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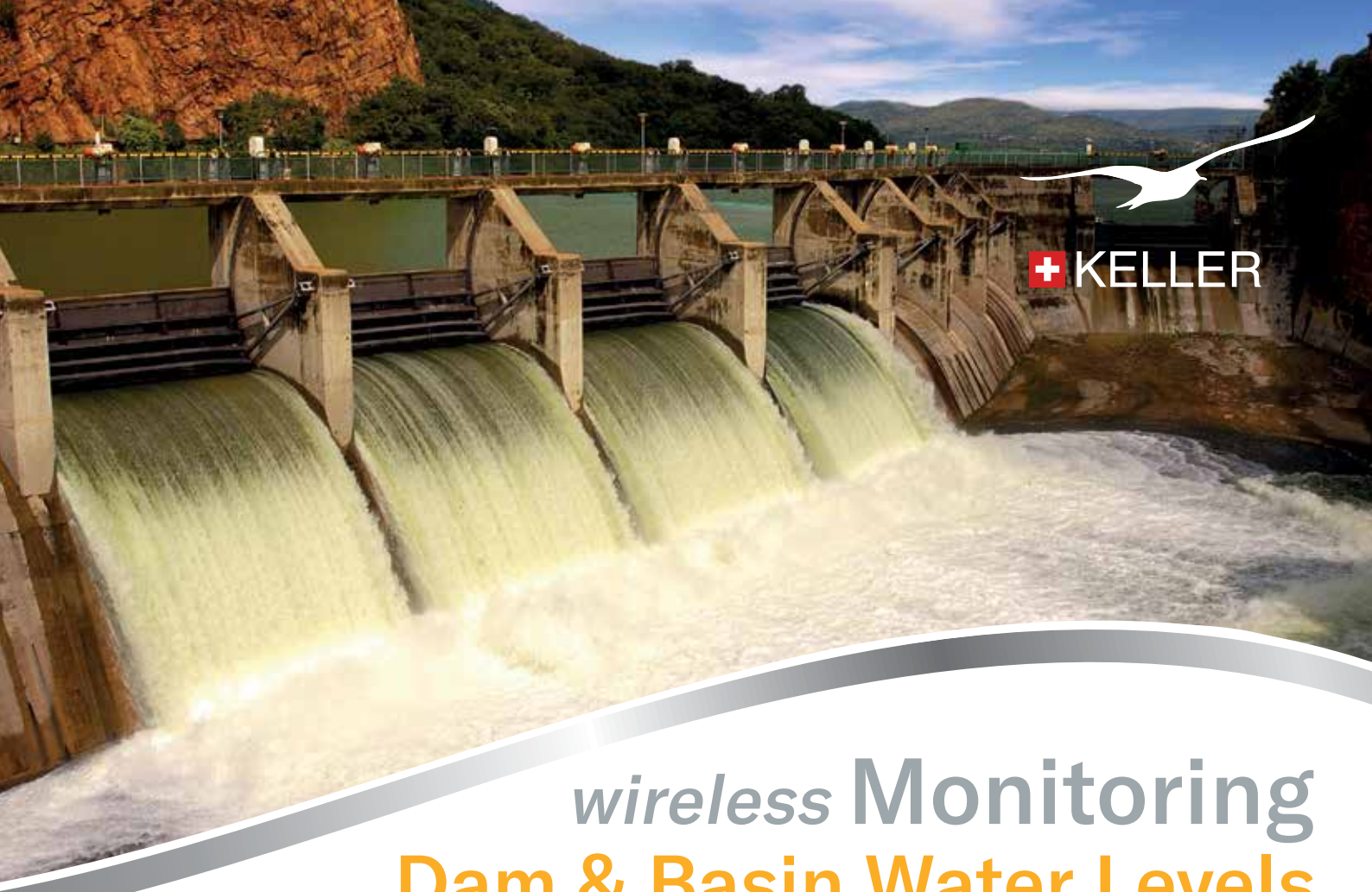

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ON THE COVER

Well-laid plastic pipe has a maintenance-free work life of more than 50 years, and a century in some cases. Built on years of innovation and experience, Sizabantu's PVC-O pipes present the ultimate future for water and sewer infrastructure. **P4**

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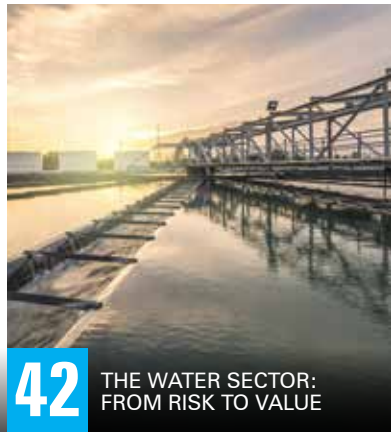

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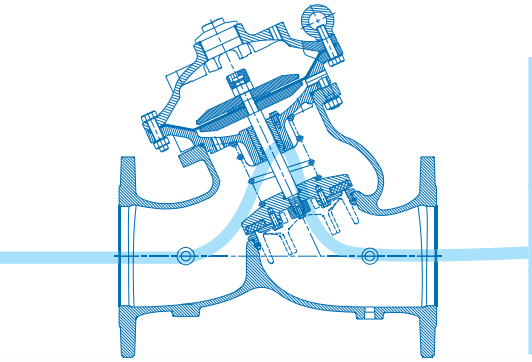

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Editor Danielle Petterson
danielle.petterson@3smedia.co.za
Managing Editor Alastair Currie
Head of Design Beren Bauermeister
Chief Sub-editor Tristan Snijders
Contributors Tinashe Chipako, Lester Goldman, Derek Hazelton, Ayesha Laher, Joyce Moganedi, Alex McNamara, Dan Naidoo, Mike Smart
Operations & Production Manager Antois-Leigh Nepgen
Production Coordinator Jacqueline Modise
Distribution Manager Nomsa Masina
Distribution Coordinator Asha Pursotham
Group Sales Manager Chilomia Van Wijk
Bookkeeper Tonya Hebenton
Advertising Sales Hanlie Fintelman
c +27 (0)67 756 3132
Hanlie.Fintelman@3smedia.co.za

3SMEDIA

novus print

Publisher Jacques Breytenbach
3S Media
46 Milkyway Avenue, Frankenwald, 2090
PO Box 92026, Norwood 2117
Tel: +27 (0)11 233 2600 Fax: +27 (0)11 234 7274/5
www.3smedia.co.za

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subs@3smedia.co.za

Water Institute of Southern Africa

WISA's Vision
Inspiring passion for water

WISA Contacts:
HEAD OFFICE
Tel: 086 111 9472(WISA)
Fax: +27 (0)11 315 1258
Physical address: 1st Floor, Building 5, Constantia Park, 546 16th Road, Randjiespark Ext 7, Midrand
Website: www.wisa.org.za

BRANCHES
Central Branch
(Free State, Northern Cape, North West)
Chairperson: Dr Leana Esterhuizen
Company: Central University of Technology
Tel: +27 (0)51 507 3850
Email: lesterhu@cut.ac.za

Eastern Cape:
Branch Contact: Dan Abrahams
Company: Aurecon
Tel: +27 (0)41 503 3929
Cell: +27 (0) 81 289 1624
Email: Dan.Abraham@aurecongroup.com

Gauteng
Branch Lead: Zoe Gebhardt
Cell: +27 (0)82 3580876
Email: zoe.gebhardt@gmail.com

KwaZulu-Natal
Chairperson: Lindelani Sibiya
Company: Umgeni Water
Cell: +27 (0)82 928 1081
Email: lindelani.sibiya@umgeni.co.za

Limpopo
Chairperson: Mpho Chokolo
Company: Lepelle Northern Water
Cell: +27 (0)72 310 7576
Email: mphoc@lepelle.co.za

Mpumalanga
Chairperson: Lihle Mbatha (Acting)
Company: Inkomati-Usuthu Catchment Management Agency
Tel: +27 (0)13 753 9000
Email: mbathat@iucma.co.za

Western Cape
Chairperson: Natasia van Binsbergen
Company: AL Abbott & Associates
Tel: +27 (0)21 448 6340
Cell: +27 (0)83 326 3887
Email: natasia@alabbott.co.za

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Please contact the WISA Head Office on admin@wisa.org.za for more information

WINDS OF CHANGE

The world was turned on its head in 2020 when the Covid-19 pandemic swept the globe and disrupted life as we know it.

In South Africa, the pandemic and resultant lockdown highlighted the inequalities that persist in our society and the many people who still struggle without access to basic services like water and sanitation.

The WISA 2020 Conference, which took place in December 2020, served as a reminder of some of the many struggles facing the sector, while highlighting some of the innovations and solutions available (read more from page 14).

Unfortunately, we face many challenges: from funding shortfalls to a lack of political will to implement projects and a severe lack of maintenance. What's clear is the need to build a system capable of delivering services to all while protecting our limited resources. We must urgently pursue the objectives outlined in the National Water and Sanitation Master Plan if we are to turn the situation around.

