Quality concerns

Water-management consultancy Envireau Water's Dr Phil Ham stresses the importance of understanding water-quality issues

"Many industrial processes have a well-defined water-quality requirement and are sensitive to even very small changes"

The continuous supply of 'good-quality', clean water is essential for any company dependent on water, especially when it is used in product.

While many companies will rely on a mains water supply that provides potable quality water, large water users will often operate independent supplies and are responsible for all aspects of their supply.

Understanding water-quality issues and why the quality of water may change can be a complex process. First of all, it is important to recognise the difference between water quality and water chemistry. Water quality is, as the term suggests, a qualitative description, whereas water chemistry refers to the actual composition and the properties of water.

For example, 'potable quality' defines the standard of water required for human consumption. However, just because water is of potable quality does not mean it has the right chemistry to make it suitable for other uses.

Indeed, the composition of potable water will vary, sometimes considerably, depending on the type and geographic location of the source water used, and sometimes even on seasonal trends.

Many industrial processes, particularly those in the pharmaceuticals and healthcare industries, have a well-defined water-quality requirement and are sensitive to even very small changes in raw water chemistry. These companies are likely to treat and engineer the incoming raw water supply, to produce water of the required quality.

Even small changes in chemistry can have a big impact on the type and level of treatment required to ensure that industrial process water is up to the required standard. Changes in water chemistry may also influence the frequency of maintenance required for pumping and treatment equipment, which will all impact on overall operational costs.

For those companies operating independent supplies, understanding water chemistry starts at the borehole source, which is often overlooked.

The operation of the borehole can have a big impact on the composition of the raw water obtained, and therefore a good understanding is essential to ensuring the consistency of supply and minimising treatment and maintenance costs.

Iron-related sludge in delivery pipework

PHARMACEUTICAL PROCESSING

Envireau Water has recently supported a large pharmaceutical manufacturer in the north-west of England, where borehole water is used to supply all its water for processing. Problems had been observed with poor quality water for many years.

In particular, a build-up of iron-coloured sludge accumulating in delivery pipework was having a major impact, requiring pumps and rising mains to be changed at regular intervals and more intensive treatment systems to deliver the required quality of water.

An analysis of water samples showed that the groundwater obtained from the boreholes contained very high levels of dissolved iron and manganese that appeared to be precipitating in surface pipework.

The issue is not uncommon, as both iron and manganese are naturally present in groundwater, sometimes in very high concentrations. While these elements remain in the dissolved form underground, when the water is brought to surface and equili-

brates with atmospheric pressure, they precipitate. Biological activity reaction tests (BART) confirmed the presence of large colonies of iron-related bacteria that were proliferating in the borehole and resulting in the sludgy deposit.

Removal of one of the borehole pumps from the worst-performing borehole revealed that the pump intake was clogged with the same sludgy, iron precipitate found in surface pipework and that the inside of the rising main was similarly clogged.

Both the interior and exterior of the rising main was also heavily corroded and contained several holes, located primarily within the zone of water-table fluctuation.

REVIEW

Envireau Water carried out a borehole condition survey, which suggested that the actual borehole was in generally good condition. Principal inflow horizons were clearly observable in the engineering and geophysical data that was obtained.

A review of operational pumping data for the borehole showed an erratic, stop-start pumping regime. Pumping water levels were below the primary inflows, resulting in cascading of water into the borehole and aeration of the water column.

Pumping water levels were also very close to the pump intake; well below the recommended net positive suction head (NPSH), and it was considered likely that air was being entrained into the water and exacerbating the precipitation of iron, and corrosion of the rising main.

REHABILITATION

To address the problem, a simple programme of borehole rehabilitation and sanitisation was carried out to remove the residual iron precipitate and disinfect the borehole. A new pump and riser were installed along with an inverter control system, to control pump speed.

Clogged pump

Water-storage filling arrangements were modified and a revised pumping programme implemented – to control pumped water levels restricted to a much lower level without materially affecting daily abstraction.

A scheme of monitoring is now being implemented to provide an early warning for any potential issues. While some precipitation is inevitable, the extreme problems observed with sludging of pipework have not been observed.

The key benefits are a much cleaner, more consistent quality of water and significantly reduced maintenance costs, all of which lead to greater security of supply.

This project shows the importance of understanding water chemistry at the source and ensuring that boreholes are correctly operated and managed to maximise performance. It also highlights the importance of regular monitoring to understand boreholes and the groundwater systems they target, and to plan maintenance activities effectively, rather than responding to the problems when they occur.

"A simple programme of borehole rehabilitation and sanitisation was carried out to remove the residual iron precipitate and disinfect the borehole"

Corroded rising main in the zone of water-table fluctuation