Application Note

Optimising Iron and Manganese Oxidation in Groundwater for Drinking Water

Objective

- Process monitoring and regulatory compliance

Parameters

- Manganese
- Total Iron

Solution

- EZ1000 Manganese Analyser
- EZ2000 Total Iron Analyser

Problem

The Drinking Water production plant of Budapest Waterworks had a challenge: Due to the high content of Iron and Manganese in the source water, preoxidation is required to remove the metals. But how could they guarantee that the finished water would meet the regulatory limits set by European legislation?

Solution

With the use of Hach® EZ series online Manganese and Total Iron analysers, levels are monitored in real-time. The results generated are connected to the customers Scada system where early warnings are detected and compliance monitoring is logged.

Benefits

The EZ analysers ensure compliance with regulatory limits. As analysers are online instruments, they provides real-time information and replace frequent manual grab sample testing in the laboratory.

Background

Budapest Water Works provides 1 million m^3 drinking water per day to consumers in the city of Bupdapest, Hungary. Most of their 756 wells are located along the river-bank of the Danube river, and therefore high quality ground water is available due to river-bank filtration. Pre-oxidation of this water source is required, as Iron and Manganese levels can be above the limits set by the European Drinking Water Directive 2020/2184.

Raw water is normally below the limit for iron of 200 µg/L, but close to the limit for manganese of 50 µg/L. Without additional water treatment, these levels would not be in compliance with regulatory limits. As a result preoxidation is applied in the water treatment process for Iron and Manganese removal. The preoxidation process is facilitated by a cascade system, where maximum aeration is created. To monitor the efficiency of peroxidation and compliance with regulatory requirements, online analysers were needed.

Iron and Manganese in Source Water

Both iron and manganese often exist together in source water such as groundwater, but manganese usually occurs at much lower concentrations. Occurring naturally in soil and in most surface water and groundwater sources, manganese is an essential element for many living organisms because of its role in the function of enzymes. For humans, the largest source of manganese is usually from food.

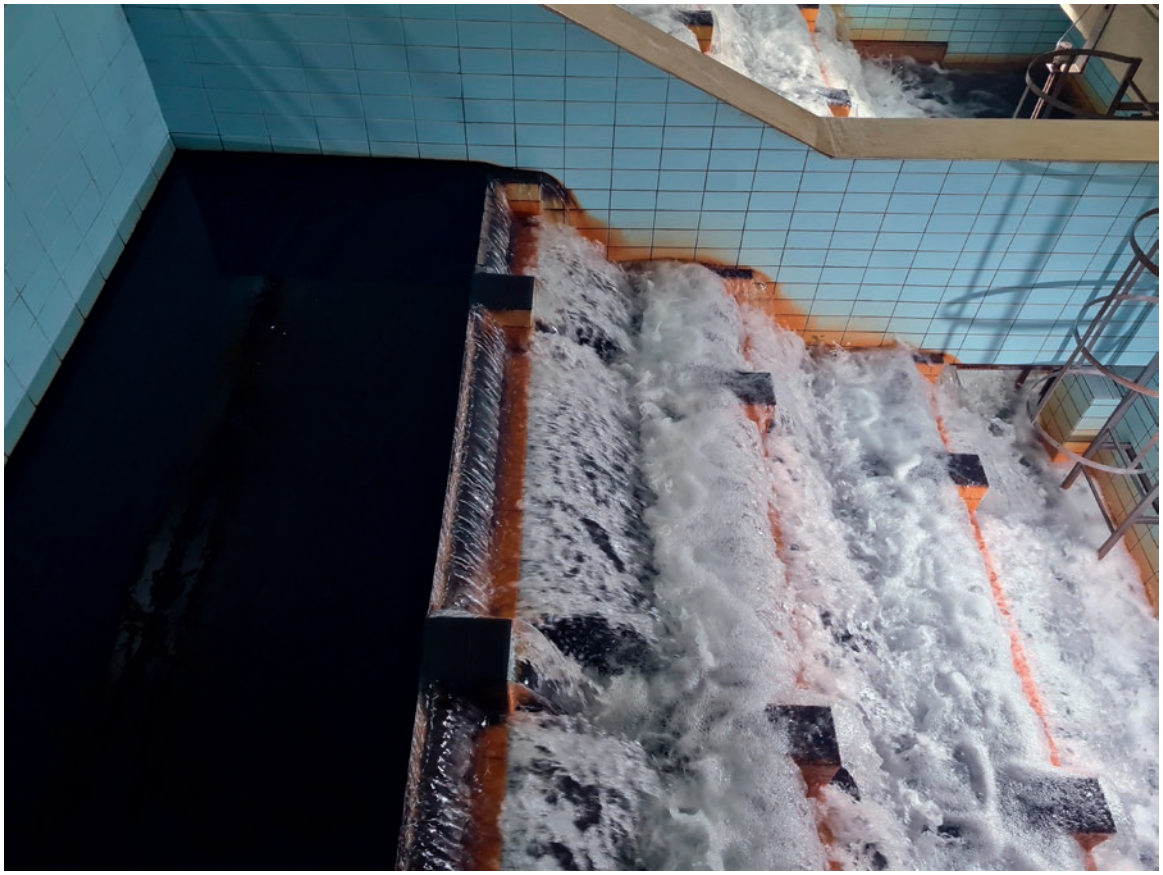
However, absorption of manganese across the gastrointestinal tract is regulated by the body to help maintain manganese homeostasis, and orally obtained manganese is generally considered to be one of the less toxic elements. Nevertheless, in the light of recent research, the guideline value for manganese in drinking water is the subject of ongoing debate.