The severe drought situation currently playing out in Nelson Mandela Bay is a stark reminder of the dire need to build a sustainable water system. If we do not begin to reduce our losses and consumption, while diversifying our supply, the Nelson Mandela Bay crisis may become a national one, particularly as climate change exacerbates our flood and drought events.

The world in 2021

It is uncertain what the future holds for us as many countries around the world experience second and third infection waves. The Covid-19 pandemic has highlighted the vulnerability of our modern society and, hopefully, taught us that we can no longer follow a business-as-usual approach.

It is encouraging to see some countries investing in green recovery plans to create jobs and cut emissions as they rebuild their economies. Our institutions, along with the private sector, must continue to lobby government and push for a just recovery from the pandemic that will lead to better service delivery for our communities.

While there have been many lows, the pandemic has also presented us with opportunities to build resilience, embrace change and reconsider the way we work. It is vital that, from this, we learn new lessons that will help us build sustainable organisations into the future.

New beginnings

It is with some sadness that I write my goodbye, as this will be my last editor's comment for **Water&Sanitation Africa.** I have, over the years, been inspired by the sector's genuine dedication to and passion for providing the vital services of water and sanitation to South Africa's communities.

Readers are in good hands with the new editor, Kirsten Kelly, who I am confident will continue to promote the excellent work that is being done in the sector and aid WISA in its mission of inspiring passion for water. 3S

Danielle

PVC-O pressure pipes stand the test of time

Around the world, research and development (R&D) initiatives present new possibilities for PVC pipes. South African manufacturer Sizabantu Piping Systems expands on the R&D evolution and its own contribution to growing the regional PVC market for water and wastewater, working together with Spanish technology partner Molecor.

By Mike Smart*

PVC pressure pipes were first used about 85 years ago and some 60 years ago, the first PVC sewer pipes were introduced into South Africa; they were not well received. Today, more than 95% of domestic sewer reticulation systems use PVC pipes – so things change.

The improvement in PVC's strength, driven by improved technology, is substantial: increasing from 10 MPa to 36 MPa as the material has metamorphosed through PVC-U (unplasticised), PVC-M (modified) and PVC-O (oriented). The 260% increase in the strength of PVC-O (Oriented Unplasticised Poly Vinyl Chloride: SANS 16422) pressure pipes provides a significant advantage to design engineers, their clients, and the people.

PVC-O was developed about 40 years ago. Molecular orientation results in the improvement of physical and mechanical properties of the material. Since inception, there have been five improvements in PVC-O material from Classification 315 to 500. The classification number is 10 times the MRS (minimum required strength) of the material that is obtained from its creep rupture curve at 50 years (438 000 hours), in accordance with the International Standards Organisation (ISO) protocol.

A 100-year-plus advantage

Classification 500 PVC-O material must have an MRS of not less than 50 MPa, which, with a design coefficient (C) of 1.4, gives an allowable design stress (σ) of 36 MPa (σ = MRS/C). This is a substantial improvement to twice the allowable design stress (σ) of PVC-M, made possible by improved in-line production technology, which Sizabantu Piping Systems' technology partner, Molecor, uses to produce its TOM® 500 PVC-O pipes. TOM is Molecor's registered brand name for its PVC-O pipes (from the Spanish *Tubería Orientado Moleculita*).

In Graph 1, the top blue curve is for TOM 500 PVC-O and exceeds the required 50 MPa at 50 years – it is 55 MPa. At 100 years (876 000 hours), the MRS is still 53 MPa, proving its service life exceeds 100 years, which is the service life now demanded by clients and consultants. This service life is more than twice the ISO protocol requirement.

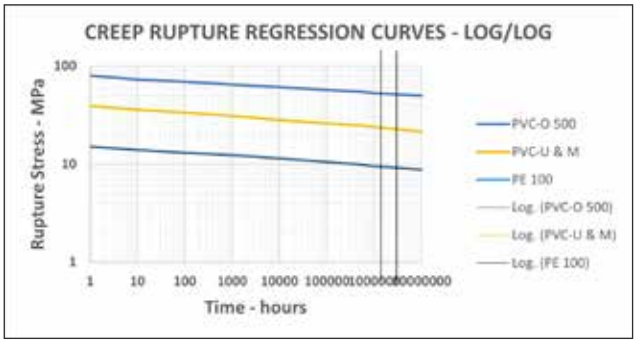
R&D advances

Innovation is one of Molecor's core values and, through appropriate technology, TOM 500 branded PVC-O pipes have increased the range of PVC-O pipes from the previous limit of 315 mm diameter class 16 to 630 mm class 25, with the M-OR-P3136 system in 2010; to 800 mm class 20, with the M-OR-P3180 system in 2013; to 1 000 mm class 16 in 2020; and to 1 200 mm class 16 in 2021, with the M-OR-P5012 system.

This track record of innovation, since their commencement in 2013, proves technological improvement is in their DNA. By April 2021, PVC-O pipes up to 630 mm in diameter will be produced locally by Sizabantu Piping Systems.

Sizabantu Piping Systems' PVC-O ecoFITTOM® fittings, another innovative first from Molecor, are available up to a 400 mm OD x 90-degree bend. Socketed steel fittings, with a 150 µm sintered epoxy coating, are also available up to 630 mm OD and with flanged ends for larger diameters.

These are exciting developments for the thermoplastic pipe industry, enabling it to compete in the large-diameter, high-pressure pipe market, which was previously beyond its capability. It enables Sizabantu Piping Systems to be equipped and ready to assist with service delivery challenges in South Africa.



GRAPH 1 Creep rupture regression curves

GRAPH 2 Infrastructure expenditure trends, 2014-2019 *(Credit: AHL Graph reproduced with kind permission of SAPPMA)*

NDP shortfalls and opportunities

The National Development Plan (21 May 2007) refers to a "lost generation of infrastructure" and notes that 30% of GDP was spent on gross fixed capital formation (infrastructure) in 1990; by 2007, this had decreased to 19% of GDP. It is currently about 6% of GDP. The pipe market shrank by 15% in 2014 and has not yet recovered. If the recommendations contained in the plan are acted upon and infrastructure – the government's planned driver of the recovery of the our economy – receives the priority and funds promised, the industry will recover.

The Preferential Procurement Policy Framework Act (No. 5 of 2000) resulted in a positive development for the thermoplastic piping industry, with a directive from National Treasury, effective 16 September 2019, that local production and content be given preference for pipeline projects – a step forward. Graph 2 shows the catastrophic effect the reduction in infrastructure spend has had on the construction industry and the 'knock-on' effect on suppliers to the industry.

The logical choice

PVC-O pipes are lightweight and do not require extensive plant to handle and lay, nor highly skilled, expensive coded welders to join them, thereby giving labour-intensive emerging contractors equal opportunity to be competitive in pipeline construction projects. Furthermore, they do not incur high capital and maintenance costs, or the cathodic protection that any pipe material containing ferrous irons requires. Other advantages include the list common to thermoplastic pipes, including zero corrosion, high impact strength (extremely high for PVC-O), negligible deterioration in the hydraulic friction factor, low celerity (extremely low for PVC-O), and embedded energy.

PVC technology has improved substantially in the last 85 years and, just as automobiles and computers have advanced exponentially in this time, so has PVC – and it's continuing to improve. These R&D breakthroughs have given the pipeline industry proven materials to use for large-diameter, high-pressure, bulk supply pipelines that steel and ductile iron historically dominated. This will serve as the catalyst for an increasing shift to PVC. 3S

**Mike Smart, Pr Eng, MSAICE, is a consultant at Sizabantu Piping Systems.*

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By April 2021, PVC-O pipes up to 630 mm in diameter will be produced locally by Sizabantu Piping Systems

LOCAL AND INTERNATIONAL COVERAGE

Sizabantu Piping Systems has a network of branches in South Africa that provides national coverage, together with an Exports Department that services SADC and other African countries. This commitment to service is supported by a local manufacturing facility in the Richards Bay Industrial Development Zone and the superior expertise of technical partner Molecor – the world leader in PVC-O pipe technology.

Investing in the future

Water professionals determine and contribute to the quality of the economy and public health, and provide dignity to communities. It is vital that we invest in our young professionals and equip them with the skills needed to drive the sector forward in a sustainable manner.

By Dr Lester Goldman

Dr Lester Goldman, CEO, WISA

Speaking during the opening panel discussion at the WISA 2020 Conference, Dr Allyson Lawless showed the significant growth in the number of young people employed in the public sector, including the water sector.

While this has, in some instances, meant a loss of technical and capacity and skills, it is also encouraging to see so many young professionals eager to take up the challenge of delivering water and sanitation services.

Skills development

According to the Energy and Water Sector Education and Training Authority's (EWSETA's) 2019/20 Sector Skills Plan, about 14% of the workforce in the energy and water sector is older than 55. As these individuals retire, the potential exists for a future gap of difficult-to-fill vacancies in a sector that is heavily dependent on high-level professionals and technicians.

