



Standards Update August 2017

Climax Molybdenum Company (“Climax”) is providing this update on the Colorado Molybdenum Standards to stakeholders to summarize the Climax proposals for revisions to the domestic water supply and agriculture molybdenum standards included in the Basic Standards, Regulation 31, and in two segments included in the Upper Colorado Basin Standards, Regulation 33. This summary follows upon several years of dialog, research and technical information exchange between Climax, its local and regional water quality stakeholders and regulatory agencies toward the application of the best available science in the establishment of protective levels of molybdenum in Colorado’s classified waters.

This update also includes a schedule of important events leading up to the December 12, 2017 hearing scheduled by the Colorado Water Quality Control Commission.

A third formative report related to the toxicological effects of molybdenum on human health was issued earlier this year. This study, sponsored by the International Molybdenum Association (IMOA), rounds out the following list of robust, quality assured scientific research:

- 90-Day subchronic toxicity study of sodium molybdate dihydrate in rats (2013)
- Developmental toxicity study of sodium molybdate dihydrate administered in the diet to Sprague Dawley rats (2014)
- Two-generation (one litter per generation) reproduction study of sodium molybdate dihydrate in rats (2017)

The three toxicity studies represent recent, state-of-the-art studies performed according to the Organization for Economic Cooperation and Development (OECD) guidelines. They establish that molybdenum is significantly less toxic than indicated in older toxicity studies.

For agriculture standards, research performed by the Colorado State University Department of Animal Science was completed and published in May 2017. This research, performed on feedlot cattle, informs the agriculture molybdenum standard from observations of the direct water ingestion of molybdenum over a chronic exposure.

As a result of this research, Climax proposes the following changes to the Basic Standards:

- Domestic Water Supply – Adopt 9,000 µg/L to replace 210 µg/L
- Agriculture – Adopt 1,000 µg/L to replace 300 µg/L

Purpose for Reviewing Basic Standards

Molybdenum water quality standards do not exist on a federal level. The current Colorado Molybdenum Standards were based on inadequate studies that did not meet appropriate guidelines nor peer-review processes, but were all that were available at the time the existing regulations were established. IMOA, in its role of developing regulatory proposals concerning molybdenum in the environment and its effects on human health, determined that new studies that would meet OECD guidelines and peer review were warranted to establish appropriate standards.

As one of its approximately 50 members, Climax supports IMOA in its efforts to develop science suitable for use in the establishment of standards for molybdenum in Colorado. Adoption of the Climax-proposed changes to the Basic Standards will not affect the company’s operating or water treatment practices.

Domestic Water Supply Standard

The proposed water supply standard of 9,000 µg/L is based on three recent toxicity studies and application of the following conventional methodology included in Colorado’s Policy 96-2 for the development of “Statewide Standards and Table Value Criteria for Domestic Water Supply”:

$$\text{Drinking Water Standard, } \mu\text{g/L} = \frac{\text{RfD} \times 70 \times 1000 \mu\text{g/mg} \times \text{RSC}}{2 \times \text{UF}}$$

As applied in this hearing:

- Reference Dose (RfD) = 0.566 mg Mo/kg-bw/day
- Weight of average adult = 70 kg
- Drinking water consumption = 2 L/day
- Relative Source Contribution (RSC) = 0.5
- Uncertainty Factor (UF) = 1.0

A total uncertainty factor of 30 was applied in developing the RfD=0.566 Mo/kg-bw/day. Application of the values above in the Policy 96-2 equation results in a drinking water standard for molybdenum of 9,915 µg/L. This value was reduced to 9,000 µg/L to include an additional margin of safety.

Agriculture Standard

The agriculture standard of 1,000 µg/L is based on the results of the Colorado State University study and an equation that was developed by the Colorado’s Water Quality Control Division in the 2010 Basic Standards hearing.

In the Colorado State University study, 30 young steers received molybdenum in drinking water at five target dose levels (0, 160, 320, 480, and 960 µg/L) in a randomized block design whereby animals in two replicate groups were chronically exposed to molybdenum in water from February through November of 2015. The results of this study showed that molybdenum added to the drinking water at levels up to 1,026.8 µg/L¹ had no impact on performance, mineral status, water intake, and carcass characteristics. The dose of 1,026.8 µg/L is considered to be a No Observable Adverse Effect Level (NOAEL) which provides a basis for the water quality standard of 1,000 µg/L. While the study design and protocol were based on the available body of research, because the highest dose tested was 1,026.8 µg/L, it is possible that a true NOAEL would be even higher. Therefore, a standard of 1,000 µg/L is justified based on the results of the study.

A standard of 1,000 µg/L is based on the results of the feedlot steer study and application of actual data from the study in the current equation used in the Water Quality Control Division’s methodology.

Summary of the Proposed Changes to Upper Colorado River Basin Molybdenum Standards

- Williams Fork River, Upper Colorado River Basin Segment 8
Agriculture – Adopt 1,000 µg/L to replace 190 µg/L
- Tenmile Creek, Blue River Segment 14
Domestic Water Supply – Adopt 9,000 µg/L to replace 210 µg/L, and delete the “current conditions” temporary modification

Schedule of Important Events

September 27, 2017	Climax Prehearing Statement including supporting evidence
October 4, 2017	Party status requests due for other parties
October 27, 2017	Respondent’s Prehearing Statement including supporting evidence
November 22, 2017	Rebuttal
November 29, 2017	Prehearing conference
December 12, 2017	Molybdenum Standards Hearing, Regulation 31 Basic Standards and Regulation 33 Williams Fork and Tenmile Creek, 10:00 AM

With whom is Climax communicating?

In addition to Climax’s participation in regulatory proceedings before the Water Quality Control Commission, Climax continues to coordinate with the Water Quality Control Division. Together we have established a stakeholder group that is open to all parties that indicated their interest in this regulatory proceeding. Those parties invited to participate include Region VIII of the U.S. Environmental Protection Agency, and its Washington, D.C. Office of Water, the Colorado Department of Agriculture, Colorado State University, representatives from Summit County municipalities, Denver Water and the Clinton Ditch and Reservoir Company. We have also provided direct updates in recent months to the Summit Water Quality Committee (SWQC), the Upper Clear Creek Watershed Association (UCCWA), the Grand County Water Information Network (GCWIN), Denver Water, and Clinton Ditch and Reservoir Company, among others. Climax is willing to meet informally with any stakeholders who may have interest in the science, the standards process, or the specifics of water management at our facilities.

Who can I contact to get more information?

If you have specific questions or you would like additional information, including copies of the published articles, please contact:

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¹The Colorado State University study notes that the target dose of 960 µg/L was actually 1,026.8 µg/L, based on the measured mean molybdenum concentration ingested by the test animals.