

# WASTEWATER REUSE: A SOLUTION WITH A FUTURE

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Windhoek wastewater recycling plant - ©Veolia

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Veolia's Africa and Middle East zone employs 9,000 people across 15 countries, providing the resources needed to ensure the wellbeing of communities, to make regions attractive and underpin the performance of businesses. It generates annual revenue of €1 billion.

A combination of water stress, fast-growing populations and the climate emergency means many African countries struggle to provide their people with sufficient clean water. For these countries, in addition to saving water, the solutions lie not so much in sharing a scarce resource as in turning to non-conventional alternative water resources, for example seawater or wastewater in place of raw water from rivers or aquifers. It is little surprise that we are seeing the emergence of ever more projects to give water a second life. Reusing wastewater seems to be the most effective bulwark against scarcity.

Recycled wastewater is the only resource that increases in step with economic growth. It is a virtuous solution that protects nature by limiting the risks of pollution discharges into the environment. It is a circular economy model that strengthens countries' water self-sufficiency by giving them access to a reliable resource located within their territory, and therefore protected from adventurous neighbors.

Veolia has developed innovative solutions for reusing wastewater in industry and agriculture as well as the home. One of the pioneers is the Namibian capital of Windhoek, where 35% of the drinking water needs for the city and its surrounding area are met using recycled wastewater. Is this a pointer to the future?

## INTRODUCTION

"In Windhoek, every drop of water counts" is the motto of the Namibian capital. Namibia is one of the world's most arid countries, traversed by the Kalahari and Namib deserts and bordered by the Atlantic Ocean to the west. In Namibia, heat causes 83% of rainwater to evaporate, with just 1% absorbed into the ground. With chronic water stress and no nearby water courses, in 1968 the city decided to recycle wastewater for reintroduction into its water supply network, making it the first city in the world to reuse domestic wastewater for human consumption.

The policy provided an additional water source for over 20 years, but was soon under pressure from Windhoek's rapid population growth following independence in 1990. In 2002, a new treatment plant was built and handed over to Veolia to operate. With a daily capacity of 21,000 cubic meters, the plant currently supplies over a third of the city's drinking water in the form of tap water used by almost 400,000 residents.

## MULTIPLE-BARRIER TREATMENT REPRODUCES THE NATURAL WATER CYCLE

Windhoek's water treatment plant uses cutting-edge technologies that mimic nature to eliminate all possible health hazards. Domestic effluents are first treated in the City wastewater treatment plant (WWTP) using an activated sludge process and maturation ponds. They then pass into the DPR (Direct Potable Reuse) plant where several treatment steps mimic the natural water cycle and ensure a water quality that meets the world's highest standards. A number of innovative technologies have been deployed, including biological filtration and granular activated carbon filtration. Critically, the multiple barrier technique reproduces the natural water cycle in several phases: pre-ozonation, coagulation/flocculation, floatation, sand filtration, ozonation, filtration, activated carbon adsorption, ultrafiltration and chlorination. These different phases have the advantage of eliminating a number of the primary elements in wastewater, such as physical and organoleptic elements, macro-elements, and microbiological and disinfectant by-products.

The resulting potable water is subject to permanent quality controls. This is key to the safety of water sources as well as to public trust. All routine testing – physical, inorganic and organic chemistry, microbiology and viral indicators – is carried out in the city's analysis laboratory. There is also a program for managing health risks that feeds into a number of research projects. These encompass advanced testing for virology, parasites, toxicity, pesticides, algae toxins, etc.,

carried out by third-party laboratories. And as the plant is fully automated, an online sampling system is located in each primary treatment unit to provide continuous inspection of turbidity, pH, conductivity, dissolved oxygen, chlorine, etc.

In total, it takes around 10 hours from the moment wastewater arrives at the treatment plant to the moment it leaves as drinking water. This high-quality recycled water resulted in the installation of new water distribution points in townships, helping to improve the health and safety of residents.

The Windhoek treatment plant has become a global benchmark and a model for innovative and sustainable water management. It is also an example of a successful public-private partnership that is increasingly visited by officials from across Africa as well as numerous experts from Australia, Singapore and the USA.

## UNTAPPED POTENTIAL CAN PROVIDE ACCESS TO WATER FOR MOST PEOPLE

The Windhoek case is the longest-running and most emblematic project for the direct reuse of treated wastewater for the production of drinking water for human consumption. But direct reuse of wastewater without a passage via the natural environment remains extremely rare. Worldwide, only 4% of wastewater is recycled. And it is a resource most commonly destined for uses other than tap water.



