river, and the remainder of the volume spilled was PPH (primarily the component dipropylene glycol phenyl ether or DiPPH) at 7.3% and water at 4.2%. Although the volume in the tank at the start of the spill is yet to be verified, and the volume spilled into the river is yet to be verified, the important piece of information in determining human risk of exposure (once the spill occurred) is the concentration of the chemical after leaving the water treatment plant.

What are the health effects expected from short term exposures to these chemicals in drinking water?

The dose of a toxin is always a factor that the Poison Center considers.

> People's exposures to the contaminated water will vary depending on their water use and adherence to the "do not use" order and flushing guidance, and their subsequent water use. There was an approximately 6 hour window on January 9, 2014 between when the West Virginia Department of Environmental Protection discovered the chemical spill at Freedom Industries and the state issued the "do not use" drinking water order. The exact start of the actual chemical release into the river and when it subsequently entered the public water supply is not known. However, given what is known know about the odor still being present with levels of MCHM that are at non-detect (< 0.010 ppm (or 10 ppb)), had the levels been appreciable, the licorice smell in the water would have been noticed prior to January 9th. While the lowest concentration at which humans can smell and/or taste MCHM has yet to be determined,

experience in recent weeks confirms that the odor/taste is present when levels are less than 0.010 ppm (or 10 ppb)

The highest concentration of MCHM reported to have been detected in the public drinking water was 3.35 ppm on January 10, 2014; but most measurements, even early after the spill, were in the 1 ppm or less range. All zones were at 1 ppm or less for 24 hours before flushing began and zones started to open. By January 17th when the "do not use" order was lifted for all zones, 6 test samples were at 0.25 ppm or less with all other samples at non-detectable levels (less than 0.010 ppm which = 10 ppb).

The highest concentration of PPH detected in the public drinking water supply was 0.011 ppm. Note, sampling was not started for PPH until January 23, 2014; the state was not notified about PPH until January 22, 2014 and reliable testing protocols first had to be developed. At this time, retrospective analysis of previously stored water samples from the initial days of the incident have been completed, in addition to analysis of current water samples. The only detected value of PPH was found in a water sample from the public drinking water system on January 11, 2014, while the "do not use" order was still in effect.

In the initial hours of the spill, the WV Poison Center used what was known about the chemical structure of MCMH to help predict what signs/symptoms might result from direct contact contaminated water through dermal contact, vapor exposure, or ingestion. At that time, measurements of MCMH were not available and estimates of the amount of chemical in the tank that had spilled into the river was not known. The Poison center predicted that (depending on individual sensitivities) skin, gastrointestinal (nausea, vomiting, and/or diarrhea), and ocular irritation might occur. If the concentration was extremely high, central nervous system depression was a possibility. Once the exposure ended, these symptoms were expected to rapidly improve.

From past experience dealing with chemical spills in a wide variety of settings and conditions, the Poison Center was aware that unusual smells, odors, and taste can cause nausea and headaches. These symptoms are not due to toxic effects but are a body's physical and real response to unusual smells/tastes.

In the days immediately following January 9, 2014, the West Virginia Poison Center received calls from over 1,900 patients reporting chemical exposures related to the drinking water. Most reported symptoms included mild rashes and reddened skin from dermal exposure, or GI distress (nausea, vomiting and/or diarrhea) from ingesting contaminated water. The symptoms tended to be mild and self-limiting.

A few days into the incident, additional studies from the manufacturer of MCMH became available to the WV Poison Center. This information confirmed the Poison Center's initial predictions in that the studies showed that MCMH could result in vomiting, nausea, and/or diarrhea. **In the research studies carried out in the 1990s, symptoms of central nervous system depression were not seen in test animals until several fold higher concentrations than the levels of MCHM detected in the public water supply in West Virginia**.

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Why does the WV Poison Center agree with the environmental health screening value for MCHM of < 1.0 ppm for children and adults?