In addition, there are not enough people studying engineering and graduates often do not have the prerequisite practical skills or experience. EWSETA further found that the standard of graduates from TVET colleges is perceived as being of low quality and not meeting industry needs.

It is vital that we place a renewed emphasis on our training authorities to ensure that they provide quality education and that we extend training opportunities to more people, particularly under-represented groups. However, training alone is not enough; we also need to ensure that the sector is able to employ graduates and provide mentorship opportunities. Mentorship has a key role to play and we must ensure that our older professionals pass on their knowledge and skills to the future generations.

Leadership

It is widely acknowledged that the development of leadership contributes greatly to the positive development of young people. The spiral impact of this greatly benefits our youth, their communities, and our country from an economic, social and education perspective, at the very least.

Leadership skills, such as goal-setting, problem-solving and sound decision-making, are not just necessary for leaders – these skills are needed for general success in today's world. They are necessary for us to achieve individual, organisational and sectoral goals. We must achieve our sustainability goals, and the only way to do this, as leaders, is through ensuring that we can institutionalise succession and continuity. Hence, we must start building mechanisms to transfer knowledge and skills, through programmes like mentorship.

Transformation

As we work to develop our young professionals, we must continue to focus on transformation objectives. EWSETA found that of 14 800 registered professional engineers in the sector, females constitute only 3%, while black individuals make up less than 12%. Approximately 2.4% of the workforce is disabled.

It is vital to ensure that more women and previously disadvantaged, as well as disabled, individuals are given the educational and mentorship opportunities to enter and remain in the sector.

Towards a sustainable future

The future of the water sector, and the country, lies in the hands of our youth. It is only through investing in them that we will create a resilient and sustainable sector moving forward. As we enter 2021, I challenge the sector to place a renewed emphasis on skills development, mentorship and leadership training.

I wish you all a prosperous new year as we work towards our goals of achieving a transformed and sustainable sector in the face of the Covid-19 pandemic. 35

TAKING A DECENTRALISED APPROACH

2020 was a year of intense disruption and change. As we enter 2021, we are offered an opportunity to reflect on our current systems and consider new, innovative and alternative solutions to some of our most pressing challenges. **By Dan Naidoo**

Dan Naidoo, chair, WISA

Many of our water and sanitation solutions to date have focused on a traditional, centralised approach. This is often driven by a belief that working at scale reduces unit costs and offers easier and cheaper operation. The result is massive infrastructure spend and long-term implementation.

But this poses several challenges. First, in our current constrained economic climate, the massive costs of large infrastructure roll-out prohibit these projects from being implemented. Risk is also a major factor for investment, and with local government's risk factor currently very high, securing funding sources presents a major challenge due to poor payment for services.

In addition, the long-term nature of these large projects means that the people who need services have to wait several years before the implementation phase is reached. Added to this, connecting many of South Africa's outlying rural and peri-urban areas to a centralised system is simply not practical or cost-effective.

Bigger is not always better; unfortunately, we often forget about the smaller, easier projects that can assist with water supply and sanitation. The Covid-19 crisis has shown that decentralised water solutions can be implemented. However, it is now vital that we focus on sustainable, off-grid solutions and plan accordingly for these in order to deliver services to the more than 3 million people who still do not have access to a basic water supply service and the 14.1 million people who do not have access to safe sanitation.

Changing attitudes

Decentralised water and wastewater treatment technologies and off-grid sanitation technologies have progressed significantly in recent years. In many cases, these technologies are just as good as their large-scale counterparts and,

more often than not, better for the environment.

This is particularly the case for sanitation technologies, many of which are now designed to reuse water and transform waste into energy or viable products such as fertilisers. Unfortunately, the promise of the flush toilet being the 'gold standard' has created a major stumbling block – a problem not unique to South Africa.

Recipients are often resistant to off-grid and decentralised solutions, viewing them as second rate. This prevents many of these technologies from being adopted and is a contributing factor to governments not considering decentralised options and stand-alone schemes at all, or viewing them as only an intermediate solution. This despite that fact that they can provide very good long-term solutions.

It is vital that we work to change this mindset and educate users on the benefits of these technologies. Importantly, communities must be consulted before such technologies are implemented in order to ensure user acceptance.

Programmes such as the South African Sanitation Technology Demonstration Programme (Sastep) – driven by the Water Research Commission – are leading the way in this regard, offering a platform and support for the development of highly innovative sanitation technologies with the potential to disrupt the sanitation space. These include:

- off-grid, front-end sanitation solutions that require little or no water for flushing
- urine diversion technologies
- off-grid faecal sludge treatment technologies
- off-grid blackwater treatment technologies
- innovative sanitary pad disposal systems
- off-grid sanitation solutions that produce beneficial products from sanitation waste.

It is vital that we support programmes like this in order to drive the off-grid revolution.

Changing the conversation

Unfortunately, the conversations around socio-economic development and providing better solutions often don't consider a decentralised approach. It is simply not possible to have every household in the country connected to centralised water and sewer networks, and it is therefore critical that we change the conversation and place a far greater focus on decentralisation.

The systemic solutions lie outside of the traditional approach – an approach that is clearly failing us as our water losses continue to climb, and we hear increasing reports of sewage polluting our natural water courses.

Last year taught us to embrace change and learn to cope with the widespread disruption of our current way of doing things. As we begin 2021, I challenge you to think more innovatively and consider alternative solutions as we continue to get #AllHandsOnDeck to address our water and sanitation needs. This commitment must present itself in revised IDPs and infrastructure master plans, together with alternative funding and economic models. 3S

NSS: sustainable sanitation in light of climate change

Access to water and sanitation is a human right yet to be afforded to all. The unprecedented challenge of Covid-19 has emphasised the vital importance of universal access to water, sanitation and hygiene services. The lack thereof has a devastating effect on the health, dignity and prosperity of millions. **By Tinashe Chipako***

Alongside World Toilet Day on 19 November, the WISA Young Water Professionals (YWP-ZA) hosted a 'Sustainable sanitation and climate change' webinar to aid in raising awareness about sustainable sanitation technologies suitable for water-scarce countries such as South Africa. The webinar was honoured by seven panellists from government, academia and business. These guests shared their insights on the challenges faced by 14 million people and over 3 600 schools in South Africa that are without safe sanitation.

Ashton Busani Mpofu, national lead, YWP-ZA, opened the webinar with a quote from the great Nelson Mandela and posed a question as to why we have not attained universal access to sanitation given the availability of suitable sanitation technologies: "Massive poverty and obscene inequality are such terrible scourges of our times – times in which the world boasts breathtaking advances in science, technology, industry and wealth accumulation – that they have to rank alongside slavery and apartheid as social evils."

Sustainable NSS

Lusanda Agbasi from the Department of Water and Sanitation opened the discussion with a presentation on the role of non-sewered sanitation (NSS) systems for sustainable, inclusive sanitation in South Africa. She noted that only 83.4% of households in South Africa have access to sanitation, but that the levels of sanitation vary greatly from province to province, with the Western Cape leading in terms of widespread access, while Mpumalanga still has some way to go.

She reminded the attendees about SDG 6 (universal access to water and sanitation by 2030) and emphasised that, in order for us to meet this goal, it is important that we understand the problem from the point of view of all stakeholders and institutions, which must work together collaboratively with #AllHandsOnDeck to effect change.

Sanitation in action

Following on was Lungi Zuma from eThekwini Municipality, who – in responding to a question from the audience – asserted that eThekwini is at the forefront of providing appropriate sanitation facilities, through its partnership with several public and private institutions, municipalities and technology providers. Within these partnerships, workshops and stakeholder engagement meetings are hosted to promote knowledge sharing. One of the municipality's successful partnerships was with Gugulethu Primary School, Khanyisa Projects and the University of KwaZulu-Natal (UKZN). Themba Sibaya from Gugulethu Primary School spoke about this successful sanitation project.

The school had a significant shortage of sanitation facilities. An innovative NSS system solution that diverts urine, recovers nutrients and recycles water for flushing was installed. In addition, solar panels were installed on the roof of the container that houses water-efficient toilet units and waterless urinals. This, together with water recycling, has helped in reducing the utility bills for the school. She noted that there is immense benefit to the students, particularly girls, who now get to be at school even during their monthly cycles.

Global perspective

Next, Arun Kumar, from UKZN's Pollution Research Group, provided insights into

similar challenges faced in India. He highlighted the Swachh Bharat Mission, a government-run initiative started in 2014 focused on eliminating open defecation and improving solid waste management in India. Since the onset of the mission, an impressive 62 million individual house toilets and roughly 6 million communal and public toilets have been built.

Further insights into sustainable sanitation solutions and their impact on users from a South African perspective were provided by Tapuwa Sahondo, also from UKZN's Pollution Research Group, who added that 31% of people worldwide use sanitation that is not connected to sewers. She noted that significant investment is still required to make leaps forwards. She went on to share numerous pilot studies conducted by UKZN, all of which had a large emphasis on decentralised wastewater treatment, as well as the recycling of water mainly for flushing.

