CLEAN AND CLEAR BREWING WATER

New ultrafiltration and reverse osmosis technology for the new SFBT brewhouse in Tunis

SFBT is a publicly-held firm and is listed on the stock exchange with its more than 20 subsidiaries in North and East Africa, the Middle East and Europe. Their product range includes soft drinks, energy drinks, dairy products, ice cream as well as wine and beer. SFBT is one of the market leaders for beer production in Tunisia with a capacity of approx. 1 million hectoliters per annum. SFBT manufactures the brands "Celtia," "Celestia," "Stella" and "33 Extra Dry." Under license, SFBT brews "Löwenbräu Original" and "Beck's." As part of its overall capacity expansion, SFBT has commissioned an additional brewhouse line and a new bottling cellar. At the beginning of 2018, Centec supplied water treatment technology consisting of ultrafiltration and reverse osmosis, thus making a significant contribution to overall output of more than 2 million hl in 2018 – a new milestone.

The facility receives the process water for beer production from the city of Tunis; a combination of surface and groundwater, with high salt content and considerable hardness. High particle loads were repeatedly registered, which led to a turbidity range of up to 5 NTU. Seasonal fluctuations in water quality, especially in terms of salt content and total hardness, call for a flexible treatment concept in order to ensure consistently good brewing water. In addition, the city water is heavily chlorinated, especially in the summer months, to meet strict microbiological requirements.

These factors resulted in the following list of tasks that needed to be completed in order to facilitate proper water treatment:

1. Safe removal of particles and turbid matter
2. Significant reduction in salt density, alkalinity and hardness
3. Consistent, reliable brewing water quality
4. Process steps that focus on worker and equipment safety

Proper water treatment is based on a dual-membrane concept:

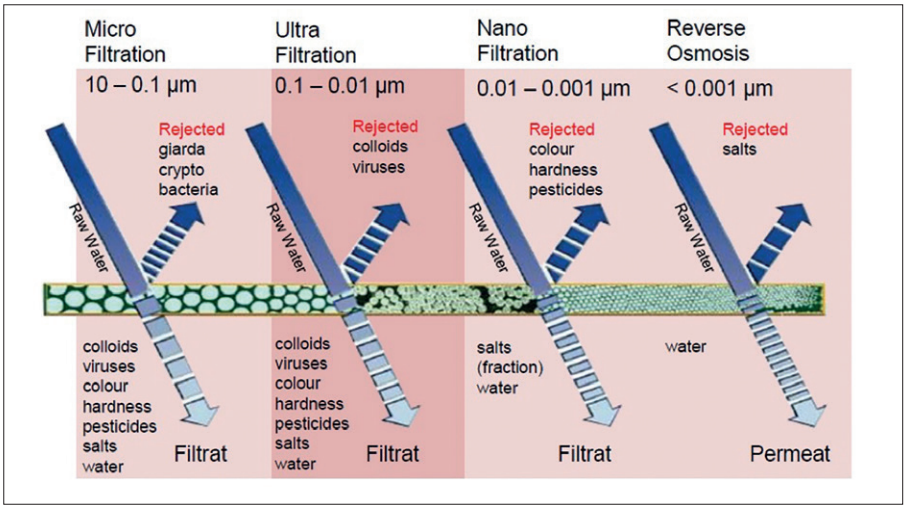
1. Ultrafiltration for particle capture
2. Reverse osmosis for desalination

Step 1: Ultrafiltration

Ultrafiltration is the ideal method for extracting process water from surface and groundwater. While sand filtration used to be the accepted procedure, ultrafiltration is more common today in modern water treatment plants. The decisive advantage of ultrafiltration is in the consistently high quality and purity of the pure water produced. Ultrafiltration systems have nanoporous capillary membranes. Due to small pore size, these membranes reliably retain inorganic particles as well as microorganisms such as bacteria and viruses. Compared to sand filtration, the process is much safer and – at the same time – space-saving.

Even if raw water quality fluctuates greatly – as in the current example – ultrafiltration membranes can reliably remove all impurities. Sand filters simply cannot compete. Ultrafiltration installations are easy to integrate in upstream or downstream water treatment systems and are also easy to operate when fully

Reverse osmosis installation



Comparing ultrafiltration to micro or nanofiltration and reverse osmosis (Image: inge GmbH, Greifenberg, Germany)

automated. Filtration, backwashing and dry cleaning are controlled by a PLC.

