

Copper Sulfate Foot Bath Treatment for Animal Health: Impact on Manure Nutrient Content, Crops, Soil and the Environment.

Kevan Klingberg
University of Wisconsin Extension / Discovery Farms Program
June 2009

Agricultural producers manage and operate many components within their business, which combined together equal their unique farming systems. To best serve our Extension customers, crop specialists need to talk to animal specialists and financial specialists and others; and vice versa. This article summarizes how a comprehensive set of information can be provided back to producers and colleagues using a team approach. University of Wisconsin - Extension Nutrient Management Team members helped assemble an understanding of the interconnected system of cow foot health and cropland soil nutrient management.

A Wisconsin dairy producer we work with inquired about installing and managing a copper sulfate foot bath in their dairy facility for animal foot health. They asked the following questions:

What is the best management practice for disposing of used copper sulfate foot bath material? Does it just get drained into the manure handling system?

Realizing that the copper sulfate material will likely be co-mingled back into the alley way and end up mixed with the manure, are there negative impacts to cropland and / or within the soil when diluted amounts of CuSO₄ are delivered as part of livestock manure applications?

Is there a more formal disposal method for dirty - used copper sulfate foot bath mix than allowing it to become part of the liquid manure product?

This question was shared with UW-Extension colleagues via e-mail. Members of the Nutrient Management Team worked together to identify the following key points as they jointly helped answer the producer's question:

1. Cow Foot and Hoof Health

Copper sulfate and other products are used to treat hairy heel warts (considered bacterial caused) and other foot & hoof ailments in dairy cattle. The material is mixed into a foot bath that cows walk through after exiting the milking parlor. Sore feet impacts overall animal health and causes dairy cattle to become and remain less mobile, reducing their desire to travel to feed and water areas, and ultimately reducing milk production. A good description from the animal management view-point is presented by N. K. Ames, Michigan State University: Hairy Heel Warts, Foot Rot, Founder: The Enemies. See: <http://cvm.msu.edu/alumni-friends/continuing-education/extension/dairy/articles-and-bulletins/hairy-heel-warts-foot-rot-founder-the-enemies/>.

2. Tools

Lameness in dairy cattle is not necessarily a one-cause ailment. Cattle foot and hoof condition are a function of bedding, walking surfaces, hoof trimming, hygiene, etc. A full scale facility and animal management assessment can identify multi-practice changes to cumulatively improve dairy cow foot health. Dr. Nigel Cook, University of Wisconsin – Madison School of Veterinary Medicine, highlights prevention, control, and hygiene as part of foot health protocol to consider along with and before treating cattle for lameness issues. Hoof and leg hygiene can be evaluated and scored to determine how often foot bathing may be beneficial. See Footbath Alternatives: http://www.vetmed.wisc.edu/dms/fapm/publicats/press/hw_footbath.pdf . Dr. Cook has also recently worked to develop a computer software tool for dairy animal health consultants, veterinarians, and

producers called “First Step.” The assessment tool is used to determine how to reduce lameness within individual dairy herds based on an analysis of farm specific environmental factors. This tool is initially being used by private sector dairy animal health consultants. Contact Dr. Cook for more information: nbcook@facstaff.wisc.edu .

3. Foot Baths

Another short fact sheet by ZinPro Animal Nutrition presents information associated with using a footbath for hoof health. A noteworthy footnote indicates that an agronomist should be consulted to consider Cu micronutrient implications to land and crops. See: <http://www.availa4.com/technical/pdf/FootBath.pdf> .

4. Crops and Soil

A comprehensive paper, Agronomic and Environmental Issues with Foot Bath Solution Land Spreading, by Mike Rankin, UWEX Fond du Lac County Crops and Soils Agent, was presented at the 4-State Dairy Conference, summer 2004. See: <http://www.uwex.edu/ces/crops/4StateCopper.pdf> . Two other papers that discuss the agronomic and animal connection of using copper sulfate footbaths are: R. Stehouwer and G. Roth, Pennsylvania State University: Copper Sulfate Hoof Baths and Copper Toxicity in Soil. See: <http://www.das.psu.edu/news/copper-sulfate-hoof-baths-and-copper-toxicity-in> ; and B. Epperson and L. Midla, The Ohio State University: Copper Sulfate Footbaths: Issues and Alternatives. See: <http://tristatedairy.osu.edu/Proceedings%202007/Epperson.pdf>

5. Copper Sulfate Material Information

A copper sulfate product label is available at: <http://www.chemone.com/default/other/copper%20sulfate%20label.pdf> . Copper sulfate chemistry, effects, fates and toxicology information can be reviewed at a web site, coordinated by Extension Toxicology Network: <http://extoxnet.orst.edu/pips/coppersu.htm> .

