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Descaling Animal Drinking Lines: The Basics, Best Chemistries, and Below-Par Bets

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OVERVIEW

The act of physically and chemically "cleaning" the insides of plastic PVC surfaces and likely layers of slime, gunk, and microbes from animal drinker lines is easy to do and well worth the effort between turns/flocks while barns are empty.

Most growers conduct waterline biogunk removal while animals are not present so they can use a more aggressive chemistry to quickly break down, shake loose, and dislodge the often scaly, crusty solids that often coat the inner workings of pipes, nipples, and pressure regulators. After filling the water lines with a descaler and allowing several hours of breakdown time, full pressure and flow is used to flush out the resulting solid crunchy bits that dislodge from these surfaces, allowing the lines to be followed by either disinfecting as a secondary step or simply filled with fresh microbe-free water.

The empty-barn method is considered the recommended approach for descaling waterlines when animals are not present. This approach allows growers to choose from various chemistries that can quickly and effectively remove buildup. However, when animals are present, the descaling options are limited to either mineral acid or organic acid pH adjustment with citric acid, acetic acid/vinegar, or organic acid blends. Unfortunately, this process is slow and less effective, usually requiring a more aggressive descaling later when the barn is empty and animal-free. Our recommendation is to execute the empty barn method initially and use a descaler as directed with animals present to prevent the buildup from reoccurring.

Dilution of liquid descaling products

Adding liquid chemical decaling product into the lines at a dilution rate listed on a label is straight forward, most of the time using a single liquid product, which is injected undiluted through the existing 1:128 dilution (0.78% by volume) medicator pump already present in the barn. The entire internal volume of the barn drinking water is quickly filled and allowed to descale prior to flushing.

"This *empty-barn method* is commonly considered the best practice approach while animals are not present, which again allows the grower to choose from several chemistries that effectively and truly descale problem drinker waterlines"

Some products are not cost effective because they are either single simple ingredients that require a greater concentration to descale, or they simply are too diluted "in the jug" (contain more water than others). The dilution rates might include injection at 3%, or ≈2 oz/gallon. The descaling product dilution rate should be strongly considered, along with crusty scale or bioscale management performance, when calculating cost per jug (gallon) and comparing true use cost between products.

This less-than-optimal 1:128 dilution problem is usually limited to simple peroxides, peracetic acid, or other non-descaling water line cleaners that may also carry a safety or regulatory burden that could place limits on shipping, farm transportation or storage concentrations. Grower should seek out economical 1:128 (or lower) descaling use concentration choices vs 3% or similar more diluted products requiring additional cost and/or time-consuming sump pump or proportioner equipment.

What is "scale" and why is it a problem?

Poultry drinker line scale is a complex buildup of hard minerals from groundwater that forms a layering of solid crust on the interior piping systems throughout farm water systems (Figure 1, left). These scale and mineral deposits have several potentially serious consequences for both the health of the birds and the functionality of the barn equipment. For example, the narrowing of the interior diameter due to restricted water flow can lead

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to unintentional water restriction (as shown in Figure 1 right). The buildup of minerals creates an ideal architecture for the formation and growth of biofilm. Additionally, the deposition of minerals on evaporative cooling pads can restrict air flow and contribute to clogged and leaking nipple drinkers. This occurs due to the presence of biosludge and/or metal oxide chunks that disrupt O-ring seals.

Figure 1. (Left) Iron scale hard film inside a brand-new (three-month-old) farm poultry water plumbing system; and **(Right)** water restriction at a pressure tank inlet on a broiler breeder farm, showing impact of iron bioscale on interior pipe diameter.

When it comes to waterline scale the three minerals of primary concern are iron, calcium, and manganese. The process of cleaning waterlines that contain these minerals requires a different approach than the use of simple peroxides, bleach, or peracetic acid. Disinfecting and removing biofilm from waterlines that contain these minerals can be particularly challenging. Fortunately, it is often easy to predict the likely presence of hard mineral deposits inside of water lines and does not require cutting into PVC to verify prior to descaling drinker systems.

Have you ever descaled your drinker lines?

If the answer is "no," then maybe it's time to delve deeper and explore whether true descaling should be incorporated into the drinker system management program throughout production cycles and during animal out times.

1) **Do I see scale on my evaporative cooling pads?** The scale will likely be very hard and very crusty, but it will not easily crunch when attempting to remove it with your fingernail. It can be red, grey, white, tan, or any combination of colors that show physical build-up on cellulose pad material. Scale on evaporative pads may require a different product for descaling vs. drinker systems but is a great indirect indicator of scale inside of PVC drinking water systems.

2) **Do I see color changes on my water filters when I change them, or are they clogging up with dark colors within a few weeks or months?** Scale tends to be a darker color and often has a smell that is caused by bacteria that use metals for food. If you see reddish or brown "chocolate" color on the white filter material, it indicates that the farm water possesses the potential to develop iron or manganese scale within the water lines.

