Beating bacteria for the Italian 'jobs'

In Italy, Milan-based Millars Products specialises in borehole rehabilitation and remediation, which includes the use of Geoquip's BoreSaver range of water treatment solutions

Among Millars Products customers in Italy is the oil refinery sector, where government regulations insist that hydraulic barriers are in place to contain any potential water leakage around the perimeter of every site. The barriers direct the water into specially drilled wells, situated at every 20-30m, with the express role of stopping it seeping into the aquifer below.

It is imperative that all the pumping equipment within the wells is working to maximum capacity as, if there is a break-down, it could have long-lasting effects on the local environment.

Giorgio Boyd, from Millars Products, explains: "While the spillage remains in the well, the water is then extracted and cleaned before being discharged into the ground.

"It's a critical process as iron bacteria will grow inside the wells very easily and, once it gets established, it can cause massive problems with the equipment and maintenance of the well, so we have to make sure it is in good working order."

To help tackle the problem, Boyd works with UK partner company Geoquip Water Solutions as the exclusive Italian importer of Geoquip's BoreSaver range of water treatment solutions. These are used to treat a cross-section of different types of bacteria, including iron-related bacteria (IRB), iron oxide and manganese oxide deposits.

One of BoreSaver's key benefits is that the treatment can take place while all the equipment is in situ, helping to ensure that downtime is minimal. Boyd says: "The fact there is no need to remove the pump or undertake a mechanical cleaning process is a real benefit as apart from this taking longer, it can also allow air into the well and, of course, the air then helps the bacteria to grow again."

The presence of a marker within the BoreSaver solution also allows Boyd's team to guarantee that no chemical residue is left in the water supply.

One treatment will usually be enough to remove the deposits that have built up and the solution is safe, easy to use and biodegradable.

Another sector where Boyd works with major customers across the country is the geothermal arena.

While introducing a geothermal system into commercial or domestic properties can deliver energy saving benefits of around 30 per cent, this only applies if systems are properly maintained, which means staying on top of potential bacteria growth.

"Like any equipment, if it is fouled through contamination, it will become much less efficient and then the customer is unhappy with how it works. With geothermal, you have water going in and out of the ground to heat or cool the system, so it stands to reason that bacteria can take hold and start to cause problems," he says.

He believes that no matter what section of industry, if there are problems with boreholes or wells underperforming, becoming less efficient, providing lower quantities and quality of water; then bacteria is most likely to be the culprit.

If allowed to go unchecked iron bacteria will grow inside a well very easily and, once it gets established, it can cause massive problems with the equipment and maintenance of the well

TESTING AND INSPECTION

Boyd has a two-pronged plan of attack. The first is to use a biological activity reaction test (BART) kit, which is both simple and cost-effective to use. It involves taking a water sample (container provided) to allow the user to see both if bacteria is present and what type it is – for example, iron-related bacteria, sulphate-reducing bacteria or slime-forming bacteria.

With the tests carried out on-site, over an eight-day period a series of indicators will develop ►

The test vial (centre) once it has been removed from the outer dispenser of the biological activity reaction test (BART) kit

within the sample vial. Typically, these will present as:

- If iron-related bacteria is found, foam will be produced and/or a brown ring develops inside the testing tube
- If sulphate-reducing bacteria is found, foam will again be produced and a black ring may develop around the interior vial of the testing tube.
- If slime-forming bacteria is found, a cloudy or gel-like growth will develop

Identifying the specific bacteria allows the correct treatment solutions to be applied quickly and effectively, flushing out the bacteria and preventing further damage to water quality or corrosion of equipment.

Further testing can then be carried out – both after the treatment and ideally at six-monthly intervals – to ensure the problem has been eradicated.

"These tests can be done quickly and simply, without having to make a major investment, allowing the customer to see if he has a bacteria problem and then look at a treatment and/or a further investigation programme," adds Boyd.

"A critical process as iron bacteria will grow inside the wells very easily"

The second line of investigation will be to use a downhole camera to take a closer look at what is happening underground, helping to rule out external damage or blockages. For this, Boyd uses a Laval R-CAM borehole camera, also from Geoquip. One of the biggest benefits, he says, is that it has a very small diameter, enabling him to use the camera in boreholes without removing the pump.

"Customers are often surprised by what we find – it can be anything from little prawns or frogs to damage caused by previous rough rehabilitation or cleaning; sometimes a well will collapse due to its age and once we surveyed a well which had been damaged by an earthquake."

By using either the BART kits and/or the use of a camera, Boyd says a cleaning, repair and treatment solution programme can be put in place to return the borehole to full capacity.

From then onwards, he recommends putting in an ongoing maintenance programme with regular checks to ensure any future build-ups of bacteria can be identified and treated before they become a major problem.