Discolouration, bad taste and staining from tap water are the most common causes of drinking water complaints from members of the public. The handling of these complaints, and the implementation of investigation and remediation measures, can be very costly. Turbidity monitors can help to raise alarms so that action can be taken to divert cloudy water from the distribution network, but turbidity can be caused by a wide range of issues, whereas raised iron and manganese levels result from specific issues, so monitoring can help identify causes and inform appropriate mitigation measures.

The health risks from iron and manganese are small, however there are risks associated with the bacteria that cause raised iron concentrations from corrosion. For humans, the lethal dose for iron is 200-250 mg/kg of body weight, which causes extensive gastrointestinal hemorrhage. However, iron toxicity is rare, and intake from drinking water is typically too low to raise health concerns. Nevertheless, iron oxides are known to be efficient scavengers of metals and semi-metals, and can be responsible for increased levels of arsenic.

Continious Monitoring

In general, laboratory analysis of process parameters helps to detect trends and identify potential problems. However, there is a time delay between sampling and the delivery of a result, and occasional sampling risks missing a spike in the concentration. Continuous monitoring therefore provides a more timely warning of raised levels and helps to identify the causes.



Pre-oxidation using a cascade system

Solution and Improvements

The EZ Series of analysers employ online colorimetric technologies to measure key water quality parameters accurately and reliably. Smart, automated features contribute to enhanced analytical performance, minimised downtime and negligible operator intervention. Cleaning is automatic and both calibration and validation frequency can be set by the user.

The EZ series has the ability to measure multiple streams simultaneously, up to a maximum of eight. This reduces the cost per sampling point, but must be specified at the time of ordering.

The **EZ2000 Iron analyser** utilises the TPTZ reagent to form a deep blue-purple colour in a reaction which measures dissolved iron Fe(II), Fe(III) and total dissolved iron Fe(II+III), and a measuring range of 0-1 mg/L.

The **EZ1000 Manganese analyser** measures dissolved Manganese Mn(II), by the formaldoxime method at 450 nm, with Iron and Manganese in drinking water a measuring range of 0-1 mg/L Mn.

EZ Analyser Managanese (left) and Iron (right) installation at Budepest waterworks

Conclusion

By implementing the EZ analysers, Budapest Waterworks drinking water treatment plant has ensured real time monitoring of Iron and Manganese. As a result early warnings are detected and compliance monitoring is logged continuously.

About the Customer

Budapest Waterworks, with its 150 years of history, is one of the leading water utility service providers in Central Eastern Europe.

MISSION
The mission is to provide excellent quality potable water in the long run at affordable prices. In addition to favourable environmental and hydro-geological conditions, preservation of excellent water quality also requires high standards and a technically sustainable operation. In addition improvement of the environmental and water resource protection via effective procurement, facilitates the reinforcement of our corporate responsibility objectives.

Our water supply core business creates value both in domestic and international markets.

VISION
Efficient and safe water supply at best value for money.

Authors:

Bart Verdonk
Applications Development Manager, Hach

Zsombor Dunai
Principal Sales Representative, Hach