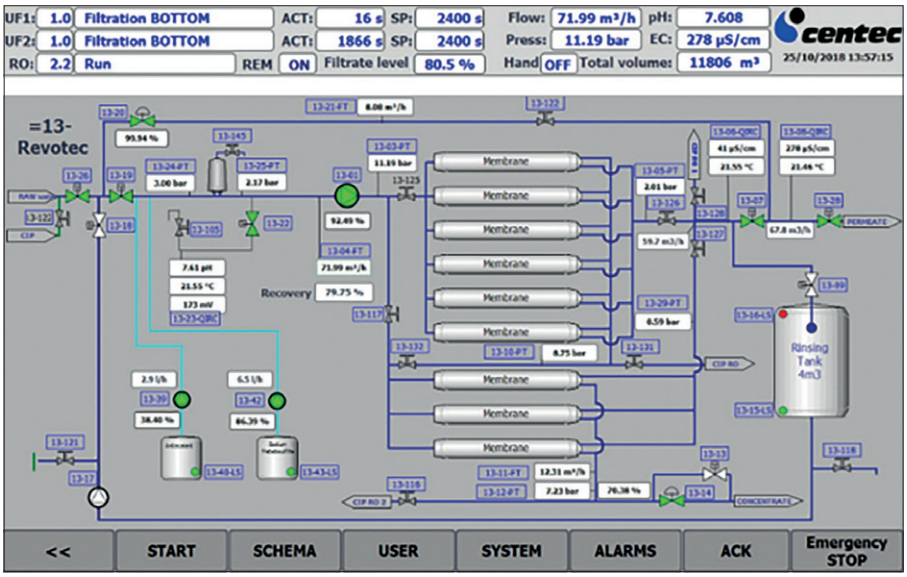
Centec's ultrafiltration plant, delivered recently to SFBT, is calibrated to process water input at the rate of 90 m^3/h. It consists of 2 x 10 modules which contain a large number of capillary membranes from BASF inge and deliver a separation threshold of 0.01 µm. All modules have a total filtration area of 1,280 m^2. The raw water is prefiltered at about 2 bar through a fully automatic fine filter with a pore size of 125 microns on the raw water side of the ultrafiltration modules. The turbid fluid flows through the capillary membranes from the inside to the outside. Particles and microorganisms are retained on the inside surface of the membrane. In defined time intervals, depending on raw water contamination levels, the UF modules are backwashed and retained substances are removed from the filter. For the conversion of colloids dissolved in water into separable aggregates (flakes), $FeCl_3$ is metered into the raw water as a flocculant. Iron (III) chloride is ideally suited for this application due to its structure and charge distribution. The colloids attach themselves to the iron ions and are thereby converted for reliable filtration.

The main task of ultrafiltration is to send consistent, perfectly filtered and "clean" raw water to the reverse osmosis membrane. This extends the life of the reverse osmosis membrane, reduces downtime due to cleaning and increases the availability of a constant water supply as it provides the brewery with the desired brewing water.

Step 2: Reverse osmosis

The process of reverse osmosis has been tried and tested in breweries for many years. The process principles need not be explained in detail at this point. Reverse osmosis produces desalinated water, the so-called "permeate," which is blended with ultrafiltered city water at a predefined inclusion rate.

The reverse osmosis plant at SFBT is designed for 60 m^3/h permeate plus 5 to 15 percent waste. Electromagnetic flow transducers include a highly accurate conductivity measurement in the permeate and in the brewing water to enable fully automatic operation and ensure that permeate conductivity remains within the required range of 150 to 300 µS/cm after being blended with raw water. The plant has 54 DOW Filmtec XLE-440 membranes.



HMI of the reverse osmosis plant

These membranes enable energy-saving operation at relatively low pressures.

To lower raw water pH values, acid is added. The primary purpose of reducing the pH value is to avoid calcium carbonate deposits in the system and to increase system efficiency. Higher efficiency is necessary in order to control costs and provide the brewhouse with properly treated water.

Mineral deposits on the membrane surface must also be avoided. For this purpose, anti-coating agents are added to the water ("anti-scalant dosage"). These are polymeric compounds that surround mineral particles, preventing precipitation.

Free chlorine damages membranes. By adding sodium metabisulfite to the water, chlorine can be removed by chemical reaction. Usually, 3 mg of sodium metabisulfite suffice to neutralize 1 mg of free chlorine. Sodium metabisulfite

Ultrafiltration plant

HMI with water treatment plant values

dosing takes place immediately after the antiscalant is introduced. Reverse osmosis, like ultrafiltration, is CIP-cleanable. Both systems are cleaned using a 40-hl-CIP-tank, also supplied by Centec.

Automization and system control

Water treatment is a very complex and critical part of the manufacturing process. Minor variations in water quality can deliver significant impact, yet can also be costly.

The membranes used are not immune to malfunction and replacement can be costly and time consuming.

Centec systems are largely self-monitoring and have a proven, application-specific alarm management system. Each water treatment system generates a complex dataset via integrated measuring instruments. To maximize system efficiency and ensure highest system reliability, relevant data is processed automatically. Essential data includes temperature, pressure, flow rate and analytical parameters such as conductivity, pH and water redox.

The data is used to determine auxiliary quantities for evaluating the functionality and performance of the central processes. These variables are, for example, “permeability” for evaluating the ultrafiltration stage, as well as “normalization” for classifying the state of the reverse osmosis system. These guiding parameters provide information about the condition of the membrane and evaluate the effectiveness of the presets for backwashing and cleaning intervals.

In particular, when operating conditions such as raw water quality and water temperatures, for example, are subjected to noticable fluctuations, these calculations become very important. The actual condition of the plant is evaluated and corrective measures (for example, membrane cleaning) initiated. Parameters are stored, trends evaluated and warning signals issued to the system operator. This prevents unplanned downtimes as it prolongs service life to avoid product loss and unnecessary costs.

Summary

Supplying fully automatic, frame-mounted water processing equipment and high-precision measuring instruments, Centec has an almost unique product range. In the cold area of the brewery Centec systems are in use at all global brewery groups and on all continents. The water treatment division is an ideal addition to Centec’s supply inventory and has seen significant growth in recent years. □

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