From a user perspective, it was noted that these systems are no different to regular flush toilets, as the front end is very similar. In addition, some of the technologies can produce biogas and generate electricity through microbial fuel cells.

Dr Samuel Getahun, from the Pollution Research Group and Umgeni Water, followed, confirming that the water-food-energy nexus and circular economy are among the driving factors influencing the innovation of new technologies. Getahun spoke of a circular sanitation economy in which the nutrient loop is closed and the recovered nutrients are reused rather than disposed of – the waste products from 80 people could be applied on one hectare of agricultural land.

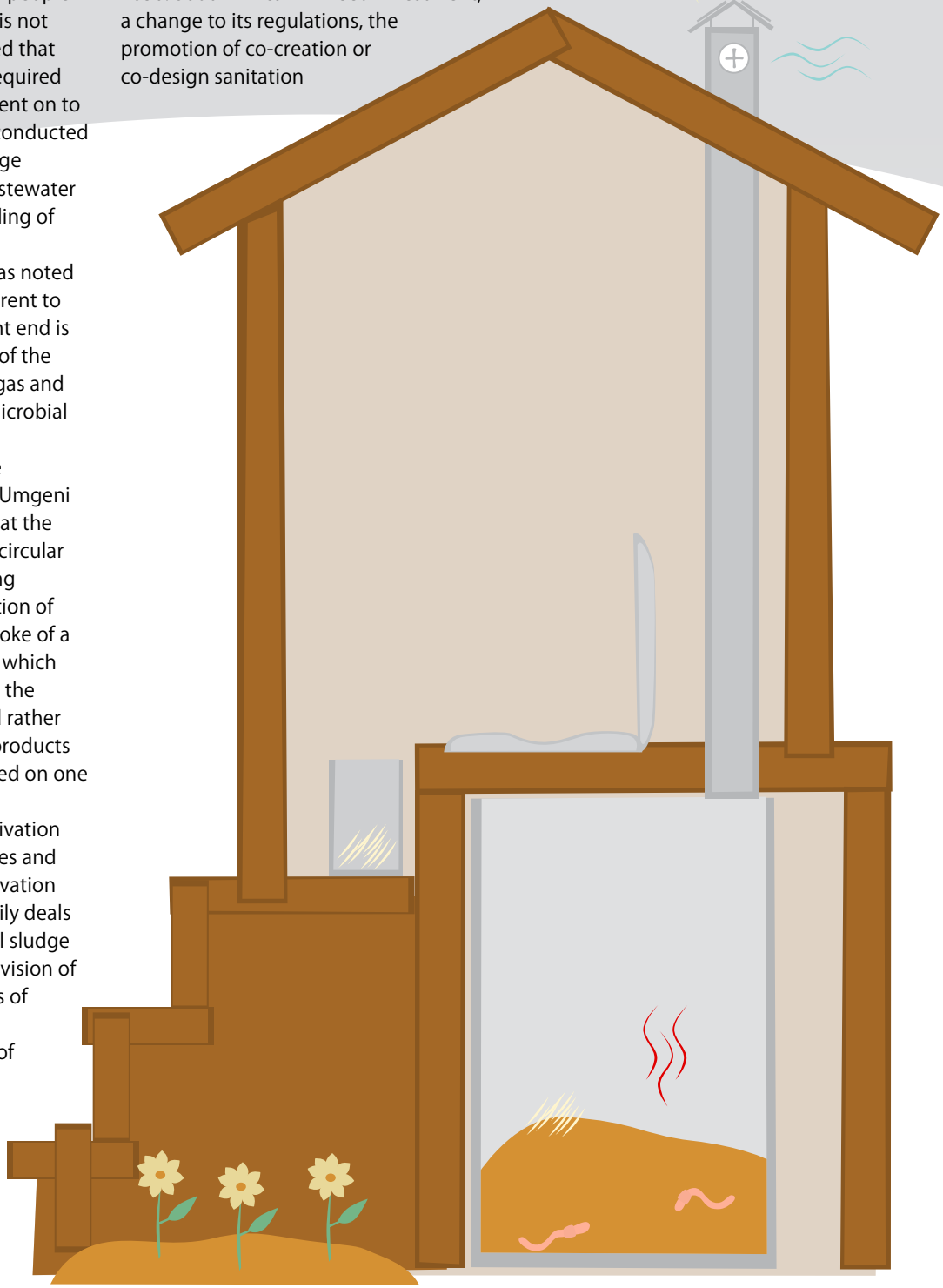
Finally, Naomi Korir from Sanivation shared the sanitation challenges and successes experienced by Sanivation in Kenya. The company primarily deals with the beneficiation of faecal sludge and has helped ensure the provision of sanitation to tens of thousands of individuals across Kenya.

She noted that roughly 10% of waste in East Africa is treated. While efforts are being made to provide NSS in Kenya, there are a number of barriers to full implementation. These include a lack of robust regulations and self-sustaining (and cost-effective) sanitation solutions, inadequate budget allocations, and low user acceptance. Additionally, other panellists highlighted health risks posed by pharmaceuticals and contaminants of emerging concern, as well as opaque markets as other major barriers to NSS, particularly the products produced.

The webinar highlighted that, while great leaps have been made in providing sanitation in South Africa, especially in large metros and in the advancement of technology, there is still a long way to meeting SDG 6 by 2030. South Africa will need investment, a change to its regulations, the promotion of co-creation or co-design sanitation projects with the public to promote user acceptance, and transparent markets. 35

***Tinashe Chipako** is a water and wastewater engineer at Zutari.*

The webinar can be viewed here: www.facebook.com/ywp.za/videos/1127919527624337



Water and sanitation in Africa

BOTSWANA

Raw water levy on the cards

Botswana's Department of Water and Sanitation is reportedly developing an informative raw water abstraction and pricing strategy for all forms of raw water.

The aim of the raw water levy is to sustain water resources management funding while acting as a demand and management tool and managing issues of equitable and reasonable utilisation.

While some are sceptical of the strategy, others are supportive but have cautioned that pricing be based on use rather than standardised.

A study on raw water abstraction and pricing is already under way, conducted by Newtech Consulting Group and ACE-GIBB. 3S

KENYA

Solar-powered desalination

Climate Fund Managers (CFM) has agreed to co-finance and -develop a portfolio of solar-powered desalination installations, turning brackish groundwater into drinking water in Kenya.

The financing will initially assist with a piloting phase for these installations and later the full roll-out of up to 200 units in Kitui County, which will reach up to 400 000 Kenyan citizens.

In Kitui, many wells that are used to provide drinking water contain salts and fluoride, rendering the water unsafe for direct consumption. The project aims to remove these substances from the abstracted groundwater and alleviate the lack of access to high-quality drinking water.

"We are very pleased with the initiative that will bring very clean drinking water to the rural population in Kitui County that needs it most. It is the most exciting project I have been part of in all my career," says Emmanuel Kisangau, Minister of Water, Kitui County.

The installations will consist of a mobile container housing reverse osmosis water treatment, solar panels and a 'water ATM', which allows citizens to purchase high-quality water using their mobile phones. Each installation will run only on renewable energy, without the use of expensive battery storage or electricity from the grid.

Photo credit: Solar Water Solutions

The primary development and technology company behind the initiative is Solar Water Solutions, a Finnish company founded in 2015 and specialising in delivering water purification solutions for sustainable water use in remote locations.

Given the comparatively low water supply coverage across Kenya, coupled with the often-poor water quality when supply is available, the benefits of the desalination installations are expected to offer significant impact potential in areas that are currently prone to water scarcity.

Upon full deployment, it is estimated that the installations will have the capacity to desalinate over 1 500 m^3 of brackish water per day and produce over 1 GWh per year of self-supporting clean energy to power the systems. 3S

MOZAMBIQUE

Recovery from 2019 cyclones

The European Investment Bank (EIB) has provided a €100 million (R1.81 billion) loan, blended with a €10 million (R181 million) grant, to improve public health and climate resilience, and reduce the spread of Covid-19 in Mozambique as the country still recovers from the 2019 cyclones.

The loan will allow the Cabinet for Post-Idai and Kenneth Reconstruction, responsible for managing and monitoring the operation, to build resilience for future adversity through improved water supply, wastewater and drainage infrastructure in affected cities.

Thomas Östros, vice-president, EIB, says: "Security of supply of clean water and ensuring that water infrastructure is protected amid the current climate emergency are priorities for the EIB. As the largest international lender to the water sector worldwide, the EIB is glad to finance and provide its expertise to this project in Mozambique, which will make local water infrastructure safer and more efficient. EU-backed investment will improve public health, [which is] even more important during the global Covid-19 pandemic."

This investment will be used to 'Build Back Better' the infrastructure that was damaged by the cyclones and subsequent floods, improving public health and making cities more resilient to climate-related risks and extreme events. New wastewater infrastructure will also help to avoid untreated slop flowing into rivers, tying the project into the worldwide Clean Ocean Initiative. 3S

Word from around Africa – including the latest industry, project and development news.

