ChemScan® Process Analyzer

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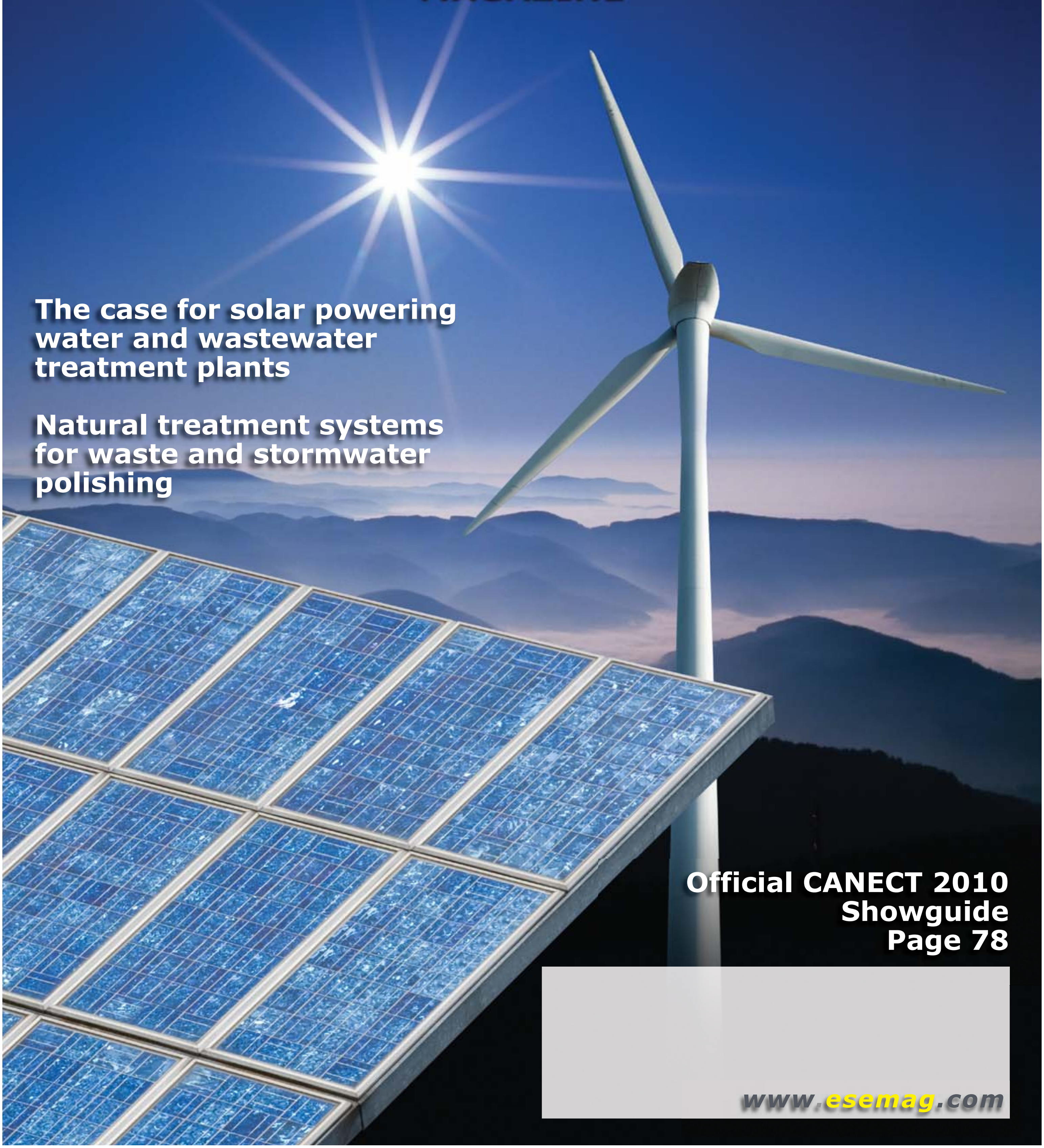

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Online process analyzer installed at F.J. Horgan WTP to monitor chloramination

By Dave Marsh

Construction was completed on the City of Toronto's F.J. Horgan Water Treatment Plant in 1979, more than 60 years after chloramine had first been used to disinfect drinking water in an Ottawa plant. By then there was little debate about the benefits of chloramination and it was incorporated into the new plant's design as part of the disinfection process.

Chloramine is more stable than free residual chlorine and better extends the disinfectant residual throughout the distribution system. It also has been shown to reduce the formation of trihalomethanes and halogenic acetic acids, while reducing taste and odour problems associated with chlorine. It is also relatively inexpensive to produce. However, producing chloramine requires precise control of the process, which has been a challenge that has long delayed its widespread use as a disinfectant.