3) **Do I see staining or color changes on soil where water continually drips?** Observe the barn surroundings, particularly areas where water from a leaky cool cell pad or faucet has slowly leaked onto the ground. Is the soil discolored or has a crusty layer formed over the soil? The mineral materials causing these issues are likely coating the insides of the drinker lines and pressure regulators. To remedy this, it is necessary to descale and thoroughly clean and slick the PVC and plastic membrane material inside of the lines and regulators.

4) **Does animal performance deteriorate in hot months or in late stages of growth prior to market age?** If interior diameters of water lines are encrusted with scale, then water volume flow may be reduced at peak usage times. Your drinker systems may be water-starving animals at peak production, especially in hot weather. Some water systems have been known to have interior water diameters almost completely clogged with hard scale. Additionally, water pressure tanks that struggle to keep up may also be a sign of scale build-up. Think of this scenario like clogged heart arteries that need to have the lipid/cholesterol "plaques" removed to allow for full flow.

If you've answered "yes" to any of these questions, then you likely have issues with "scale" on the farm Follow-up should include taking a water sample to understand groundwater (well water sample) levels of both hardness and additionally ppm levels of iron and manganese.

Do you have a dual threat – hard water and microbes?

While the presence of hard ground water on farms can lead to the formation of scale in drinking and evaporative cooling water, the biology originating from groundwater microbes can create a more complex challenge for drinker lines. These microbes can encompass both pathogens (like coliform, E. coli, etc.), and non-pathogenic biofouling microbes that form non-health impacting biofilms. This organism contributes to the formation of physical bioscale that 1) reduces water volume and flow to animals, and 2) supports an environment with favorable conditions for animal of food-safety pathogens to hide and grow.

Non-pathogenic scaly biofilms can also create organic byproducts that can either feed and/or simply utilize nutritional supplements to compound water clogging. Bio-scale may also harbor microbes that thrive in sulfur, nitrogen, or iron-rich ground water to impact and increase corrosion and, more

importantly, impact the taste and odor of drinking water. The most effective solution for tackling this combination of hard water and groundwater microbes in water lines and farm water is to remove the scale with a true descaler, followed by waterline disinfection or continuous drinking water sanitation (for pathogens in ground water sources)..

Water chemistries to consider for descaling drinker lines

Combination chemistries have become the dominant players in live animal production, with products like the glutaraldehyde/quat combinations, peroxyacids (e.g., liquid and dry peracetic acid), "synergized peroxides," and chlorine dioxide (acid + chlorite) topping the performance and cost economy categories for both farm/transport surfaces and drinking water applications. The unique synergies achieved by combining different chemistries have been proven to deliver superior product performance at lower concentration or lower cost for live production.

This is also true for hydrogen peroxide when added to pH reducing (acidification) and chelating chemistry, affording both chemical acid descaling and mineral removal from solubilized surface iron, manganese, and calcium, coupled with well-known physical "bubbling" oxidation action on organics and microbes.

Our **ProMax®** product is used overnight at a 1:128 dilution rate (Figure 2) and is a "best in class" combination chemistry descaler. ProMax contains economical high-concentrations of both hydrogen peroxide and etidronic acid (described below) to chemically descale and physically remove crusty, smelly layers inside of drinker line system, between out-time animal production cycles.

Figure 2. Water line flush after 12 hours of contact time of **ProMax®** inside the water lines, showing the dark, smelly biogunk flushed from the scaled broiler drinker lines. **ProMax®** was metered into the lines at 1:128 using a simple medicator pump.

Etidronic acid (HEDP): Etidronic acid, also known as HEDP, is a well-known chelating agent used to effectively bind metals present in water and water lines. HEDP also assists in the stabilization of hydrogen peroxide by protecting against metals that break down the peroxide as it flows from the medicator throughout the interior of the drinker lines, regulators, filters, and drinker nipples. By utilizing the technical approach of chelation, HEDP aids in the elimination of iron, manganese, and calcium, allowing for optimal penetration and scale removal in animal drinker systems. The solvation of these metal ions occurs at acidic pH allows for best penetration of scale architecture within animal drinker systems. Look for HEDP in your water line descaling product as it acts as both a pH reducer and chelator, providing comprehensive water treatment.

Mineral Acids: Most mineral acid-based products a good choice for descaling of waterlines if a single ingredient or single class product is going to be used. The unique behavior and concentration of most mineral acid products allow them to achieve true descaling of waterlines. Among these products, hydrochloric and sulfuric acid blends are the most used acids in this category, with phosphoric acid being the third. As mentioned above, these acidifiers, which are single-ingredient or single-class products, rely solely on a less efficient, highly acidic pH to remove scale efficiently.