NIGERIA

New water bill controversies

Minister of Water Resources Suleiman Adamu has allayed controversies over the proposed National Water Resources Bill, arguing that the bill was the product of extensive national consultations. He believes the new legislation will promote the equitable development and management of groundwater resources.

Speaking at the 27th Regular Meeting of the National Council on Water Resources in Abuja, Adamu stated, "The debate over the bill comes against the backdrop of a situation where the country's health is being undermined by unsafe drinking water, its agriculture battling with under-production, threatening our national food security, while the sources of water supply have been subjected to much abuse with the attendant threat on the environment.

"The bill is, therefore, the manifestation of the government's desire to ensure that the citizens derive maximum benefits from the country's water resource endowments and potentials."

Once signed into law, the bill will provide a regulatory framework to ensure water resources are protected, used, developed, conserved, managed and controlled in ways that:

- consider citizens' right of access to clean water and sanitation
- meet the basic needs of current and future generations
- adapt hydrological boundaries
- ustainably protect the water environment and aquatic ecosystems
- recognise the polluter-pays principle. 3S

TANZANIA

Malagarasi Hydropower Project get $120 million loan

The African Development Bank (AfDB) has approved a US$120 million (R1.8 billion) loan to fund the construction of a 50 MW hydropower plant in Western Tanzania that will provide reliable, renewable energy to households, schools, clinics and small and medium-sized enterprises in the Kigoma Region.

An additional $20 million (R300 million) will be contributed by the Africa Growing Together Fund – a co-financing fund with resources from the government of the People's Republic of China. The government of Tanzania will provide the remaining $4.14 million (R62 million) to meet the project's overall project estimated cost of $144.14 million (R2.16 billion).

The Malagarasi Hydropower Project has several components, including: a run-of-river hydropower plant facility; a 54 km, 132 kV transmission line that will connect to Tanzania's national grid; a distribution network expansion operation, which includes rural electrification and last-mile connections; project management and contract administration support; and compensation and resettlement of affected persons.

The hydropower plant's expected average annual output of 181 GWh will meet the electricity needs of as many as 133 649 Kigoma households, bringing the region's electrification rate more closely in line with the rest of the country.

The project is expected to create about 700 jobs during construction, cut the region's electricity generation costs to approximately $0.04/kWh (R0.60/kWh) from the current $0.33/kWh (R5.00/kWh), and also reduce reliance on greenhouse-gas-emitting fossil fuels. The cost of doing business will also fall because industry will no longer need to maintain costly backup generators. 3S

#AllHandsOnDeck for water and sanitation

The WISA 2020 Conference & Exhibition took place as a virtual conference from 7 to 11 December under the theme #AllHandsOnDeck.

Speaking to the conference theme, #AllHandsOnDeck, Dan Naidoo, chair of the WISA Board, highlighted the vital need for all local and regional players in both the public and private sectors to work together to address South Africa's water challenges and implement appropriate solutions.

"We have the skills and technologies needed to address our challenges and must now turn our attention to broadening the discourse in the sector to explore the economic, political and behavioural aspects that govern water and sanitation if we are to implement effective and sustainable solutions."

To discuss some of the challenges and solutions, several of South Africa's leading sector professionals participated in a panel discussion facilitated by Professor Mike Muller, technical chair, WISA.

The skills gap

Dr Allyson Lawless, managing director at SAICE Professional Development and Projects, highlighted the dire need to rebuild South Africa's technical skills base. Between 2005 and 2015, the number of public sector employees has grown significantly, and is now largely dominated by younger people. "We have lost large numbers of engineers and older people," said Lawless. The result is limited scheduling of maintenance, limited capacity to address increased challenges due to Covid-19, limited long-term planning, inadequate input by engineers into the budgeting process, limited in-house expertise, limited time available for senior staff to train juniors, and a loss of institutional knowledge, systems and processes.

Despite water services being complex and highly technical, there are very few engineers in place and much of the work is being done by young people with little experience in running water service institutions. "There needs to be a recognition by government of the need for technical skills," Lawless stressed.

She highlighted that, despite spending millions on training engineering graduates, there are no posts available to employ them and management posts in technical departments are frequently filled with non-technical people. Furthermore, technical staff have limited authority and do not have the opportunity to input on budget, supply chain and management issues.

Lawless called for an end to overbearing procurement legislation, restrictive OSD (occupation-specific dispensation), water losses, non-payment, political interference, and corruption. We must rebuild technical structures with urgency and implement infrastructure-friendly procurement. To achieve this, she called for institutes like WISA, IMESA and SAICE to lobby government for change.

> **"There needs to be a recognition by government of the need for technical skills."**
> *Dr Allyson Lawless*

The municipal challenge

Neil Macleod, former head: Water and Sanitation at eThekwini Municipality,

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To register, visit wisa2020.org.za.

> "Having 144 WSAs to me does not make sense, especially when the MuSSA shows that many of them are not viable."
> *Neil Macleod*

pointed out that municipalities, which are the face of water and sanitation, are contributing to an incapable state.

The 2018 Municipal Strategic Self-Assessment (MuSSA) paints a desperate picture of the state of local government, which resultantly struggles to attract skilled professionals. The MuSSA showed that 40% of water services authorities (WSAs) are extremely vulnerable, 38% are highly vulnerable, and only 6% are functioning properly. Some did not even realise how vulnerable they were, and most are heavily dependent on capital funding from national government. More than half of WSAs collect less than 70% and have high levels of non-revenue water.

"Behind all of this is the fact that the management capacity is just not there," said Macleod, echoing Lawless' sentiment. He stressed the need to have older experts to mentor and train young professionals to create efficiencies and the environment that is needed.

In addressing corruption, Macleod was encouraged by Minister of Cooperative Government and Traditional Affairs Nkosazana Dlamini Zuma's recent announcement that people who hold office in political structures can no longer work for local government. "That is the first small step, but we need far more severe actions to create the separation between political oversight and executive management."

Macleod stressed the need to create viable institutions. "Having 144 WSAs to me does not make sense, especially when the MuSSA shows that many of them are not viable." He argues that we should consider cutting the number of WSAs to 50 or fewer and locate their head offices in towns where people want to live.

Lastly, he emphasised a need for management contracts to bring in the private sector to create systems and train staff, as was done at Johannesburg Water, which was turned around in under five years. "We need to do things differently," he stressed.

The new model

Dhesigen Naidoo, CEO, Water Research Commission (WRC), pointed out the need to think about future human capital in a different way. Although there has been a decrease in expertise, Naidoo believes the increase in the number of young people entering the sector is very positive in that they have a newer view of the world and how the future economy should operate.

"There needs to be an injection of mentorship, and there are models that show us how this can work," he said. In 2011, around 70% of the WRC's projects had leaders who were older white males. Today, this has shifted to 80% previously disadvantaged individuals without altering any of the quality criteria. "We just made a much higher investment in capacity building and training, and we brought in the older folk to be mentors in the system. It's working really well," said Naidoo.

He also identified a need for a vastly expanded water team that extends beyond technical and scientific knowledge to include behavioural, social and financial acumen to organise water security into the future.

The master plan

Trevor Balzer, acting director general, Department of Water and Sanitation (DWS),

spoke to the National Water and Sanitation Master Plan (NW&SMP), which seeks to avoid a water deficit that could grow to 17% by 2030.
He highlighted South Africa's many backlogs and challenges that must be urgently addressed to achieve water security. These include insufficient infrastructure investment, inadequate management of water resources, increasing levels of pollution, and a lack of skills.

The NW&SMP outlines seven areas of priority, namely:

1. Immediate institutional change to get back on track on the road to water security
2. Planning and infrastructure investment to address the country's strategic water challenges
3. Information to improve performance and support sustained, inclusive development
4. Transforming the water sector
5. Ensuring financial sustainability
6. Legislative review
7. Protection and restoration of ecological infrastructure.

Balzer is assigning champions to drive each of these seven areas.

"While the Covid-19 pandemic has had a severe impact on the country's economy, and despite the constraints on budget availability, the implementation [of the NW&SMP], I believe, will help enable a coordinated recovery regarding basic services for the benefit of public health and hygiene, food security, and socio-economic development in general," he said.

He also expressed a desire, shared by Minister Lindiwe Sisulu, to create a reserve force of retired engineers that can be called on to assist the DWS in areas of need.

Moving forward

A position paper and pledge for action will be drawn up and shared with the sector based on the outcomes of the conference.

"Our past conferences have provided a platform to discuss the problems and solutions facing the water and related sectors. Now is the time to create mechanisms and an enabling environment to set us on a path of implementation and impact," said Dr Shafick Adams, chair: LOC, WISA 2020.

