

Online Measurement Ensures Drinking Water Quality

Problem

The Langelier Saturation Index indicates the potential of drinking water to cause scaling or corrosion in a pipeline distribution network. Such events pose a challenge to the water quality at Sydsvattens Vomb drinking water treatment plant. Lack of correlation between simple online hardness monitoring and actual alkalinity concentration require manual analyses and manual adjustment of process settings to maintain a good way of operation at the plant.

Solution

Sydsvatten has tested and validated the EZ4004 online alkalinity analyser to automatise process control and reach stable alkalinity values in its drinking water. The analyser provides 24/7 online results for alkalinity calculated as HCO_3^- and ensures the correct dosing of softening chemicals based on actual online values after the softening process.

Benefits

The EZ analyser has been providing a stable online result for alkalinity over a long period of time which allows to calculate accurate values of the Langelier Saturation Index and as a result

- the risk of corrosion / scaling is reduced significantly,
- chemical dosing is under better control,
- manual lab measurements are under better control.



The operational area of Sydsvatten stretches over a large area in southern Sweden.

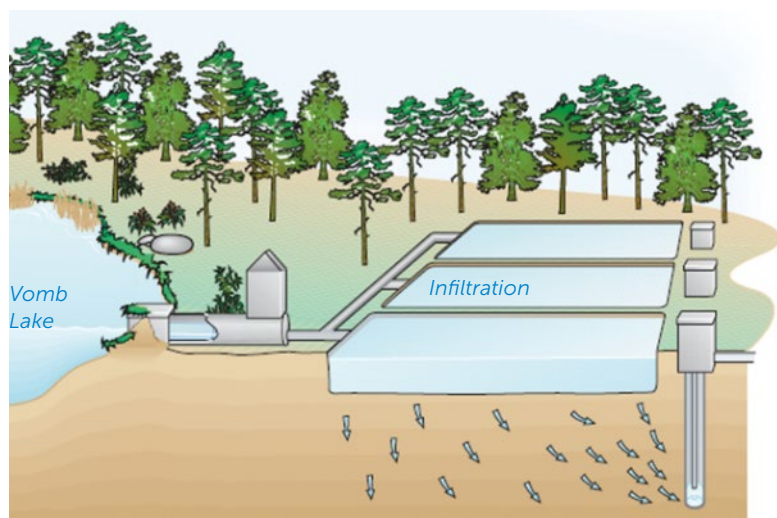
Background

Sydsvatten AB is a municipally owned drinking water company producing drinking water for 900,000 inhabitants in the region of Skåne, south Sweden, and ultimately distributes to 17 joint owner municipalities. Sydsvattens first priority is to ensure the water quality to the consumers. To accomplish this Sydsvatten works to establish water protection areas in order to increase the protection of raw water sources. The establishing of redundancy of both raw water and drinking water in the whole of Sydsvatten's supply system, is an ongoing process.

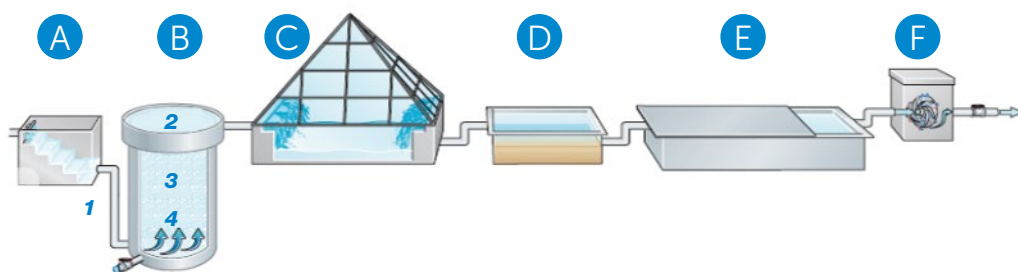
Sydsvatten currently takes raw surface water from two lakes in south west Sweden: Lake Bolmen and Lake Vombsjön with a backup Lake Ringsjön. To reach a sustainable supply of water in the future, it has been decided that water from Lake Bolmen shall also be utilised at the Vomb Plant. This is a decision of great strategic importance towards the future.

