Iron Bacteria
Technical Bulletin 2009-03

GENERAL	NOTES
If you have a brown/red to black slimy, faintly foul smelling deposit in toilet tanks, heat exchangers, valves, and pipes, and you are feeding a water heat pump from a well directly or indirectly (storage/pressure tank), then you probably have an infestation of iron bacteria. The effects of this bacteria growth as thing as ¼" in a 5 ton installation can reduce its efficiency as much as 50%. Being aware of iron bacteria, its habits and its treatment are important to your customer's comfort and your pocketbook. Iron bacteria is most commonly introduced into the well by careless well drillers, pump servicemen, or other well/plumbing related personnel. The presence of iron bacteria in an aquifer can cause iron bacteria to appear in a well. However, because of the lack of oxygen in an aquifer, the iron bacteria usually does not travel more than 100 feet before it dies. Even when inadvertently inoculated into a well, iron bacteria usually languishes because of the absence of oxygen sufficient to support its metabolism. Seepage from ground contamination into wells that are improperly grouted and sealed is also a low probability source of the contamination. Should your heat pump system have the misfortune of hosting the "rusty monsters," the system can usually be successfully cleaned up. Since the customer only perceives that he/she is hot or cold, the module and you will get full blame, and you may end up with a warranty claim unless you are knowledgeable. First, work with a reputable driller who routinely sterilizes his/her bits and rig. As a minimum, the driller must routinely sterilize or disinfect the well before it is put into service. A small amount of care at the time of drilling can save a lot of later conversation and costs. It should be noted that young (new) wells have a higher incidence of iron bacterial contamination than older, mature wells. The iron bacteria can be classified in several ways, and there are several types of critters. They come in a wide variety of physicals forms.	

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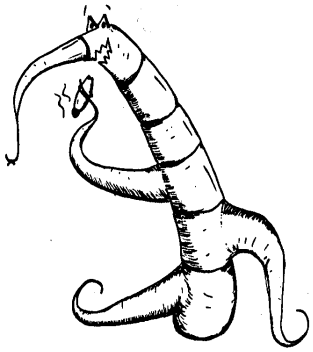
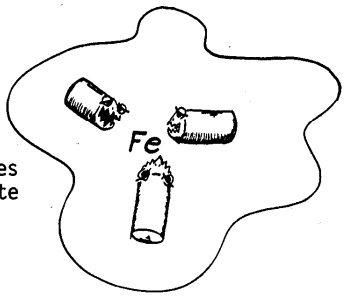
Critters come in a wide variety of physical forms:

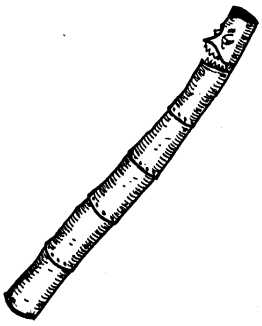
1. Gallionella -- A common form, bean shaped cell that excretes a twisted ribbon waste product.



2. Crenothrix -- Another common form, long tapered filament with separate cells end to end making up the filament.

3. Coccoid -- Short rods that surround themselves with Ferric Hydrate (rust-brown).





4. Lepthrothrix -- A simple nontapered thread which is usually encrusted with iron along the entire sheath.

The ideal growing conditions for the generalized family of bacteria are:

Well depth – 30 to 400 feet (122m)
Low Temperature – approximately 50°F(10°C)
Ferrous Iron – more than .015g/gal (.25mg/l)*
PH – near neutral 6.0-8.0
Dissolved Oxygen – low 1.0-3.0 mg/l
Conductivity – moderately high (300-700 micromho/cm)
*Note: the human body requires about 5mg of iron per day

Keep in mind these are average ideal conditions and any number of variables could allow the bacteria to grow. The Gallionella has been found in hot springs as warm as 117°F (47°C).

Temperatures above 120°F (49°C) for periods of more than 10 minutes appear to be lethal to the Gallionella and probably other members of the clan.

NOTES

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Placing the heat pump module in the air conditioning mode and turning off the water supply should let the water heat exchanger climb to about 120°F before the compressor goes off on the high head. This should be performed with refrigeration gauges attached and at no time should the heat pressure exceed 330psi. This technique should kill the bacteria in the heat exchanger. But this certainly won't affect the source of the bacteria (the well or the pipes). The killed bacteria and their slimy byproducts, ferrous hydroxide, must be removed with an acid treatment. Flushing with dilute muriatic (hydrochloric) acid will dissolve and clean a heat exchanger. Do not use nitric acid for this procedure under any circumstances. An installation with mixed metals, such as iron and copper pipe should use a weak acid to prevent plaiting and subsequent electrolytic action. Acids as sulfamic or hydroxyacetic should be used in these "mixed metal" systems. The heat exchanger and its supply pipes should then be flushed with chlorinated and then clean water before being reconnected.

The well driller has a more difficult problem since he/she must treat* the bacteria from the outside to the inside. The driller should know the proper procedures, by the "Johnson's Ground Water & Wells or Water Well Technology (Campbell & Lehr, 1974)" are references if there are questions.

The driller must flush or surge the well for an hour with a shock (heave, 400-1,000mg/l) chlorination*, four hours of jet development to loosen the encrustation, then acid treat to dissolve the slime and shock chlorinate again to get the bacteria residing under the slime that the first chlorination didn't reach. Some drillers prefer to use a copper sulfate solution (more than 1.0mg/l). In both cases of chlorination and Copper Sulphate, only a complete job will do the trick. Other well treatments, such as Sodium Hypo-chlorite, Potassium Permanganate, Hydrogen Peroxide, Hexameta-Phosphate and others do kill bacteria, but may not have the penetrating ability of the chlorine or copper sulphate.

Remember that in all of these cases, the treatments are poison and your home owner would take a dim view of the well not being completely flushed after the last treatment.

Also, keep in mind, as well as notify your customer, that certain strains of these bugs are very resistant. That coupled with an ideal well could cause regrowth, and under severe cases it may even require abandoning the well.

All in all – a clean drill rig from the start can save a lot of grief!

*Refer also to Water Energy Distributors Technical Bulletin 2009-37 for Well Disinfection Procedures.

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