Wastewater goes through multiple barrier treatment at the Windhoek reuse plant - ©Veolia

The full potential of wastewater remains very much under-exploited. But this is a “new black gold” according to a 2017 UN report on wastewater released to coincide with World Water Day. The report’s authors suggested that we should think of wastewater as a resource. Reuse is an inescapable solution if we are to limit the ballooning demand for water caused, in every corner of the planet, by population growth, better living conditions in developing economies, urban growth and the demands of agriculture.

Water is a resource under pressure and, although the first response is to optimize consumption, reusing recycled wastewater is a way to protect this resource. Take agriculture as an example. The use of recycled wastewater for irrigation represents 32% of the global market, but this use could become far more systematic. Wastewater is rich in nitrogen and phosphorus so it can provide nutrients to crops. The critical challenge for agricultural irrigation is to preserve a portion of the nitrogen and phosphorus contained in the wastewater, because these are valuable nutrients for plants. This also avoids using fertilizers that are energy- and resource-intensive to manufacture, particularly with phosphorus potentially in short supply by 2050.

Providing access to water to the majority of people while also protecting the environment is a twofold objective that wastewater reuse delivers – it is a solution with a future.

After irrigation for agriculture, reuse is primarily focused on watering green spaces (20%) and in manufacturing (19%). To recycle water is to boost its productiveness. This is a key issue for manufacturers when you consider that it takes 400,000 liters of water to make a car, 11,000 liters to make a pair of jeans and 1,300 liters for a cellphone. This is what we are doing in Durban, South Africa, where we recycle 98% of the wastewater from the city’s Southern Wastewater Treatment Works (SWTW) for reuse by manufacturers in their production processes.

Veolia put this virtuous solution for adapting to the climate emergency in place as part of South Africa’s first ever public-private partnership.

Recycling water for industrial applications means less water has to be taken from the natural environment and freshwater resources can be reserved for the production of drinking water. The plant can indeed provide an additional capacity of 47,000 cubic meters of drinking water each day, equivalent to 13 Olympic-size swimming pools.



In Durban, wastewater is reused for industrial purposes - ©Veolia

And as water can account for as much as 15% of industrial costs (process water, hot water, air conditioning, washing, etc.), the reuse of recycled wastewater is a fantastic opportunity in terms of cost control: the Durban-based manufacturers partnering with the project save over €5 million a year.

The time has come to think differently about the water we drink, the water that is used to irrigate fields, water parks and gardens or as part of industrial processes, before it is returned to nature.

There is, however, no escaping the fact that this alternative solution will develop at different rates in different parts of the world, reflecting the specific requirements of each local regulatory environment. It also suffers from problems of social acceptability and, despite all the economic and environmental advantages, projects involving reuse of wastewater can be a source of concerns. Recycling equates to waste reuse and, no matter its potential, this is something that remains unacceptable for certain religious or cultural reasons. In all cases, these types of projects have to be backed by the full range of educational and awareness-raising measures that are vital to gaining the trust of all stakeholders concerned. Responding to community anxieties is absolutely critical.

## CONCLUSION

The Windhoek experience demonstrates that it is possible to boost a city's drinking water supply by using recycled wastewater in a safe and responsible manner. However, operating wastewater retreatment plants requires exemplary professionalism and faultless reliability. These are preconditions for ensuring consumers' health.

Depending on uses and needs, wastewater treatment plants could provide water of a quality suited to every situation. Regulations permitting, we can provide high-quality drinking water in this way thanks to innovative treatment and surveillance technologies that guarantee the absence of any risk to human health.

Under these conditions, are we ready to put our worries and taboos to one side and use recycled wastewater on a daily basis? It all depends on the planned uses, of course, but growing awareness of the environmental emergency and fears of water stress, coupled with technologies that are now mature, should mean that reuse cements its position as an effective solution for guaranteeing access to water in the years to come.

This is a solution for the future in all parts of an African continent experiencing a population boom that, according to the UN, will mean that 75 to 250 million people will be living in regions grappling with major water stress by 2030.

# Wastewater for city watering: an innovative partnership between the city of Tangier and Amendis (Veolia)

Interview with Driss Riffi Tamsamani, Vice-President of Tangier municipality

The Tangier region is suffering from the climate emergency and seeing annual population growth of 3%, leading to a 67.7% fall in water reserves behind the Ibn Battouta and 9 Avril dams in 2020. Working with Amendis, you have rolled out measures to manage the urban water cycle, including treatment and reuse of wastewater from the Boukhalef treatment plant, used for watering royal and private golf courses and municipal green spaces. Looking back, how would you sum up this solution implemented five years ago to adapt to climate change?

