Water reuse and long-term supply solutions

Thys Els is currently leading Veolia's Technical Department, which is responsible for deployment of Veolia's circular economy solutions for Water, Waste and Energy management.

MechChem Africa talks to Thys Els, technical manager at Veolia Services Southern Africa, about water reuse and the innovations that could help us to overcome short- and long-term water scarcity, discharge quality and treatment capacity issues.

Windhoek became the home of the first ever direct potable reuse (DPR) water treatment plant when the Water Reclamation Plant at Goreangab was commissioned in 1968. "This was the first plant in the world to process municipal secondary effluent directly into potable drinking water. While no potable reuse guidelines were available at the time, literature from the time identified specific processes with the ability to remove the constituents of concern. As such, an extensive pilot study was conducted from 1962 to 1965 in order to prove that a multi-barrier treatment approach is effective in removing microbial contaminants," Veolia's Thys Els tells *MechChem Africa*.

In the 50+ years since then, this pioneering plant has been continuously delivering safe drinking water to the water-stressed city of Windhoek. With an initial capacity of 4.8 Mℓ/day, the Goreangab plant has been upgraded several times over the years: to 7.2 Mℓ/day in 1986; to double that capacity in 1994; and, in 2002, a new plant was commissioned with a capacity of 21 Mℓ/day of direct potable reuse water.

The plant is now called the New Goreangab Reclamation Plant and it is operated on behalf of the Windhoek Municipality by a public-private partnership called the Windhoek Goreangab Operating Company (WINGOC): consisting of Veolia, the majority shareholder; and VATech Wabag, who constructed the new plant.

The New Goreangab Reclamation Plant incorporates several additional modern barriers; including pre-ozonation at the input stage; Dual Media Filtration, which follows Dissolved Air Flotation; a primary ozonation stage; Biologically Activated Carbon (BAC) to supplement a Granular Activated Carbon (GAC) stage; as well as Ultrafiltration as the final barrier in this multi-barrier approach.

As with any direct water reuse scheme, water quality monitoring is a critical component. "As well as incorporating water quality validation and treatment integrity tests through Critical Control Points monitoring, Veolia also has vast experience in conducting bioassays and chemical footprint analyses at facilities across the world, including Goreangab," Els explains. Tests are routinely done to prove that each process unit of the treatment system is intact, many of which can be automated on a pass/fail basis.

"Bioassays for example, specifically address the impact of micropollutants on cells, such as genotoxicity, mutagenicity and endocrine disruption to name a few, while the chemical footprint quantifies the presence of pharmaceutical and other industrial contaminants. Through this continuous monitoring and validation we are demonstrating that the DPR plant is in fact producing water to the safest possible standards," he assures.

The New Goreangab Reclamation Plant, which was completely rebuilt and modernised in 2002, can now deliver 21 Mℓ/day of direct potable reuse water.

Industrial water recycling and reuse

One big advantage of Windhoek's water infrastructure, continues Els, is that municipal and industrial effluent have been kept separate. This means that the plant's feedwater is not constantly changing due to unknown industrial influences. "If the feed is routinely changing, the treatment reliability can be compromised, which is unacceptable for potable reuse facilities.

"Industrial effluents can often be variable by nature, both from quality and quantity perspectives, which results in variable feed water quality to the downstream wastewater works. In most instances, the wastewater works are designed to treat municipal sewage, which implies that the performance of the works can be compromised if it receives variable, and often challenging to treat, industrial effluents. Since the performance of the reuse plant is directly affected by the performance of the wastewater plant, any risk to the operation of the wastewater works should be mitigated as early as possible. Through its global footprint, which reported approximately 990 Mm^3 water recycled in 2022, Veolia has proven experience in assisting with the compilation of Water Safety Plans (WSP), which form the basis of any successful direct or indirect water reuse scheme (DPR/IPR). These typically start with the feed source definition to define the process streams and, where possible, ways to isolate industrial effluents from the feed supply.

To ensure microbial safety of the water, the plant at Goreangab utilises ultrafiltration as the final physical barrier in a multi-barrier approach.

"In addition, we believe that water reuse for industrial use can be highly cost effective and should really be expanding," Els continues. For the past 22 years, Veolia has been operating the Durban Water Recycling (DWR) plant in KZN, which it also constructed, where sewage is being treated to industrial water quality for use as utility, process and cooling water for local industries such as papermaking. "This comes in at a fraction of the price of using municipal potable water. Our drive in South Africa should be to provide industry with directly suitable quality, rather than having to rely on expensive and scarce potable water for industrial use," he notes.

"While wastewater treated to environmental discharge level is usually not quite good enough for industrial use, it is always less costly to produce industrial quality water than to take the water quality to potable standards," he confirms.

"While the DWR example showcases the possibilities on a relatively large scale, the implementation of decentralised reuse solutions, such as at an industrial park level or for rural areas, could be equally successful. In all instances, the approach should be to produce the water that is fit for purpose," he notes

Industrial water recycling is another key opportunity. "We now have several successes in the dairy industry for example, in the treatment and beneficiation of process effluent streams. "As well as treating the wastewater for reuse through our patented Memthane® technology – which combines anaerobic biological treatment and membrane separation – we are also able to generate methane-rich biogas as a valuable by-product.

"The Memthane® technology maximises COD removal and, therefore, biogas yield, with the biogas being used instead of coal to fire boilers. In addition, the process generates a filtrate that is of adequate quality to be forwarded to a Reverse Osmosis system for desalination, without the need for additional treatment steps.

"While the valorisation potential of industrial effluents to produce a valuable by-product such as biogas often plays a vital role in defining the feasibility of industrial water recycling, the positive impact of securing operational sustainability becomes much more important. " Els adds.

Management of non-revenue water (NRW)

Producing potable water is both energy intensive and increasingly expensive. Yet in South Africa, 41% of the income for the drinking water produced is either lost through leaks, or not being used by a directly paying client. Of these losses, 35% of that 41% is due to leaks. "While there are certainly success stories, with various municipalities reporting NRW levels near the global best practice of 15%, many areas of South Africa are faring much worse," notes Els. This is a global problem, though, for which Veolia offers a number of mitigation solutions. "The starting point is to develop a macro level map of the entire water supply and reticulation network. We can then offer revenue-optimisation services in innovative ways: installing smart metering; doing leak detection at critical points; implementing pressure modulation schemes; and identifying key metering points to give an accurate and continuous view of where the leaks are, where the water is going, and who to charge for it," he explains. "In New York City alone, for example, we realised US$44-million in annual savings in 2016, and the payback periods on the costs of implementing Veolia's comprehensive NRW services could typically be less than one year," he adds.

An industrial wastewater treatment facility that uses Veolia's Memthane® technology for optimal treatment of organic contamination and for reuse purposes.

"There is no doubt that South Africa is a water-scarce country and that it is likely to be further adversely affected by climate change and population increase. In addition, our wastewater infrastructure is aged, while the power crisis and the lack of backup power often results in wastewater treatment plants having to pass untreated sewage directly into the river systems or the sea. This, inevitably, poses a risk to downstream water users."

"Veolia has proven long-term supply solutions, though. Plants can be upgraded and efficiently and economically run through PPPs; our municipal and industrial wastewater can be safely reused, either directly or indirectly, resulting in much more efficient use of our limited resources; and we have the planning and management experience to better reduce water and income losses due to leaks and metering failures," concludes Thys Els.

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