Facts and figures

The specific capacity (Q/s_w) of a well is the discharge per unit drawdown in the well and is usually expressed in Lpm/m. This is a measure of the effectiveness of a well.

Based on the following:
well diameter 350mm
well depth 160m
well static 80m
pump depth: 120m

Flow prior treatment: 20L/sec.
drawdown: pump in cavitation so at -120m

Flow after treatment: 40L/sec
drawdown: 80-82m

The specific capacity of the well at the beginning prior to treatment was:
20L/sec = 1200Lpm
Drawdown – 80m >> 120m therefore 40m
Specific capacity = 1200 / 40 = 30Lpm/m

The specific capacity of the well at the end AFTER to treatment was:
40L/s = 2,400Lpm
Drawdown – 80m >> 82m therefore 2m
Specific capacity = 2400 / 2 = 1,200Lpm/m

The result shows an impressive 3,900 per cent improvement in the specific capacity of the well.

Case study – a well deep clean doubles water flow

A water well that had effectively been mothballed because of problems with bacteria dramatically reducing its output, has doubled its water flow from 20L/sec to 40L/sec and improved its specific capacity by 3,900 per cent, thanks to a major deep clean project.

A water well, owned by the city's potable water supplier in the Italian region of Lombardy previously provided drinking water to local residents. More recently, however, the loss of flow and water pressure due to problems with bacteria meant it had been consigned to being used only as a back-up source or in the case of an emergency.

When the decision was made to rehabilitate the well, specialist Italian company GN Tecnopompe was brought in to tackle the problem of its restricted flow. Working in partnership with Milan-based Millars Products, the two organisations began a deep cleaning programme using both mechanical cleaning methods and a chemical treatment solution.

Giorgio Boyd, from Millars Products, explains: "An initial inspection revealed that the main problem affecting the well was the growth of iron-related bacteria (IRB), which is a relatively common occurrence if regular treatment is not carried out.

"If allowed to develop unchecked, the bacteria will quickly impact on performance, causing problems with biofouling and clogging of the pumping equipment and potentially damage to the borehole wall and casing."

Made with a carbon steel casing and screen, the borehole was approximately 160m deep, with a static level at around 80m and a diameter of 350mm. At the time the experts were brought in, its maximum output was just 20 litres per second and the pump, installed at minus 120m, often had cavitation problems due to quick dropdown.

The remedial work, which took place in May this year, saw GN Tecnopompe start with a mechanical clean of the well using a piston and brushing method, with an airlift to remove residual deposits.

With the initial clean completed, the next stage was to tackle the bacteria with chemicals and the Millars Products team brought in BoreSaver Ultra C Eco, a specialist treatment solution imported exclusively from its UK partner Geoquip Water Solutions.

An application of over 500kg was inserted into the borehole, using the airlift system to create regular purges to help to circulate the chemical. Over a two-day period, water samples were regularly taken for pH testing and, by the end of the second day, the samples were showing a neutral pH with crystal clear water.

Although the water quality had now dramatically improved, further borehole investigations with a downhole camera revealed that the bottom of the well still contained some residue, and that not all the slots in the casing had fully opened.

The decision was made to apply a second much-smaller BoreSaver treatment, this time using camera technology to ensure it was carefully targeted at the remaining problem areas. By injecting the chemical directly at specific depths and with further piston and brushing combined with a purge using a submersible pump, the remaining residue was successfully cleared.

Tests showed that the well was now producing double the amount of water – 40 litres per second without impacting on the top of the pump, while the water level went down to 120m instead of the previous 80m.

BoreSaver Ultra C is poured into the borehole of a well in Italy that had all but been mothballed due to problems with bacteria dramatically reducing its output

The sample bottle (left) shows how cloudy the water was and demonstrates the mud found in the borehole. The sample (right) was taken one hour later after the mechanical clean but before the chemical treatment

Boyd adds: "We carried out another video inspection and we could see significant improvement on our screens. It was a tremendous result and the quantity and quality of the water now being pumped from this borehole is very impressive. So much so that the well's owners are now ready to treat other wells that have similar problems."

Giovanni Naoni, director of GN Technopompe, says: "We were extremely pleased with the results achieved from the cleaning and treatment process. It was carried out efficiently and with the minimum disruption and we look forward to working with the teams again on future projects."

The BoreSaver range of treatments is designed to tackle different types of bacteria and is easy to use because borehole equipment can stay in place while the treatment takes effect. The presence of a marker within the solution also allows the cleaning team to guarantee that no chemical residue is left in the water supply.

Ongoing maintenance treatments are also recommended to avoid future build-ups of iron contamination.