6. Manure Pit Operation and Maintenance

Technical assistance for manure storage is available to livestock producers from WI Land Conservation Departments and USDA – NRCS staff. The disposal of concentrated copper sulfate material directly into a manure pit from a discrete source or container is prohibited, yet NRCS standards do allow that residual foot bath material can get mixed, diluted and co-mingled into manure storage facilities. NRCS does not consider copper sulfate that is mixed and diluted with the manure volume to be worthy of special consideration relative to crop and soil toxicity. Within manure storage management, the only time copper toxicity is considered is in the design and operation of manure and wastewater treatment systems where bacteria play an active role in treatment, i.e. aerobic lagoons and manure digesters designed to generate methane. In such cases, copper sulfate mixed into the livestock manure would reduce bacteria populations and minimize or prevent proper treatment.

7. University of Wisconsin – Extension Staff

Other University of Wisconsin staff that may have insight into copper sulfate foot bath material, its use in the dairy facility, and the implications of extra copper in the crop and soil system are: Nigel Cook, UW School of Veterinary Medicine (nbcook@facstaff.wisc.edu), Keith Kelling, UW Soils Dept. Emeritus (kkelling@facstaff.wisc.edu). Larry Bundy, UW Soils Dept. Emeritus (lgbundy@wisc.edu). Carrie Laboski, UW Soils Dept. (laboski@wisc.edu). John Peters, UW Soils and Forage Analysis Lab, Marshfield (jbpeter1@wisc.edu). Zen Miller, UWEX Outagamie County Dairy Agent (zen.miller@ces.uwex.edu). Scott Gunderson, UWEX Manitowoc County Dairy Agent (scott.gunderson@ces.uwex.edu). Matt Hanson, UWEX Dodge County Crops and Soils Agent (matt.hanson@ces.uwex.edu). Paul Kivlin, UWEX Nutrient and Pest Management Specialist (paul.t.kivlin@uwrf.edu). Kevan Klingberg, UWEX Outreach Specialist (Kevan.klingberg@ces.uwex.edu).

8. Answers to Producer's Questions:

What is the BMP for disposing of used copper sulfate foot bath material? Does it just get drained into the manure handling system?

Yes, current management strategies are to allow used copper sulfate foot bath solution to become a component of the stored manure product. This dilutes the concentrated copper solution, and it does raise the copper concentration of stored manure. Producers should pay close attention to the strength of copper sulfate solution they desire in the foot bath, and mix properly to avoid excessive foot bath concentration.

Realizing that the copper sulfate material will likely be co-mingled back into the alley way and end up in the manure, are there negative impacts back out to the land receiving manure that has diluted amounts of CuSO₄ in the manure mix?

Soil copper levels will increase as a result of many years of heavy applications of manure with copper sulfate in it. It is recommended that soil, crop, manure and feed lab analysis be conducted periodically to monitor copper cycling on the farm and potential copper build up in the soil. Although copper is an essential crop nutrient, cycling and draw down in the soil is very slow. Manure will have higher copper concentrations. Crops may also have elevated copper levels. Crop toxicity and heavy metal ceiling benchmarks are quite high, yet continued use of high copper content manure (or other bio-solids) on the same field over many years should be avoided. Monitor crop / feed copper content and manage to avoid animal health concerns associated with copper toxicity. Producers should rotate crops, as well as fields that receive this kind of livestock manure.

Is there a more formal disposal method for dirty / used copper sulfate foot bath mix than allowing it to become part of the liquid manure product?

Yes, and it would require higher management and additional cost. The material could be collected and handled separately, directly out of the foot bath structure. This concentrated material would need to be handled and managed as an industrial waste product, resulting in significant handling and disposal costs. The current BMP is to dilute used copper sulfate foot bath mix into the manure pit and apply to cropland according to nutrient management standards.

Summary: Keeping and handling used copper sulfate foot bath material separate from the manure classifies it as an industrial waste. Allowing the material to become mixed with manure removes this designation. There are alternative materials to using copper sulfate in footbaths, and there are alternative treatments, therapies and prevention strategies for lameness in cattle. Heavy use of copper sulfate foot bath material in the dairy facility, with associated manure applied to the same field for 30 continuous years (supplying 160 units of N) would hit the DNR lifetime loading limit. Field and crop rotation (i.e.: manured 2 years out of 6, plus crop removal) greatly minimizes soil accumulation of copper. Periodic soil, crop, manure and feed lab analysis are recommended to monitor copper levels through the cycle and farming system. Copper sulfate is a problem when a manure digester is involved, as the copper material kills bacteria necessary for the digestion process. Contact your local University Extension Agent or professional agricultural consultant with questions.

All internet web links updated and confirmed to work, June 17, 2009. Kevan Klingberg, UWEX Outreach Specialist, Discovery Farms Program. Kevan.klingberg@ces.uwex.edu.