MCHM and PPH are not regulated under federal or state drinking water laws. No "acceptable" levels of these chemicals in drinking water have been established. At the request of the state for this emergency event, the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry (CDC/ATSDR) developed a short term ***environmental health screening value*** of 1 part per million or milligrams per liter (ppm or mg/L) for MCHM in drinking water and 1.2 ppm for PPH in drinking water.

CDC/ATSDR used the limited toxicologic study information available on January 9, 2014 to calculate the MCHM health screening value. To do this, CDC/ATSDR used a widely accepted and commonly used approach in environmental public health and risk assessment of extrapolating downwards from animal toxicity studies. The only information available on January 9, 2014 was an oral animal study evaluating the crude MCHM mixture. At CDC/ATSDR's request, the manufacturer subsequently provided additional toxicologic information, including the full texts of their animal studies and specific studies on the pure 4-MCHM compound. Therefore, CDC/ATSDR looked at a range of studies from the manufacturer of MCHM (both crude MCHM and pure 4-MCHM) in their evaluation. From the studies available, scientists used the lowest 4-MCHM exposure dose that showed no adverse effects in the test animals in the screening value calculations to be as conservative as possible. **When the environmental health screen value was recalculated with the additional information, the initial value was determined to be the correct value.** The ATSDR team has over 200 years of toxicology experience and specializes in environmental toxicology assessment.

Environmental health screening values help guide agency decisions about the public health implications of a chemical exposure. These values do not represent thresholds for health effects, but are designed to incorporate a measure of additional safety from actual health effect levels. **The health screening value is set at a level far below what is expected to cause toxicity.** In environmental public health, exceeding a screening value does not mean a health effect occurred; instead, a value which exceeds this triggers further evaluation of the exposure.

At the state's request, CDC/ATSDR also developed an environmental health screening value for PPH. From the available studies, scientists and toxicologists used the lowest PPH exposure dose that showed no adverse effects in the test animals in the screening value calculations to be as conservative as possible. The PPH screening level was based on studies on PPH. It was not possible to calculate a screening value for DiPPH specifically, because studies identifying a no adverse effect level are not available DiPPH. However, the limited toxicological information available and the similar chemical structure of PPH and DiPPH suggest that the screening value calculated for PPH would also be protective for DiPPH.

Throughout the process of developing the environmental health screening values for MCHM and PPH, CDC/ATSDR included estimates of children's size and ingestion rates, and incorporated "uncertainty factors" into the health screening value calculation. "Uncertainty factors" in environmental health risk evaluation are defined as default values (generally 10-fold) used in creating screening values to apply to humans in the real world when experimental data from animals is the only information available. Applying uncertainty factors is a method to build additional protection into these estimates. For the MCHM and PPH screening values, CDC/ATSDR applied uncertainty factors to take into account the differences between animals and people, possible effects on special populations, and the limited availability of data. The screening value also takes into considering exposure to vapors that might result from the environmental health screening value.

What was CDC's recommendation for pregnant women based on?

On January 15, 2014, CDC made a recommendation to the state that pregnant women might wish to consider an alternative drinking water source until MCHM was at non-detectable levels (i.e., less than 0.010 ppm (10 parts per billion) in the water distribution system. The CDC based this recommendation on an abundance of caution for this sensitive population. This is common practice during pregnancy for any environmental or drug exposure in which multiple studies during human pregnancy have not been conducted. The CDC did not change the environmental health screen value of < 1.0 ppm MCMH for this population.

Are there any medical tests relevant for patients exposed to these chemicals in their drinking water?

There is currently no method to quantitate MCHM or PPH in biological samples. On the basis of available information about these and similar chemicals, these chemicals are likely to be very rapidly metabolized in the body. Therefore, attempts to measure levels are likely to be fruitless and any results uninterpretable. Moreover, other routine laboratory tests such as liver functions, renal functions, urinalysis, CBC, etc., are much more likely to turn up abnormalities that are totally unrelated to this exposure than to turn up abnormalities related to these chemicals. On the basis of the animal data, one would not expect any changes in these parameters from these short-term, low-dose exposures.