"Water is everyone's business, and everyone should be involved in ensuring we have water security. This is more important than ever, as we need to navigate issues of pandemics, climate change, weather variability, demand growth, infrastructure needs and more." 3S

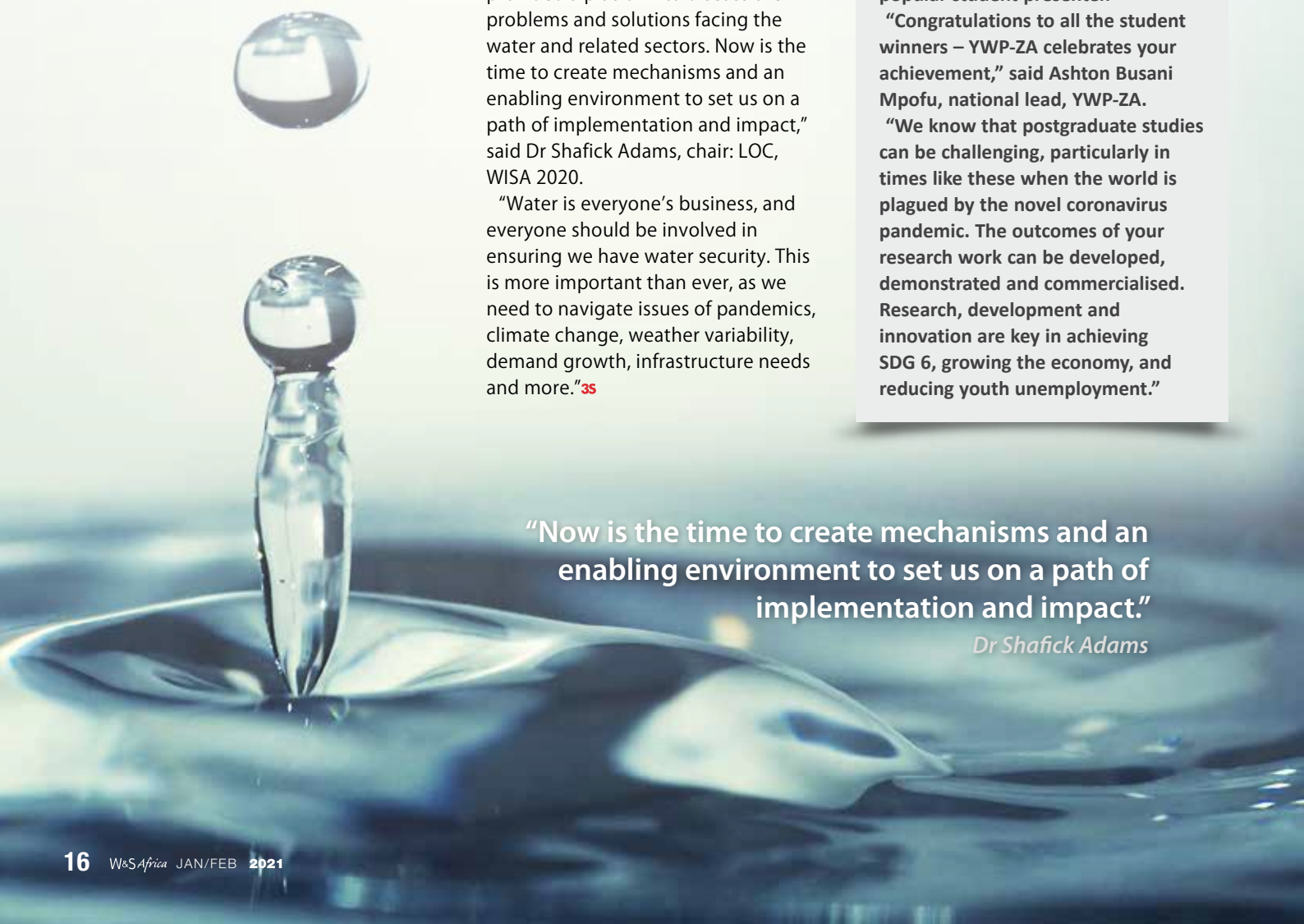
STUDENT AWARDS

To encourage student participation and reward postgraduate research excellence, the South African Young Water Professionals (YWP-ZA) presented an award for the best student presentation at WISA 2020. Webster Magowo, PhD student at the University of the Witwatersrand, took first place for his research topic, 'Co-treatment of acid mine drainage and Fischer Tropsch wastewater using dissimilatory sulfate reduction.' He received a cash prize of R3 000 and free registration for the next WISA conference.

First runner-up went to Alice Harvey, MSc Eng student from the University of Cape Town. The second runner up was Leny Letjiane, MEng Chem student at Tshwane University of Technology, and the third runner-up Craig Tanyanyiwa, PhD student at the University of Cape Town. Tanyanyiwa also received the award for the most popular student presenter.

"Congratulations to all the student winners – YWP-ZA celebrates your achievement," said Ashton Busani Mpofu, national lead, YWP-ZA.

"We know that postgraduate studies can be challenging, particularly in times like these when the world is plagued by the novel coronavirus pandemic. The outcomes of your research work can be developed, demonstrated and commercialised. Research, development and innovation are key in achieving SDG 6, growing the economy, and reducing youth unemployment."



"Now is the time to create mechanisms and an enabling environment to set us on a path of implementation and impact."
Dr Shafick Adams

CAPE TOWN GEARS UP for permanent desal plant

With droughts predicted to become more frequent and intense, the City of Cape Town (CoCT) has confirmed plans to build a permanent desalination plant.

The CoCT is enhancing the management of its existing water supply and pushing ahead with the objectives laid out in the Water Strategy to build resilience and water security.

According to the CoCT's executive mayor, Alderman Dan Plato, improved water conservation has bought some time but – with droughts predicted to become more frequent and intense, and the area's population continuing to grow – the municipality is working to diversify its water sources and increase its available supply.

The CoCT has already made progress in pursuing its New Water Programme, which aims to increase available water supply by 300 million litres per day over the next 10 years. The projects outlined in the programme, some of which are already under way, are designed to ensure that high-level water restrictions, such as those put in place during the recent drought, should not be required again in the near future.

Desalination ambitions

The CoCT has confirmed that a permanent desalination plant is in the planning phase and is provisionally scheduled for completion in 2026/27. The cost of the plant, which will produce 50 million litres per day, is currently estimated at approximately R1.8 billion.

The permanent plant will be built using the experience gained from the temporary desalination plants built at Monwabisi, Strandfontein and the V&A Waterfront to provide emergency water supply during the drought.

According to Plato, the operation of the temporary desalination plants provided valuable hands-on experience in producing desalinated water, which will help as the CoCT works towards larger-scale desalination projects.

In addition to desalination, the Table Mountain Group Aquifer is already providing 15 million litres of groundwater per day and construction has commenced on the Cape Flats Aquifer Scheme. The CoCT is also working towards the implementation of a large-scale water reuse scheme by 2026 and continues to clear alien vegetation in its catchment areas.

Long-term water security

"Our Water Strategy commits the city to not only becoming water resilient, but also to provide a service for all, which includes improving water and sanitation services in informal settlements, and to transform our relationship with water by becoming a water-sensitive city," says Alderman Xanthea Limberg, MMC: Water and Waste, CoCT.

She adds that simultaneously fulfilling the Water Strategy's other commitments around universal access and reducing pollution of urban waterways should see Cape Town entrench itself as the only African city to be a world leader in the provision of water and sanitation services.

The CoCT is also working towards becoming the first African member of the Leading Utilities of the World – a network of the world's most forward-thinking water and wastewater utilities.

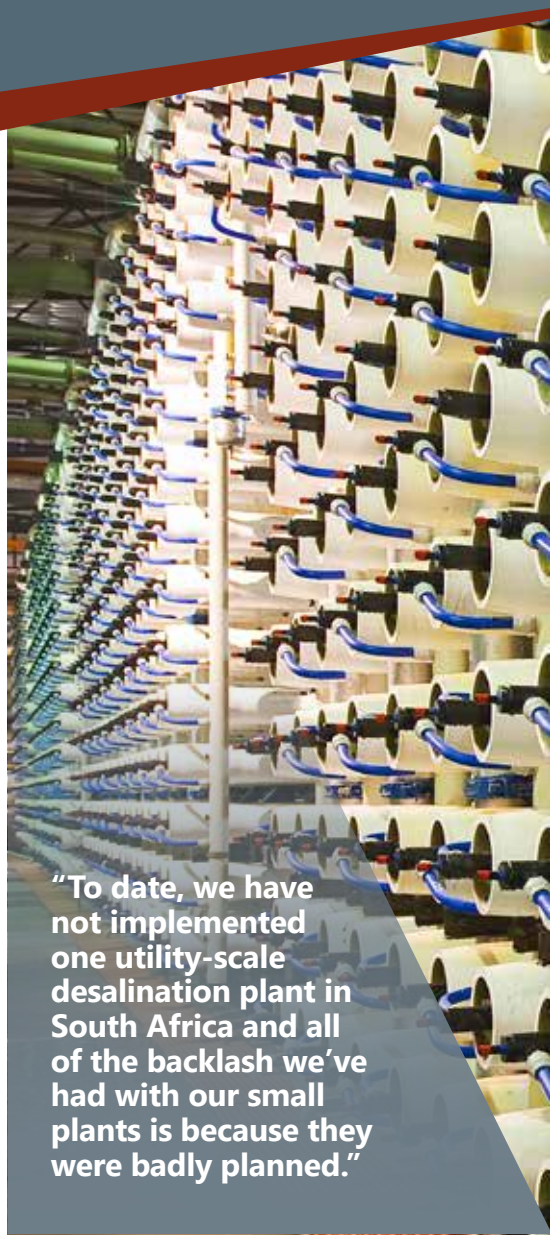
"The objective of the initiative is to create a global network of the world's most successful and innovative water and wastewater utilities, to help drive performance across the sector by recognising achievement, providing a network for sharing ideas, and inspiring others to improve. We are confident that the city's innovations in this sector to date place us in a position to start building a case for entry," says Limberg.

