



Disinfection of water bores

The occurrence of iron bacteria in water bores has become the single largest maintenance problem facing groundwater users today. Maintenance costs to pumps and bores alone amount to millions of dollars each year. The disinfection of new bores and existing bores following maintenance will reduce the chances of contamination occurring.

What are iron bacteria?

Iron bacteria are micro-organisms which oxidise soluble ferrous ions into insoluble ferric ions. This results in a slime which causes the majority of the iron-related problems in bores, including clogging of screens, slots and pumps; it has adverse effects on taste, colour and odour; and corrosion can occur as a by-product of the process.

Where do the bacteria come from?

It is now well known that many types of bacteria are native to, or have adapted to exist in, saturated sediments and rock. They are present in significant numbers in most water supply aquifers. Given both time and an available route, bacteria will migrate into any aquifer.

Drillers and pump installers/servicers can also introduce these micro-organisms during their operations. Bacteria may also arrive via leakage around poorly sealed casing.

At present there is no practical way of determining the source of bacteria once it is in a bore.

Why should bores be disinfected?

Water bores must be disinfected to destroy any naturally occurring bacteria as well as any iron bacteria inadvertently transported from other bore sites.

The drilling process itself creates perfect conditions for accelerated growth of bacteria - high nutrients and aerated water. In addition to iron bacteria, other

harmful bacteria may also be present on drilling tools, in drilling fluids or on casing being installed. In areas adjacent to septic tanks or land disposal pits, bacteria may migrate from upper contaminated zones to lower uncontaminated zones.

The driller has a responsibility to leave a completed bore in a state that is not harmful to users, the pump or the bore itself. For any responsible driller, bore disinfection is not a maybe but a MUST.

What disinfectants are available?

Chlorine

Chlorine is by far the most commonly used disinfectant in the world today. It exists in three main forms: gaseous chlorine, calcium hypochlorite and sodium hypochlorite.

Sodium hypochlorite is liquid chlorine and is readily available throughout Australia. It generally has 10-12% available chlorine and is relatively cheap and safe to use. However it is somewhat unstable, and over time in storage may lose a significant percentage of its useful chlorine. For safety reasons, liquid chlorine is recommended for bore disinfection rather than gaseous chlorine or calcium hypochlorite.

Proprietary chemicals

A number of proprietary chemicals exist on the market which have been produced specifically for bore disinfection.

The major benefits claimed for these chemicals over chlorine is that they are non-corrosive, safer to handle and more environmentally friendly. Manufacturers can assist you with technical data relating to their products.

Dosage for chlorine disinfection

Disinfection may be achieved by dosing the bore with liquid chlorine to a level where there is 50 milligrams per litre (mg/L) of free chlorine in solution in the bore.

As chlorine is highly CORROSIVE to metals, care should be taken to avoid unnecessary contact with metallic fittings. When determining the size of the dose, allowance should be made for:

- dilution of the dose with the water in the aquifer, and
- chlorine being taken up by sediment in the newly completed bore.

The table shows the volume of sodium hypochlorite required to disinfect different diameter bores for a range of dosage rates. Experience will show what dosage you need to achieve the required level of free chlorine.

Casing Size (mm)	Dosage Rate (mg/L)			
	50	100	250	500
	Volume Sodium Hypochlorite (litre/m water in the bore)			
100	.01	.015	.04	.08
125	.01	.025	.06	.12
150	.02	.035	.09	.18
200	.03	.06	.16	.31
250	.05	.1	.25	.49
300	.07	.14	.35	.71
350	.1	.19	.48	.96

This table assumes sodium hypochlorite has 10% available chlorine. If liquid chlorine of a different concentration is used, the volumes given should be changed in proportion.

Procedure to disinfect a bore

- Ensure the bore is fully developed and the water clean.
- Measure the depth of water in the bore and calculate the volume of liquid chlorine required using the table above. If using proprietary chemicals, determine the dose rate using the manufacturer's instructions.
- Distribute the chemical consistently throughout the bore, preferably using a small diameter plastic pipe or drill stems. As a last resort the chemical can be poured down the bore from the top. For ease of handling, the chemical may have to be mixed with water prior to introduction to the bore.
- The water in the bore should be agitated using a surging tool (which acts as a column of air) to ensure the chemicals enter the water bearing formation.
- If using liquid chlorine, test to ensure that a residual chlorine concentration of at least 50 mg/L remains in the bore water. A swimming pool test kit can be used to check residual chlorine

concentration. If the residual is less than 50 mg/L additional chlorine should be added.

- Leave chlorine in the bore for at least four hours, or for proprietary chemicals, as indicated in the manufacturer's specifications.
- Pump or air lift water from the bore until no chlorine residual remains, or until no chemical smell is apparent in the water. A test kit should be used to confirm this.
- Seal the bore to prevent air borne bacteria from entering.

Prevention better than cure

Once iron bacteria have become established in a bore, they are very hard to eradicate entirely. It is far better to adopt practices which reduce the chances of bacterial problems occurring. This applies to drilling new bores, rehabilitation of existing bores, maintaining pumping equipment or in the routine operation of bores.

- Drilling contractors must ensure that drilling rig and tools are disinfected before working on a new site. Equipment should be chlorine washed or steam cleaned after having worked in a known iron bacteria area.
- Drilling fluids should not be contaminated with water containing iron bacteria. Avoid using drilling water obtained from swamps or streams as these are likely to contain the bacteria. If this water has to be used it should be chlorinated.
- Pumping equipment firms should ensure that their pumps are free from contamination when being replaced in a bore, or used for testing purposes.
- Landholders can also adopt measures to prevent contamination by ensuring that surface runoff into the bore does not occur, and any maintenance work carried out includes disinfection where required.

Further information

Should you require assistance or advice on this topic, please contact a local groundwater consultant. You will find their contact details in the yellow pages under the headings of 'Natural Resources Consultants' or 'Boring and Drilling Contractors.'

Further information on groundwater or other natural resource management topics may be downloaded from the Natural Resources and Water web site at <www.nrw.qld.gov.au>. ■