Closing the water cycle

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Credit: SA Water

Combining advanced wastewater treatment technologies may enable industrial companies to use water in a more sustainable way. But the approaches are mainly suited for high-income countries.

Clean freshwater faces various threats such as increasing demand by population growth, pollution and changes in the hydrological cycle due to climate change. According to the United Nations World Water Development report, a country's industrial water use increases with its income. It ranges from 5% in low-income countries to over 40% in some high-income countries. Thus, water use is an important issue for a country's sustainable development.

The main water consuming activities include those from the textile, chemistry, paper and food industries. The EU-funded AquaFit4Use project, that ended last year, aimed at developing new approaches for a sustainable water supply and use in these industries. Such technologies should enable an increased reuse of water, thereby reducing freshwater needs. And, ultimately, closing the water cycle.

One approach tested during the project was an advanced oxidation process (AOP) using ozone and hydrogen peroxide as part of a combination of independent remedial technologies for cleaning industrial wastewater at two pilot sites. The first is a chemical plant owned by Swedish company Perstorp and the second a paper mill in Southern Germany. Ozone has been used for disinfecting drinking water for more than a century and is also used for treating wastewater.

The challenge of the project was to combine existing technologies to address the needs of the industrial partners rather than developing new technologies, Jörg Mielcke tells youris.com. He is a senior scientist at Xylem in Herford, Germany, a company specialised in fluid technology and equipment solutions for water issues. Developing criteria such as which water quality is needed for certain reuse purposes was "hard work," he notes.

"Using ozone, we can specifically alter the water quality," Mielcke explains. Combined with other treatment processes, it improves the water quality by cracking refractory organic compounds and micro-pollutants. It also reduces colour and unpleasant odour. The combination of treatment used in the pilot study in Sweden produced water of such quality that it could be reused as cooling or wash water within the production. However, the company did not adopt the new technology. In contrast, the paper mill company "has come to appreciate ozone," Mielcke tells youris.com and uses it for detoxifying but not recycling wastewater.

Experts regard such projects as essential. "Research is fundamental for both optimising and finding new solutions," says Giorgio Bertanza, professor of sanitary-environmental engineering at the University of Brescia, in Italy. But he is also sceptical: "Based on my experience, among numerous technologies which are proposed by researchers, only a few find practical applications."

Other experts consider ozone as a suitable tool for treating industrial wastewaters under certain conditions: "Many recycling processes nowadays use membranes to filter the water. The advantage of AOPs is that no residual concentrate is produced," says Sven-Uwe Geißen, professor of environmental process engineering at the Technical University Berlin, Germany. This may be a key factor for companies, for example, wishing to keep their locations in emerging economies such as China or India where "zero liquid emission" may be required.

Middle-income countries with an urgent need for sustainable water use due to the arid climate, such as in North Africa, may adopt water reuse technologies within the coming five to ten years, Geißen remarks. But "the AOP-technology is energy-intensive," Geißen adds, and therefore not suited for low-income countries or more local industries. He also points at a dilemma: "Each technology for recycling water also leads to higher CO2 emissions." Thus, in the future, for each purpose and each location, water reuse and CO2 emissions have to be weighed against each other.

Whether a company may adopt water reuse technologies is mainly a matter of costs, Bertanza believes. These in turn depend on water availability and quality, as well as on the price for drinking water, which already varies greatly within Europe. He does not believe that such technologies may benefit low-income countries, however. "They have other priorities and water consumption is very low, in comparison to our countries," he says.

Mielcke also acknowledges the drawbacks: "[The ozone technology] is only applicable if there is plenty of electricity. The project did not provide low-budget solutions," he says. However, he is still confident that the proportion of water reused within industrial plants will increase in the nearer future. He concludes: "The project has shown that it is possible."

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