With climate modelling as we know it no longer a reliable metric on which to predict the availability of water in terms of rainfall, the CoCT has affirmed its dedication to building on the resilience and partnerships that saw Team Cape Town avert Day Zero. 3S

The case for desalination

According to the International Desalination Association, there are more than 18 000 desalination plants operating across the globe, with a cumulative installed capacity of 88.91 million m^3/day. However, South Africa has been slow to adopt this technology – often labelling it too expensive – and remains highly reliant on surface water resources.

By Danielle Petterson



"To date, we have not implemented one utility-scale desalination plant in South Africa and all of the backlash we've had with our small plants is because they were badly planned."

Water is beginning to take centre stage globally as countries around the world are faced with exhausted water supplies. In South Africa, this is highlighted by Nelson Mandela Bay, which is currently in crisis, having declared 'Day Zero' amid a severe ongoing drought, and Cape Town, which narrowly escaped a similar fate.

Desalination has taken off in several parts of the world. With its abundant coastlines, South Africa has significant potential for desalination plants, but desalination is often thought to be too expensive, largely due to its high energy requirements.

However, Benoît Le Roy, CEO of the South African Water Chamber, argues that desalination can be financially viable and should be embraced if South Africa is to avoid a water crisis. He points to areas like the Middle East where desalination is cheaper than surface water is in South Africa.

He likens the growing shift towards desalination to the mammoth growth we've seen in the renewable energy sector: "Renewable water is becoming a lot more efficient. This is being driven by private sector competition and, within that, the race to reduce energy footprints, the bolting on of renewable energy, and a shift from thermal to membrane and hybrid technologies." As a result, the price of desalination has halved compared to 10 years ago.

Why South Africa should desalinate

South Africa has exhausted its surface water and most of its groundwater resources, with the Department of Water and Sanitation predicting a potential 17% water deficit by 2030 unless serious action is taken to reduce losses and demand, while diversifying and boosting supply.

Le Roy argues that by shifting the coastal cities to desalination, these areas no longer need to rely on water from rivers that stem from further inland. This would lead to more water being available in these rivers for use by inland areas. "If we add water reuse inland, our water balance changes completely and we no longer have a crisis. But there are a lot of solutions that need to be implemented in parallel."

Financial feasibility

"In South Africa, we install small-scale package plants. And while there is a place for these small plants, they are generally not feasible compared to utility-scale plants in cities and metros. To date, we have not implemented one utility-scale desalination plant in South Africa and all of the backlash we've had with our small plants is because they were badly planned. When you implement these small-scale plants during a drought, they often tend to fail, because you rush the process and you implement the wrong size plant," says Le Roy.

He argues that the temporary desalination plants installed in Cape Town were a futile exercise, contributing only 1% of the city's water demand.

One of the key factors with desalination is that the plant needs to run continuously in order to be financially viable. This is the major challenge with temporary desalination plants implemented during droughts.

Australia has developed an innovative solution. When their dams are full, they draw on surface water resources to meet their water demands, and their desalination plants recharge aquifers in order to bank water for the future. During periods of low rainfall, they can rely on desalination to meet their needs.

According to Le Roy, Australia has more than 12 utility-scale desalination plants that run 24/7. He adds that, by reducing stress on surface water resources, many of the country's wetlands have begun to rejuvenate, attracting wildlife and contributing to eco-tourism. "In South Africa, we're over-abstracting from our ecological reserve and that will harm our tourism. We need our wetlands to recover for our eco-tourism to thrive."

The rise of renewable energy is another boon for desalination, and small-scale renewable plants are increasingly being tacked on to desalination plants. By running desalination plants with renewable energy, you can largely decouple from the energy grid and significantly reduce running costs. In South Africa, this has the added benefit of being immune to load-shedding.

Another argument against desalination is what to do with the brine it produces. However, Le Roy argues that South Africa's deep open seas and high currents mean that this brine can be safely discharged back into the ocean if it is properly diffused. "If you engineer it correctly, the environmental damage is absolutely negligible, if there is indeed any," he says. In addition, brine is hygroscopic, and Australia has shown in some cases that its sea life has improved since implementing desalination.

"As our available surface water continues to decline due to climate change, it is vital that we decouple from rain," stresses Le Roy. "Desalination offers an ideal solution and we must embrace it if we are to avoid a water crisis." 3S

Benoît Le Roy,
CEO of the South African Water Chamber

Desalinating water with sunlight

An international research team, led by Monash University, has developed a method that can successfully desalinate water using sunlight.

Desalination has been used globally to address escalating water shortages, but is considered too costly in many areas due to its high energy and chemical requirements. Now, a global research team has successfully transformed brackish water and seawater into safe drinking water in less than 30 minutes using metal-organic frameworks (MOFs) and sunlight.

MOFs are a class of compounds consisting of metal ions that form a crystalline material with the largest surface area of any known material. The research team created a dedicated MOF called PSP-MIL-53, which was synthesised by introducing poly(spiropyran acrylate) (PSP) into the pores of MIL-53 – a specialised MOF well known for its breathing effects and transitions upon the adsorption of molecules such as water and carbon dioxide.

Desalinating 2 233 parts per million (ppm) of water sourced from a river, lake or aquifer, the team demonstrated that PSP-MIL-53 was able to yield 139.5 ℓ of fresh water per kilogram of MOF per day, with a low energy consumption.

The process also filters out harmful particles and could provide potable water for millions of people across the world. The World Health Organization suggests good-quality drinking water should have a total dissolved solids (TDS) of <600 ppm. Researchers were able to achieve a TDS of <500 ppm.

According to lead author Professor Huanting Wang, from the Department of Chemical Engineering at Monash University in Australia, this highlights the durability and sustainability of using this MOF for future clean water solutions.

Sustainable solution

"Sunlight is the most abundant and renewable source of energy on earth. Our development of a new adsorbent-based desalination process through the use of sunlight for regeneration provides an energy-efficient and environmentally sustainable solution for desalination," says Wang.

The PSP-MIL-53 MOF can adsorb salts from brackish water and seawater, and provide clean drinking water in less than 30 minutes. The entire desalination process is energy efficient, low cost and sustainable.

In addition, the MOF can be regenerated for reuse within four minutes when the MOF crystals are exposed to sunlight.

"Our work provides an exciting new route for the design of functional materials for using solar energy to reduce the energy demand and improve the sustainability of water desalination," says Wang.

"These sunlight-responsive MOFs can potentially be further functionalised for low-energy and environmentally friendly means of extracting minerals for sustainable mining and other related applications."

The research was published in the prestigious journal *Nature Sustainability* and is available here: www.nature.com/articles/s41893-020-0590-x. 3S

Electrodesalination offers alternative to RO

Louis Koen, process engineer, Zutari

Given South Africa's growing need to consider alternative water sources, Zutari is championing membrane capacitive de-ionisation (MCDI) – a commercially available electrodesalination water treatment technology that has become a successful alternative to reverse osmosis (RO) membrane treatment trains.

Consisting of just a two-step process, adopters of MCDI need fewer pre-treatment steps, as there is a limited risk of fouling and/or scaling compared to other desalination processes. In addition, there is no need for remineralisation, typically required with RO due to exceptionally high salt rejection.

RO is a pressure-driven desalination process that focuses on processing the brackish water stream via membranes that are selected to reject the dissolved ions in the water. The operating cost is primarily related to the volumetric flow rate of water, which needs to be fed to the RO skids at relatively high pressure to overcome the osmotic pressure across the membranes. As such, the process is considered energy-intensive. Very good pre-treatment of the water is also required to safeguard the RO membranes against potential fouling.

Conversely, MCDI technology is governed by electrochemical processes that operate at relatively lower pressures. The design is focused on the electrochemical removal of solute (ions) present in the water. This distinction is important when considering the scalability and appropriateness of the two technologies for feedwater with various salinities.

Technology comparison

Take two feed streams flowing at the same rate, one with a low salinity (less than 2 000 mg/ℓ) and one with a high salinity (more than 4 000 mg/ℓ). The cost difference associated with RO plants to treat each stream will be negligible, as this is most strongly influenced by the solvent quantity.