For patients complaining of continued symptoms, it is important to evaluate for other medical conditions in order to avoid a delayed diagnosis. This time of year viral gastroenteritis, influenza, the common cold, and other infections are common. The Poison Center has fielded many calls from patients who thought they were ill from contaminated water, but were later formally diagnosed with influenza, for example. Furthermore, many patients have dry skin during the winter months and using hand sanitizer is desiccating as well. The poison center has noted that many rashes were the result of frequent hand sanitizer use without the ability to wash because of the "do not use" order. Many disease states can mimic others.

Are there any long term health concerns for my patients?

The short term exposures to MCHM and PPH in drinking water in WV are not expected to result in long term health effects.

Will the health agencies be studying this event further?

At the request of the State, CDC/ATSDR sent a response team to review medical records, survey hospitals, assess disaster epidemiology capacity, and make recommendations. The West Virginia Poison Control Center is sharing information collected during the event with public health agencies for further review. Evaluation of this information is ongoing.

Is the WV Poison Center comfortable with what is currently known about the concentrations of MCMH in the affected counties when making it recommendations for use of the water?

The WV Poison Center has reviewed all levels tested by the state that have been posted in the public domain and continues to do so. The WV Poison Center is also aware that concentrations "at the tap" have been tested. At the tap testing was done when school and hospitals were tested. In addition, private testing results (paid for by the owners), which have been at the tap, have also been showing levels at non-detect (< 0.01 ppm or < 10 ppb) or very close to this value (these results are held by the owners and are not in the public domain unless the owners choose to post them).

The Safe Drinking Water Act developed primary standards to protect public health by limiting the level of contaminants in drinking water. The word "safe" is used in this act despite the fact that allowable amounts of contaminants such as arsenic, mercury, and pesticide byproducts, for example, are allowed in amounts that are not zero. Therefore, a contaminant need not reach zero in order to be "safe" according to this act. Like MCMH, there are many other contaminants in drinking water that do not have an agreed upon standard under the Act; therefore, they cannot appear in the Safe Drinking Water Act.

The WV Poison Center believes that water with an MCMH level < 1.0 ppm can be used for any purpose a person desires (drinking, bathing, etc.). While water with an odor or taste may make the water aesthetically undesirable for use in bathing or drinking, this concentration of MCMH is not expected to cause toxicity at the concentrations currently being reported.

More information about the chemical spill for health professionals and patients

Updated Information about the water situation and water quality from the state and water company:
http://www.dhsem.wv.gov/Pages/WV-American-Water-Emergency.aspx
(http://www.dhsem.wv.gov/Documents/How%20to%20Flush%20Your%20Plumbing%20System.pdf)
http://www.wvdhhr.org/
http://www.amwater.com/wvaw/about-us/news.html, **1-800-685-8660**

http://www.amwater.com/files/Elk%20River%20WQ%20FAQ%201-17-2014%201.45%20pm.pdf

Frequently asked questions: Pregnant women and water consumption
http://www.governor.wv.gov/Documents/WV%20BPH%20CDC%20FAQ.pdf

Toxicologic information about MCHM and PPH:
http://emergency.cdc.gov/chemical/MCHM/westvirginia2014/index.asp
http://emergency.cdc.gov/chemical/MCHM/westvirginia2014/pdf/MCHM-Summary-Report.pdf
http://emergency.cdc.gov/chemical/MCHM/westvirginia2014/pdf/DiPPH-PPH-calculation.pdf
http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@DOCNO+8182
http://www.eastman.com/Pages/Eastman-Crude-MCHM-Studies.aspx

Safe Water Drinking Act:
http://water.epa.gov/lawsregs/rulesregs/sdwa/

Contacts for health professional questions:
West Virginia Poison Control Center, **1-800-222-1222**
Mid-Atlantic Center for Children's Health and the Environment **1-866-622-2431, macche@childrensnational.org**