The best approach – true descaling and continuous water treatment

The best approach to achieving both descaled, "slick" clean water lines on farms with poor water quality and/or pathogens present in source water is a combination of true descaling coupled with continuous water treatment to include drinking water disinfection at low ppm levels (i.e., chlorine dioxide systems) as part of a complete animal health management approach. This process eliminates the need for water line disinfection after descaling and allows for other improvements in animal production, such as reducing metal antinutrient precipitation and enhancing taste and odor of drinking water.However, some hard-water farm growers might not want to:

1) commit to the time or equipment requirements for a dual chemical injection system to operate a chlorine dioxide system,

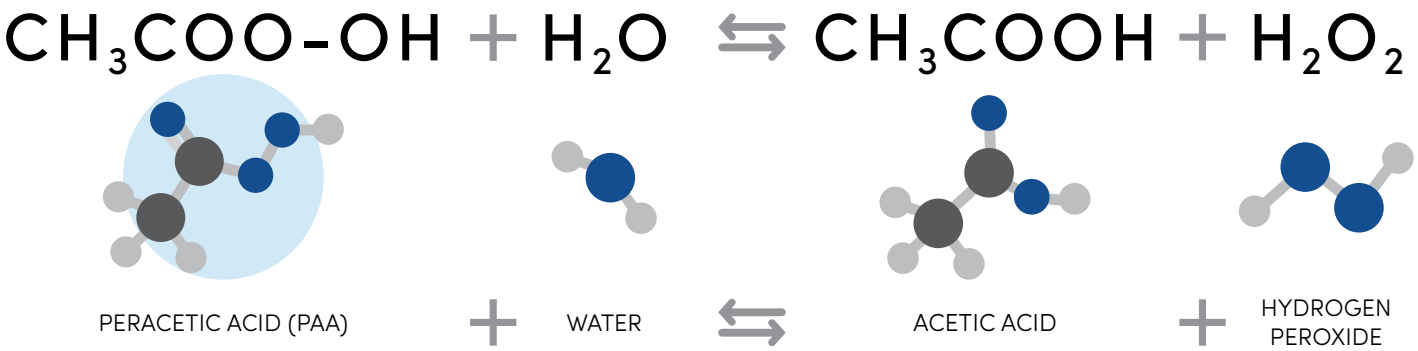
2) have farm water pH levels that will not buffer acid products significantly allowing them to descale and control low level pathogen management in the water itself, and/or

3) have microbial pathogen and/or metals oxidation needs, but also require pH reduction for slow, low-level descaling that will not clog nipples.

For farms facing challenges with hard water and not experiencing water restriction (i.e., mostly clogged with seriously thick scaled interior diameters) an innovative acid/oxidation blend offers a "one-stop shop" solution to

scale removal. **Remember: this is a very slow approach to descaling and might take months or years to see significant improvement, depending on the thickness of the mineral scale.** To ensure the safety of animals, it's recommended to use biocidal levels of drinking water with ppm levels monitored at the end of the drinker line, while strictly following label instructions. In other words, consider this as an alternative plan "B" rather than the primary plan "A" choice.

EPA Registered Peroxyacids: These products are equilibrium blends of an acid and peroxide, usually a liquid organic acid and liquid hydrogen peroxide, that forms a synergistic combination of the two as a peroxyacid (see figure below).



Peroxyacids like peracetic acid (PAA) are excellent biocidal oxidizers that maintain the ability to kill pathogens in the presence of organic material. PAA breaks down into harmless byproducts — vinegar, oxygen, and water. PAA is the overwhelming leading chemistry for chill tank and carcass pathogen management sprays and does not require a rinse. Other peroxyacids and peroxyacid blends have gained traction in animal agriculture but have not been approved for drinking water use.

Some EPA-registered PAA products like Perasan A and Peraside 15 have poultry drinking water instructions. All PAA products used for continuous biocidal and descaling applications should have an EPA registered label, and adherence to that label for drinking water uses should be strictly followed.

Growers may want to avoid these interventions

Dry Acid Packs: Dry Vinegar and Citric Acid vs Sodium Bisulfate (Jake to write, best for intermittent pH reduction, not decaling) Anhydrous or dry acids are available for several acids that are widely used in production such as dry vinegar or citric acid. However, most of these dry acids are not well suited for descaling waterlines due to factors such as cost, concentration, and their behavior in water. Dry acids are more effectve for intermittent pH reduction. Citric acid may be the one exception due to its ability to chelate metals.

Organic Acid Blends: Organic acids blends such as those found in dry acid packs are better suited for uses other than descaling or cleaning water lines. Organic acids are most effective when used for their inhibitory properties or nutritional benefits for animals. Like dry acid products, the cost, concentration and behavior of organic acids in water make them less suitable for descaling compared to mineral acid products.

Hydrogen Peroxide (alone): Hydrogen Peroxide alone is not effective for significant true descaling of internal drinker line surfaces and should not be used as a standalone solution tool for this purpose. Hydrogen Peroxide and/or other peroxygens are best utilized as co-ingredients with true pH-reducing chemistries for waterline descaling or EPA-registered continuous water line descaling and sanitation. Some hydrogen peroxide products function as physical "biogunk" cleaners that rely on very high levels of oxidation action, while others serve as disinfectants, that require precleaning and/or descaling to prepare the surface for proper disinfection.

Summary

To effectively clean and descale animal drinking water lines, it is recommended to adopt a multi-ingredient approach. This involves combining true descaling methods with continuous water treatment that includes disinfection of the drinking water at low ppm levels. For optimal results, it is advised to use EPA-registered peroxyacids, which are equilibrium blends of an acid and peroxide. These peroxyacids create a powerful and efficient combination that effectively eliminates contaminants.

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