Under the terms of our national water strategy, reused wastewater is a major non-conventional water resource. Its recovery and reuse has to happen within the overall regional integrated water resources management policy. Since 2015 the city of Tangier, with over 400 hectares of municipal green spaces and levels in our water reservoirs falling year by year, has opted to phase in reuse of wastewater for watering golf courses and municipal green spaces.

## Phase 1:

This phase was unveiled by His Royal Majesty on October 6, 2015. It provides watering for 110 hectares of green spaces at the Qatari Diar golf course thanks to commissioning of the Boukhalef tertiary treatment plant (10,700 cubic meters treated a day), the installation of an 8 km pipe network and construction of a 5,000-cubic-meter reservoir and a 120 liter-per-second pumping station.

## Phase 2:

This phase aims to extend the reuse network toward the city center, from the Boukhalef treatment plant, for watering municipal green spaces and the golf course at the Tangier Royal Country Club. This phase includes delivery of several projects, including:

- creation of twin 6,000 cu. m storage reservoirs;
- construction of a 120 liter/second pumping station;
- installing around 21.5 km of pipe.

It also includes creating a second tertiary treatment unit at the Boukhalef plant. Construction began in 2017 and is currently in its final phase. This phase aims to provide



Boukhalef wastewater treatment plant operated by Amendis - ©Veolia



Wastewater from the Boukhalef treatment plant is used for watering golf courses and municipal green spaces in Tangier - ©Veolia

watering for 128 hectares and entered partial service in 2019. As of now, some 115 hectares in the municipalities of Tangier and Gzenaya, including 70 hectares at the Tangier Royal Country Club, are watered using treated wastewater. Work is still in progress to roll out watering to the outstanding 13 hectares during 2020.

#### Phase 3:

This phase aims to ramp up output to 32,000 cubic meters daily, the current capacity of the Boukhalef wastewater treatment plant, and to extend the watering network to the remainder of the city for watering around 150 additional hectares. Work to extend the treatment plant is now in its final phase and studies for extending the watering network are at the preliminary design stage.

To sum up, reuse of treated wastewater now allows watering of 225 hectares of private and public land in the city of Tangier. This is about 39% of the total area of golf courses and municipal green spaces identified in the city. It has led to savings of around 3 million cubic meters of raw water over the years 2016 to 2019. For 2020, we project savings of around 1.5 million cubic meters of raw water.

**The Kingdom of Morocco aims to reuse 325 million cubic meters of wastewater a year by 2030. What are your views on this ambitious target for water reuse and the green economy?**

Morocco is located in a region suffering water stress and is vulnerable to the effects of the climate emergency. Morocco has made the green and inclusive economy a strategic pillar of its sustainability policy. This green economy is required to respect ecological balances and must be designed to pave the way to the creation of new opportunities for wealth creation and long-term employment. Institutional, regulatory and financial reforms as well as incentive measures are already in place to help improve integration of environmental factors and spur growth in strategic sectors such as renewable energy, energy efficiency, water saving, sustainable management of solid and liquid

wastes, inclusive agriculture, aquaculture and eco-tourism. Against this background, the national water strategy aims to manage water demand and reuse, focusing mainly on improving drinking water distribution network efficiency, using less water for irrigation, managing and extending the services offered, and conserving and protecting water resources, the natural environment and fragile zones. Morocco has set itself the ambitious target of reusing 325 million cubic meters of water annually by 2030.

**On what terms, and for what uses, is wastewater reuse permitted in Morocco?**

Wastewater reuse is a solution for the future to combat water scarcity. After treatment, wastewater can be used for a variety of applications including watering green spaces and golf courses, crop irrigation, fire-fighting and street-cleaning, or it can be used to recharge aquifers. The new water law, 36-15, strengthened the legal framework surrounding wastewater reuse (chapter V, section one, articles 64-71). Operators and owners of wastewater treatment plants and authorized standalone sanitation plants that reuse wastewater are eligible for financial aid from the water basin agency, in accordance with conditions set out in the legislation.

**In your view, is wastewater reuse a solution that can create synergies between the public and private sectors?**

Morocco is determined to mobilize every actor and set up innovative public-private partnerships that will increase amounts invested in projects that respect the environment and are likely to create value-added and lasting employment. The reality is that reusing wastewater is an expensive solution that delivers low returns. This is why it is so important to mobilize all forms of public and private investment when attempting to deliver the related infrastructure. It also demands innovation, research and the use of sophisticated technologies. The Tangier case is one example of such a partnership.