Drinking water treatment needs many control parameters, some related to public health but also some product / taste related control parameters like iron and manganese. One final production parameter often controlled by drinking water companies is the alkalinity of the produced drinking water. Not only does alkalinity affect the taste of drinking water, it is also important to the Langelier Saturation Index (LSI) of water being transported towards their customers. The LSI describes the tendency of water to cause calcium carbonate scaling or corrosion in pipeline networks and is directly affected by the content of calcium based salts in the drinking water. In order to get this parameter under control reliable monitoring of alkalinity is required.

Alkalinity in Drinking Water



Artificial groundwater infiltration



Drinking water production process

- | | |
|------------------------------|--|
| A Aeration | 1 NaOH |
| B Softening reactor | 2 Softened water |
| C Mixing chamber | 3 Granules of precipitated lime |
| D Rapid sand filters | 4 Hard water |
| E Water reservoir | |
| F High pressure pumps | |



Data trend of the online analyser (red) and spot lab measurements (to be divided by 1.22)

Situation

At the Vomb water works, raw water from Lake Vombsjon is 'filtered' through a natural ground water storage basin and produced as if it were a normal ground water production setup. This process is called artificial groundwater infiltration.

After the water has been taken-in from one of 114 wells it is aerated to remove naturally occurring iron and manganese. After aeration, the water is treated in the softening reactors where the goal is to remove the naturally occurring calcium salts causing alkalinity and hardness. This is done by adding sodium hydroxide so that calcium ions can be precipitated as lime on the grains of sand in the softening reactor. The softened water is released on top of the reactors.

To get a better control of the process Sydsvatten added an alkalinity analyser to its online measuring array which already included a hardness analyser. This existing online hardness measurement was not proven to be sufficient as the hardness remains stable over time while alkalinity fluctuates significantly. Given the alkalinity in this water is also caused by added hydroxides, it requires a more robust titration setup: Something that can be done by using the EZ4004 which measures alkalinity in a chemical titration titrating down to pH 4.3 expressing values in mg/L CaCO₃.

Sydsvatten prefers to use HCO₃ over CaCO₃ as this is more convenient for their chemical dosing program. To cover for this difference a factor of 1.22 is build in to correlate based on molar mass. These conversions can easily be done in the panel PC of the EZ analyser which allows a user not only to put in local factor modifications or sequence modifications, but also remote stream selection.

The data shown in the graph in red shows the online analysis (including 2x calibration) versus the manual lab measurements to be divided by the factor 1.22.

The Hach® EZ4004 online analyser measures the total alkalinity of drinking water and Sydsvatten tested and verified the EZ4004 for nearly 1.5 years and recently acquired a second identical analyser for a second operating location



Aerial view of Vomb waterworks



Softening reactors at Vomb waterworks

During the upcoming plant revision the analyser will be installed into the production process potentially leading to a more optimised way of dosing sulfuric acid to adjust the pH of water before distribution. However, goal of Sydsvatten is ultimately to improve and automate control over the chemical dosing which is expected to result in a far better grip on the production process allowing Sydsvatten to offer better and safer drinking water to its customers.



Installation of the EZ4000 Total Alkalinity Analyser at Vomb waterworks

Conclusions

- Sydsvatten tested and validated the EZ4004 total alkalinity analyser on its Vomb waterworks in a range between 130 and 150 mg/L CaCO_3 for well over a year. Output data of the analyser in Calcium Carbonate (CaCO_3) is confirmed by manual lab measurements and converted to Hydrogen Carbonate (HCO_3) using a stable chemical factor so that the output data can be used to control Sydsvatten's drinking water production process in safe way.
- A change of process control at the plant is upcoming, the change of using manual data for process control will be changed to automated control using online measurement values. This will result in a far more stable and safe way of operation.
- Successful operation of the EZ4004 total alkalinity analyser at the Vomb waterworks has convinced Sydsvatten to purchase a second EZ4004 analyser for operation at the Ringsjö plant where ranges will be between 30 and 50 mg/L CaCO_3 .

Images and illustrations courtesy of Sydsvatten.