FACTSHEET

Controlling iron, manganese and limescale in livestock water systems

Figure 1. Sediment blocking nipple drinker filters

The link between mineral levels, water system efficiency, and pig growth and health

High levels of minerals in water can cause problems in water systems, affect water consumption and directly impact animal health and productivity; for example, at >2 parts per million, iron can result in scour, reduced water palatability and subsequent intake in pigs.

When exposed to air, iron creates a green precipitate (solid) that turns orange-brown in water over time (Figure 3). While not as common as iron, manganese is also present in water and behaves similarly when exposed to air, creating a brown-black solid (Figure 2). These precipitates can block pipes and filters (Figure 1), reducing flow and water pressure; more energy is then required to pump water through pipes, increasing energy and maintenance costs.

Water contaminated with iron and manganese often contains bacteria that feed on these minerals, creating a biofilm (slime); once established, biofilm can also block drinkers and pipelines, reducing flow rate.

Biofilm

When microorganisms attach themselves to pipe surfaces, they can create a resilient, slimy structure called biofilm. Precipitation and biofilm can blockage pipes and drinkers, which will reduce water intake and subsequent feed intake.

Bacteria such as E.coli use iron as an energy source. A deep clean (shock water treatment) is an effective way of removing biofilm.

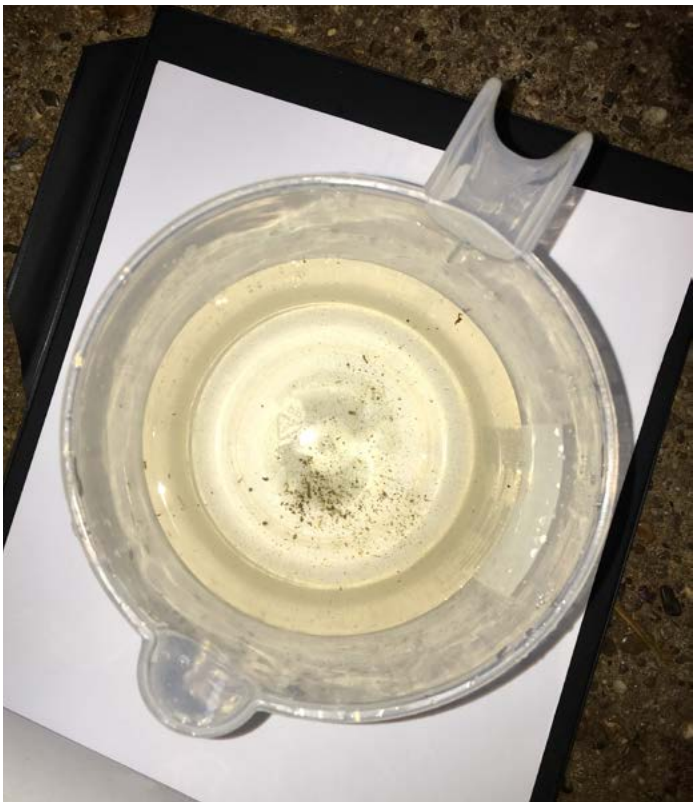

Figure 2. Manganese precipitate in a water sample

Figure 3. Iron deposits in water samples

How does limescale form?

Water is classified as hard water, when calcium carbonate concentrations are high (Table 1). When water evaporates, it leaves behind calcium carbonate deposits known as limescale, a chalky, off-white, solid residue. Limescale deposits can build up quickly on any surface with which hard water is in contact, including the inside of pipework and drinkers, reducing water flow rate. Reducing or removing calcium and magnesium from water can, therefore, help to prevent scaling. Limescale develops most frequently when water is left standing; this is often the case in all-in, all-out systems.

Table 1. Hardness of waters

Water	Hardness mg/l $CaCO_3$ (calcium carbonate)
Soft	Up to 50
Moderately soft	50–100
Slightly hard	100–150
Moderately hard	150–200
Hard	200–300
Very hard	Over 300

Source: Adapted from: Private Water Supplies, 2006

Common problems caused by high levels of minerals

- Blocked pipes
- Reduced water pressure due to reduced pipe diameter
- Increased water use and cost
- Bacterial growth in drinking water pipes
- Frequent leaks and the need for repairs or replacements of water system elements
- Unpleasant taste and reduced water intake, which may lead to a depressed feed intake

Pigs can tolerate calcium in water, but high levels can interfere with the absorption of phosphorus and the effectiveness of antibiotics.

Controlling the mineral content of water

Frequent testing will identify the type and level of minerals to target when selecting a suitable treatment (Table 2), and also confirm the treatment and cleaning method is effective; cleaning can be done regularly, or targeted (shock water treatment). Discuss results and actions with relevant staff and/or your veterinary surgeon to ensure the chosen treatment is appropriate and safe for treating minerals, bacteria and the volume of water (Table 3).

Table 2. Example water sample results

	Calcium, Total as Ca	Iron, Total as Fe	Manganese, Total as Mn
Sample number	ug/l	ug/l	ug/l
A1	92	<230	8.5
A2	89.9	<230	14.9
A3	87.9	<230	9.3

Good quality water may enter the farm, but corrosion of iron or steel pipes, or other components of the plumbing system, may be a problem. Converting any dissolved minerals into a precipitate by oxidation with a chemical, e.g. chlorine, and then removing these traces by filtration is a common approach; but more than one method may be required, as, for example, calcification of the biofilm will protect microorganisms from the effects of chlorine sanitisation. High mineral and pH levels can increase chlorine demand and reduce the efficiency of chlorine disinfection.

Ongoing maintenance and treatment will be necessary and it is always advisable to speak to the manufacturers when selecting a product; they will also be able to provide a guide on costs.

Table 3. Treatments for iron and manganese in drinking water

Cause	Indication	Treatment
Dissolved iron or manganese	Water runs clear with red-black solid particles Water runs a red-black colour (colour can remain longer than 24 hours)	Phosphate compounds (use for <3 mg/L (mg/L) iron) Water softener (use for <5 mg/L iron and manganese) Oxidising filter (use for <15 mg/L iron and manganese) Aeration filter (use for <25 mg/L iron and manganese) Chemical oxidation and filtration (use for >10 mg/L iron and manganese)
Oxidised in the water supply	Water runs with red-black solid particles that settle out when left standing	Particle filter
Corrosion of pipes and equipment	Water runs with red-black solid particles that settle out when left standing	Raise water pH and install a particle filter
Iron or manganese bacteria	Red-black slime in pipelines and tank	Shock treatment and filtration
Multistage treatment: If water has high levels of iron and manganese in both the dissolved and solid forms, a multistage treatment operation is necessary. The first stage is chlorination to oxidise dissolved iron and kill bacteria; the water can then be filtered mechanically to remove particles. This can be followed by filtering with activated carbon to remove excess chlorine and, finally, softening to control hardness and remove any residual dissolved minerals.		

Source: Adapted from: Drinking water problems: Iron and manganese, The Texas A&M University System.

Further information

- ***Managing mineral content of water for pigs***
- ***Designing a water supply system for livestock*** guide
- ***Deep cleaning farm drinking systems, a shock water treatment*** guide
- ***Survival time of pathogens in water*** factsheet
- Standard Operating Procedures: ***Water sampling for microbiology, minerals, flow rate and water temperature,*** and ***Water sampling for microbiology***

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