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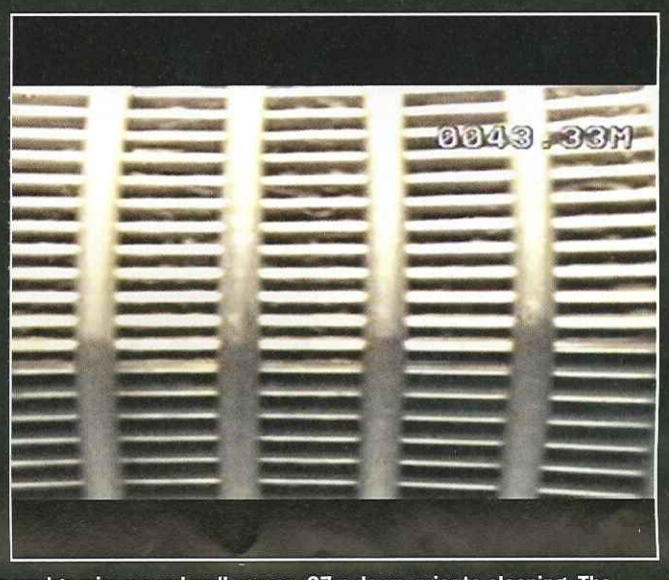
How the wizards of Oz won iron bacteria battle

Groundwater bores can have terrible problems with iron bacteria that forms into slimy deposits and solid encrustations. But Boresaver, a range of cleaning solutions developed in Australia, is proving an effective treatment, says Mike Deed



Left to right: removing the pump from the G150 well in the Gwelup Borefield; G140 Well in the Gwelup Borefield. A side view picture of the Johnson wedge wire wound well screen, 27m down, prior to cleaning. The screen is almost completely obscured by soft, slimy biofilm and residue caused by iron bacteria; the same screen after treatment but at a depth of 43m

IRON BACTERIA is becoming an increasing problem in groundwater bores, and is estimated to affect about 40% of the world's water bores with anecdotal evidence indicating that this number is steadily increasing.

Iron bacteria derives energy during its metabolism through oxidising soluble ferrous iron, present in the groundwater, to its insoluble ferric form. The resultant biofilm is commonly found as a slimy or gelatinous deposit and over time these deposits develop into solid encrustations that become difficult to remove.

Symptoms of biofouling including reduction in the capacity of the bore, deterioration of water quality, motor burn out of the submersible pump, and encrustation on the pump, column, bore casing, screens and reticulation systems.

Whether caused by natural bacteria or chemical means, residues will eventually affect most people

Iron is one of the most common elements found in nature and accounts for at least 5% of the earth's crust. Whilst most groundwater contains a certain concentration of dissolved iron, iron bacteria do not affect all bores.

There is some debate as to why certain bores suffer adversely from iron bacteria while others never become infected. Possible reasons for infection include presence of bacteria before a bore is drilled, introduction of bacteria via contaminated water used during the drilling process or changes in the chemistry of the groundwater that provides an environment in which bacteria can become established.

Whether caused by naturally occurring bacteria or straight chemical means, these residues will eventually affect nearly everyone who sources water from groundwater aquifers.

Biofilm growth

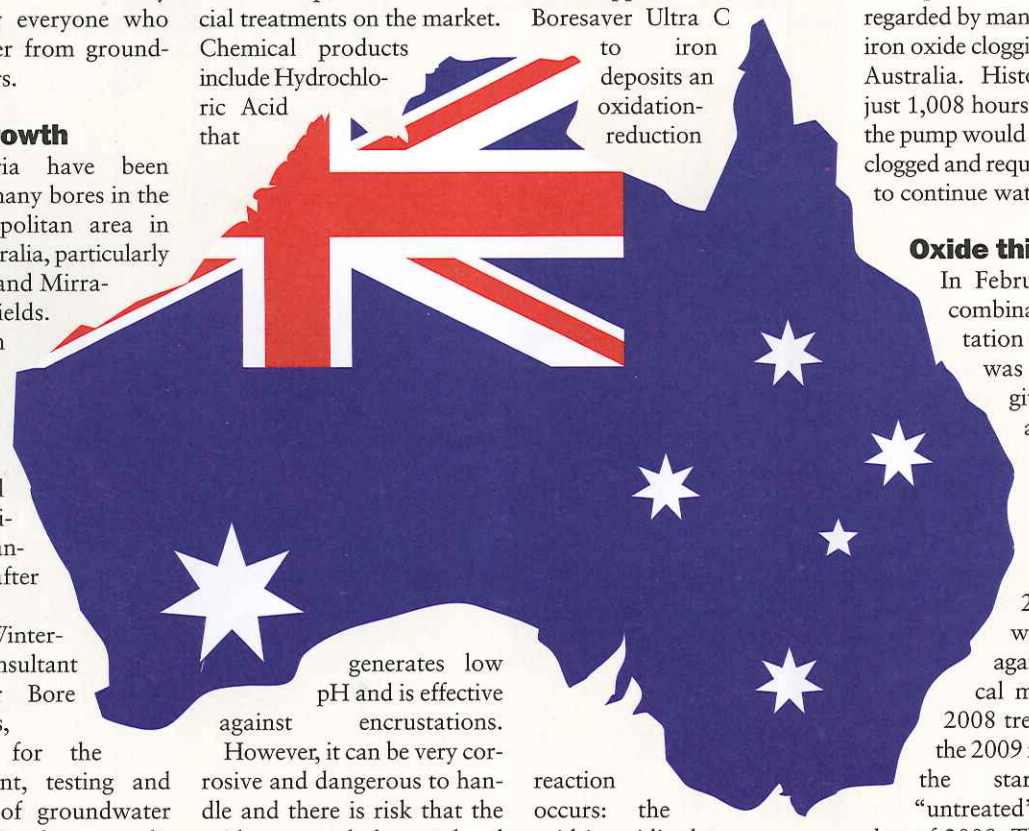
Iron bacteria have been detected in many bores in the Perth metropolitan area in Western Australia, particularly the Gwelup and Mirrabooka borefields. The biofilm growth is particularly rapid in these areas with several bores experiencing substantial growth after six weeks.

