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Jill D. Jonas, Director
Bureau of Drinking Water and Groundwater
Department of Natural Resources
101 S Webster Street, Box 7921
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Subject: Response to Request for Review of Molybdenum Toxicity Information

Dear Ms. Jonas:

This letter is in response to the Wisconsin Department of Natural Resources' (DNR) March 1, 2013 request that the Wisconsin Department of Health Services (DHS) review molybdenum toxicity information and provide a recommendation whether any action on current molybdenum NR140 Public Health Groundwater Quality Standards should be considered at this time. We have reviewed the correspondence attached to your letter as well as published information on molybdenum toxicity in light of the requirements for establishing Groundwater Quality Enforcement Standards under Wis. Stat. Chapter 160. Based on our review of the toxicological studies and since the "Federal Number" is under active review, we recommend that an interim health advisory level of 90 micrograms per liter ($\mu\text{g/L}$) of molybdenum be used when advising about the safety of private drinking water supplies. The interim health advisory level for molybdenum was developed using methods consistent with Wisconsin law.

The current Wisconsin Groundwater Quality Enforcement Standard for molybdenum of 40 $\mu\text{g/L}$ was adopted in 2006. Pursuant to Wis. Stat. sec. 160.07, the molybdenum Groundwater Quality Enforcement Standard is based on a Federal Number: the Lifetime Health Advisory Level (LHA) for molybdenum that was developed by the United States Environmental Protection Agency (EPA). This LHA is derived from a study that describes an increased incidence of gout-like symptoms and increased blood uric acid levels in villagers in Soviet Armenia who had a high dietary intake of molybdenum (Koval'skiy et al. 1961).

In response to your March 1, 2013 letter we reviewed the NR140 Public Health Groundwater Quality Standard Support Document for molybdenum as well as the currently published literature. We found published reviews of molybdenum toxicity that noted several concerns regarding the methods used in the Koval'skiy study. The small number of controls ($n = 5$) compared to the number of exposed subjects ($n = 52$) in the clinical data (blood and urine molybdenum, copper, and uric acid) does not permit high statistical confidence in the evidence of a cause-effect relationship between molybdenum exposure and increased blood uric acid. In

addition, it is unclear how exposed and control subjects were chosen, and detailed data on the subjects were not provided. The information on the analytical methods used in the study to estimate dietary molybdenum and copper intake and measure blood molybdenum and copper levels is very limited. As a result, it is difficult to confirm the scientific validity of these protocols. Reviews, including ones by the U.S. National Research Council, the Food and Nutrition Board of the Institute of Medicine, and the European Commission's Scientific Committee on Food, concluded that these concerns were significant weaknesses in this study. Ultimately, the Food and Nutrition Board of the Institute of Medicine and the European Commission's Scientific Committee on Food decided not to use the Koval'skiy study as a critical study for establishing health-based guidelines.

Although the association between molybdenum exposure and human gout-like symptoms or increased serum uric acid levels is biologically plausible, after our literature review, we found that the concerns with the analytical protocols used in the Koval'skiy study significantly reduced our confidence in the reliability of using it as the critical study for establishing health guidelines.

In light of these concerns, we evaluated the published scientific literature to determine whether there are studies that could be used to assess molybdenum toxicity with greater confidence than the critical study used by the EPA when deriving the LHA. Although there are no human exposure studies that could be used other than the Koval'skiy study, there are animal exposure studies. Of those reviewed, we determined that the study from Fungwe et al. (1990), which describes reproductive and developmental effects of molybdenum in Sprague-Dawley rats, is best suited for use as the critical study to calculate a molybdenum advisory level with the greatest level of confidence. Using the data from this study and methods consistent with Wis. Stat. sec. 160.13, we calculated a molybdenum advisory level of 90 µg/L. It is our opinion that drinking water containing molybdenum at this level for an entire lifetime would not result in increased risk of adverse health effects. DHS has prepared a support document (attached) describing our analysis and calculations of this advisory level.

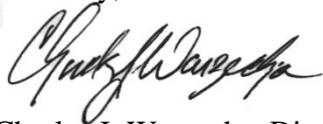
Given the lack of confidence in the reliability of the Koval'skiy study, if DHS were to propose revision of the current Enforcement Standard, our recommendation would probably result in a new Enforcement Standard that is different than the current Federal Number. However, it is our understanding that DHS and DNR legal counsel have determined that, under Wis. Stat. sec. 160.07 (4) (e), in order for DHS to recommend adopting a new Enforcement Standard that is different than the Federal Number, the new standard must be justified on the basis of "significant technical information which is scientifically valid and which was not considered when the federal number was established." In our review of published toxicity information, we found EPA documents published in 1975 (Friberg et al., EPA-600/1-75-004) and 1979 (Chappell et al., EPA-600/1-79-006) that clearly state the concerns with the Koval'skiy study described above. As such, it can be reasonably concluded that EPA was aware of the critiques of this study, but still chose it as the critical study driving the LHA. Given this, we cannot conclude that there is "significant technical information" that was not considered by EPA when the LHA was established. Therefore, DHS cannot at this time recommend proceeding to propose an Enforcement Standard different than the current federal LHA.

We understand that EPA is currently reviewing the LHA for molybdenum (J Donohue, US EPA, personal communication, March 2013). We are unable to predict when EPA will finish its review and what level EPA may establish as a result of that review. The federal process for this review has been underway for some time and may take years to complete. The result of that review could be a value other than the 90 µg/L that DHS would recommend for use to advise well owners. In addition, the NR140 rule revision process would take approximately two years to complete.

For the many homeowners making decisions about their drinking water today, it is neither practical nor necessary to wait for the issuance of a new Enforcement Standard. Although there is less confusion when the Enforcement Standard is the same as the level used for advising individual homeowners, we are not required to use the Enforcement Standard when issuing individual drinking water advisories. Therefore, although legal counsel for the agencies have concluded that a revision of the current Public Health Groundwater Quality Enforcement Standard for molybdenum is not appropriate, DHS recommends that, until EPA concludes its review, the agencies begin using a 90 µg/L value for molybdenum in individual drinking water advisories.

Please do not hesitate to contact me if you have any questions regarding this review.

Sincerely,



Charles J. Warzecha, Director
Bureau of Environmental and Occupational Health

References:

Chappell WR, Meglen RR, Moure-Eraso R, Solomons CC, Tsongas TA, Walravens PA, Winston PW. 1979. Human health effects of molybdenum in drinking water. EPA-600/1-79-006, U.S. Environmental Protection Agency, Cincinnati, OH.

Friberg L, Boston P, Nordberg G, Piscator M and Robert KH. 1975. Molybdenum – A Toxicological Appraisal. EPA-600/1-75-004, U.S. Environmental Protection Agency, Research Triangle Park, NC.

Food and Nutrition Board. 2001. Molybdenum. *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc*. Institute of Medicine, National Academy of Sciences, Washington, DC

Koval'skiy VV, Yarovaya GA and Shmavonyan DM. 1961. Changes of purine metabolism in man and animals under conditions of molybdenum biogeochemical provinces. Zh. Obshch. Biol. 22: 179-191. (Russian trans.)

National Research Council. 1977. *Drinking Water and Health*. Safe Drinking Water Committee, Advisory Center on Toxicology, National Academy of Sciences, Washington, DC.

Scientific Committee on Food. 2000. Opinion of the scientific committee on food on the tolerable upper intake level of molybdenum. SCF/CS/NUT/UPPLEV/22 Final, European Commission Health and Consumer Protection Directorate-General, Brussels, Belgium.