Recently the F.J. Horgan WTP plant installed an online chloramination analyzer to help monitor and optimize its chloramination process. After researching leading analyzers, plant operators selected the ChemScan Model UV-2150/S, manufactured by Applied Spectrometry Associates Inc., which monitors the four key parameters necessary to maintain tight control of the process: monochloramine, free ammonia, total ammonia, and total residual chlorine.

The ChemScan allows for the acquisition of two samples from two different sampling points. One sample is taken after the addition of sulphur dioxide for residual chlorine reduction, the other prior to chloramination of the finished water. Knowledge of these four parameters provides the plant operator with the information necessary to determine where the plant is operating on the breakpoint chlorination curve.

The unit was officially commissioned at the F.J. Horgan WTP in April 2009, following extensive pilot testing at the plant.

Challenges of chloramine production

Chloramine is formed by mixing ammonia with free residual chlorine in a complex process depicted by the breakpoint curve that separates the chloramination process into a series of steps.

In the early stages of the process, ammonia added to free residual chlorine produces monochloramine. When the process is optimally controlled, all of the ammonia and available residual chlorine are combined to form monochloramine. However, inefficient process control will result in an imbalance between the amount of ammonia and the amount of residual chlorine, each creating its own set of potential problems.

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Excess residual chlorine continues to combine with monochloramine, converting it to dichloramine. The remaining residual chlorine then combines with dichloramine to form trichloramine. Plant operators lacking access to fast, reliable chloramination chemistry data will likely first hear about the problem from customers who complain about unpleasant tastes and odours from their tap water, which are typically associated with these undesirable chloramine species. While the drinking water is safe for consumption, these characteristics make it aesthetically unpleasant.

The other type of chemistry imbalance is excess free ammonia. When allowed to enter the distribution system, it will eventually cause serious problems, such as nitrification, algae growth, dissolved oxygen deficiency, and corrosion, which are difficult to detect.

Production of a given concentration of monochloramine, while avoiding the formation of dichloramine and trichloramine, or the accumulation of excess ammonia, requires adding precise amounts of ammonia and chlorine. In order to be successful, operators need timely and current information on key process parameters to make the necessary adjustments.

This is what the new chloramination analyzer provides at the F.J. Horgan facility. It enables plant operators to monitor the chloramination process precisely and provide the data necessary for proper adjustment of the ammonia and residual chlorine ratios, before dichloramine forms.

Challenges of raw water quality

The F.J. Horgan WTP has a nominal rated capacity of 450 million litres of water per day, drawing its raw water from an intake pipe that extends 3 km into Lake Ontario. Prior to installing the new online analyzer, plant operators had been using a residual chlorine analyzer, in conjunction with grab samples, to mon-

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itor the process. These methodologies do not take into account the seasonal effect of pH, temperature, dissolved organics, and disinfection demand of the raw lake water, which affect the chloramination process. They add more complexity and make it even more critical for plant operators to have access to timely process chemistry information.

The varying raw water quality at the F.J. Horgan plant is a challenge shared by many North American surface-water treatment plants that still use grab sampling to control their chloramination processes. This becomes particularly problematic during the season when runoff carries large amounts of animal waste and organic matter into the surface-water source.

Treatment plants fed by groundwater can also be affected by inconsistent water quality. Groundwater can be contaminated by fertilizers and other contaminants, creating a high background ammonia concentration in the water. Using an appropriate online analyzer can help adjust to these changing conditions by providing a rapid automatic analysis of the key chloramination control parameters, including free ammonia, total ammonia, monochloramine and total residual chlorine.

Real-time analysis allows the plant operator to adjust the water chemistry promptly. Adjustments can be accomplished automatically using a plant SCADA system. While multiple grab samples throughout the day provide good information for plant operators, an online process chloramination analyzer helps provide timely information to make adjustments to the water chemistry.

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To operate at the optimal residual chlorine to ammonia nitrogen ratio, the chloramination process needs to be constantly monitored with the appropriate parameters; a single parameter may not be adequate. For example, the same total chlorine reading can be obtained at different locations on the breakpoint curve. Monitoring multiple parameters, such as free ammonia, total ammonia, monochloramine and total residual chlorine, helps to determine the actual chlorine to nitrogen ratios, the concentration of total chlorine and the amount of total chlorine that is actually in the form of monochloramine.

Today, the ChemScan analyzer provides an early warning if too much chlorine is being fed, and plant operators can adjust the process before taste and odour compounds form.

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