Kevin Wintergreen is a consultant with Water Bore Redevelopers, responsible for the redevelopment, testing and monitoring of groundwater bores in the Perth metropolitan area. "Apart from drilling, we were very involved in bore redevelopment using cable tool surging for 28 years, using what was thought to be the best available chemicals. In 2005 we stopped drilling and concentrated on redeveloping only, realising a better system was needed than the one being used for the past 50 years.

"We therefore set about developing a system using Boresaver and a camera video inspection to see problems and results, and a purpose-built rehab rig."

There are several methods that can be employed to rehabilitate wells with iron bacteria and there are a wide variety of chemical products as well as a number of patented commercial treatments on the market. Chemical products include Hydrochloric Acid that generates low pH and is effective against encrustations.

However, it can be very corrosive and dangerous to handle and there is risk that the acid may attack the metal and require an inhibitor to control its aggressiveness. Chlorine is another product that has had limited success but it needs to be used very carefully because of the extreme level of chemical activity and the potential to form THMs.



Boresaver is manufactured by Geoquip's Australian partner, Aquabiotics Industrial Pty, and is a range of cleaning solutions for systems that are contaminated with iron oxide, manganese oxide and iron related bacteria. Boresaver Ultra C and Boresaver Liquid are approved by the Secretary of State under regulation 31 of the Water Supply (Water Quality) Regulations 1989 for use in potable water applications.

On application of Boresaver Ultra C to iron deposits an oxidation-reduction reaction occurs: the acid is oxidised to water and carbon dioxide and the iron oxides/hydroxides into soluble iron. While this process is under way the slimes that form the large proportion of the clogging problem are disrupted and dissolved.

With the clogging and iron oxides dissolved it becomes a simple matter to remove them from the bore by either airlifting or pumping.

Boresaver was one element of a phased combination rehabilitation treatment programme put together by Water Bore Redevelopers Pty, which involved using a purpose-built cable tool rig and a video inspection camera to record pre and post treatment results.

One of the wells in the Perth metropolitan area had what is regarded by many as the worst iron oxide clogging in Western Australia. Historically after just 1,008 hours of operation, the pump would be completely clogged and require a swap out to continue water extraction.

Oxide thickness

In February 2008, a combination rehabilitation treatment was undertaken giving the client a 200% improvement in the specific capacity.

In March 2009 the well was treated again in an identical manner to the 2008 treatment. With the 2009 rehabilitation, the starting point "untreated" was double that of 2008. This means the well performance had not deteriorated anything like as much as when standard rehabilitation techniques were used.

Previously the oxide thickness on the pump every 1,008 hours of operation would be about 25mm thick with the intake port almost completely blocked. After the 2009 treatment an inspection at 4,000 hours revealed just 3mm on the motor and no clogging at all of the intake port. Moreover, the expected decline in well performance, which had previously occurred every 1,000 hours of pump operation, was not evident even after more than 4,000 hours.

The phased treatment programme has significantly increased the time between maintenance intervals, eliminated, to date, the clogging of the pump intake port and reduced rehabilitation costs.

One of the wells in the area had possibly the worst iron oxide clogging in Western Australia

Wintergreen concludes: "Other bores for the Water Corporation now being cleaned on a regular basis, are showing an improvement between cleans, and maintaining production. Another bore needed to be cleaned every six weeks, but now only needs cleaning every six to nine months. Not one aspect on its own will do the job, but a combination cleaning process and Boresaver has given the best results yet." ■

Mike Deed is managing director of Geoquip Water Solutions, UK partner of the Aquabiotics Industrial Pty.
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