In contrast, the design of MCDI plants for each feed stream will vary significantly owing to the different salinity levels, which will in turn impact the cost associated with each MCDI plant. An MCDI plant treating low-salinity water will be significantly cheaper compared to a plant treating high-salinity water. Consequently, MCDI plants have become economically advantageous over traditional RO plants at lower salinity levels.

The full process train consists of filtration of the abstracted water through two autonomous gravity sand filters as a pretreatment step to remove particulate matter, temporary storage in a balancing tank, desalination via the MCDI plant, and disinfection via UV sterilisation. Sodium hypochlorite is also dosed prior to storage in a final treated water reservoir in order to provide a chlorine residual in the treated water.

Such a simple configuration delivers a fully automated treatment works with a minimal footprint, reduced pumping requirements, and reduced chemical consumption compared to a traditional RO plant. Adopters of this technology can expect direct opex to be half that of the conventional approach, leading to a significant reduction in the total life-cycle cost.

"Our solutions always consider the impact on the environment and communities, but we also consciously deliver outcomes that help clients stay and thrive in business. It is for this reason that our engineered solutions employ the use of novel technology to achieve a water treatment performance on par with conventional means, while reducing expenditure over the full life cycle of the asset," highlights Louis Koen, process engineer, Zutari

While MCDI is already showing commercial advantages over RO plants, the technology is still in its infancy. "We can expect ever-increasing innovation and improvement as research and development in the field develops further," concludes Koen. 3S

BUILDING A WATER-EFFICIENT SECTOR

The agricultural sector accounts for the vast majority of South Africa's water use and could be severely impacted by anticipated future water shortages. Water&Sanitation Africa speaks to Janse Rabie, head: Natural Resources, Agri SA, about how the sector is adapting and implementing water efficient practices.

As the largest water user in SA, how is the agricultural sector working to reduce water consumption?

JR Although the agricultural sector is the largest user of water in South Africa, consuming approximately 60% of available water resources, it is interesting to note that the global average water consumption of the agricultural sector is approximately 70%. It is also important to bear in mind that the sector only receives what remains after all other water uses are served. This includes domestic, industrial, mining and governmental uses, adhering to international obligations and preserving the environmental reserve.

South Africa is the only country in Africa that is technically food secure in that it can provide its population with sufficient domestically produced food and is a net exporter of agricultural commodities, generating significant foreign revenue. Given that South Africa is a water-stressed country, its relative food security is a significant achievement.

Water is a critical resource to the agricultural sector and the efficient use thereof is vital to the social stability and economic growth of South Africa. As a significant input cost component, the efficient use of water is crucial for farmers. This entails technical improvements in water delivery and application – e.g. micro-irrigation, use of remote sensing and satellite imagery, cultivation of appropriate drought-resistant cultivars, and metering/measurement of water consumption. It also entails the maintenance and improvement of raw-water storage and supply infrastructure.

The management of water resources at the appropriate management level is crucial in this regard. Although national government is the overall custodian of our water resources, local-level management institutions – including water-user associations and irrigation boards, as well as catchment management agencies – are vital in ensuring efficient water use.

South Africa predicts a potential 17% water deficit by 2030. What impact might this have on food security?

The anticipated water deficit will clearly detrimentally affect food security – not only in South Africa, but the wider region. Unless all stakeholders come together and address this issue as a matter of utmost importance, South Africa's food security is at risk. This food security is a major contributor to national and regional social stability and economic growth – it cannot be underestimated.

How have South Africa's recent and ongoing droughts affected the agricultural sector?

Recent and ongoing droughts continue to have a severe impact on the agricultural sector. These are felt the most at local and commodity-specific level. For example, the ongoing severe drought in parts of the Northern Cape has had a particularly severe impact on sheep farming in that area.

In light of these droughts, how is the agriculture sector adapting to lower water availability?

Farmers in different parts of the country implement diverse adaptation measures to deal with lower water availability. In the case of the meat and wool producing commodities, this often means reducing herd sizes. Other examples include removing fruit trees and vineyards, cultivating fewer hectares of other crops and, where possible, replacing them with more drought-resistant commodities. Again, continuing and improving water-use efficiency is crucial to the viability of the sector.

Are there water efficiency measures that can be widely implemented to reduce consumption in the sector?

Agriculture is always the first sector to face restrictions in times of water stress.

Water restrictions, both at local and national level, are still among the most significant consumption-reduction measures.

Technologies such as micro-irrigation and use of satellite imagery and remote sensing can be widely implemented to reduce water consumption, but the costs associated with implementing these can be prohibitive.

The best water efficiency measure, however, remains adequate planning and management. In this regard, the accurate and appropriate measurement and metering of water use is critical to ensure efficient use and reduced consumption.

What are the impacts of declining raw water quality on the sector?

The impacts of pollution and deteriorating raw-water quality are a significant concern to Agri SA. Deteriorating water quality not only affects the sector's ability to produce agricultural commodities and products, but also the cost of ensuring food safety – costs that must be borne by the entire value chain and, ultimately, the consumer. In this regard, Agri SA is particularly concerned by government's appetite for high-risk industrial, mining and shale gas developments, especially in high-value agricultural areas.

How is Agri SA engaging with government on water issues?

Agri SA has a strong and active working relationship with government. Our approach is to inform and assist government when it comes to managing our country's water resources as much as possible. This includes regular meetings and interactions with the Department of Water and Sanitation, being involved in and commenting on legislative and policy developments, and having access to the highest levels of government in addressing water-related matters. Where needed, and where no other course of action is available, Agri SA resorts to the courts to challenge certain actions by government that we believe threaten the position and continued viability of the sector.

We have a significant interest in ongoing litigation in the Supreme Court of Appeal concerning the legal ability to transfer water from one water user to another and from one property to another in terms of the provisions of the National Water Act (No. 36 of 1998). The ability to transfer water-use entitlements in accordance with the provisions of the Act is an important tool with respect to achieving water-use efficiency and maintaining the stability and viability of the sector. 3S

Closing the gap through reclamation and reuse

Not only is South Africa a water-scare country, but it is in the grip of a water shortage crisis. Just two years ago, this was illustrated by Cape Town facing the imminent threat of four million taps running dry.

By Joyce Moganedi

During 2019, more than 70% of the country's total water supply was earmarked for business – mining, industrial use, power generation and agriculture – leaving less than 30% for consumption by a population of more than 60 million people.

Water levels are reaching tipping points across the nation as rapid urbanisation sees increasing numbers of people gravitating to cities, which also results in increased industrial activity.

According to the World Bank, industry in South Africa will require 50% to 70% more water, and energy production will use 85% more of the country's water supply. More effective industrial water and wastewater reuse is therefore of major importance if South Africa is to plug the gap between growing demand and dwindling supply of one of the planet's most precious resources.

Smart thinking

Producing more water to satisfy demand is one piece of the puzzle. Equally important is the efficient use of existing water supplies by the industrial sector in South Africa. Automated and digital technologies can help water treatment plants optimise every drop – reducing, reusing and recycling water, while simultaneously recovering resources and replenishing water ecosystems.

In doing so, companies stand to gain in their own operations, by boosting efficiency, cutting costs, and ensuring compliance with legislation aimed at monitoring the discharge of effluents into the environment. Globally, 80% of wastewater is unprocessed; protecting groundwater from chemical agents and other pollutants that damage ecosystems and the quality of drinking water is a priority.

Overseeing this process is the Department of Water and Sanitation (DWS) – the overarching regulatory body charged with protecting South Africa's water resources and ensuring they are allocated in a sustainable manner. Industries such as mining and power generation recognise the importance of water reuse as a way of running sustainable businesses and effectively maintaining production levels.

With South Africa seen as key to the entire continent's industrial growth, this good-news story can be rolled out across Africa, to the ultimate benefit of economies and wider society.

Tap into digital innovation

ABB is determined to be part of this revolution and help alleviate the water crisis in South Africa. Our portfolio of automation, control, and digital and electrical solutions enables the smarter reuse of wastewater, helping operators to optimise performance and reduce energy consumption.

Increasingly, water utilities in South Africa and worldwide are looking to integrate their operations – wastewater treatment plants, water treatment plants, pumping stations – in a centralised control centre using a single Scada system, enabling them to better manage assets and guarantee security of supply. ABB solutions are specifically designed to facilitate this transition.

For example, the ABB Ability open industrial internet technology platform, encompassing both the Symphony Plus and 800xA distributed control (DCS) and

Scada systems, takes data from smart sensors throughout the treatment plant and contextualises it in the cloud, giving operators the insights they need to make informed decisions that automate and streamline production and improve safety. This level of automation has the potential to lower operating costs by 7% to 8% in a typical, mid-sized water treatment plant.

Leakages and losses are also estimated to run to 50% to 70% in developing countries. ABB's digital water management system incorporates web applications that provide plant operators with a single, holistic cockpit view of the entire facility remotely on a mobile device, identifying and alerting them to leaks and bursts in real time, and ensuring that production levels are maintained and KPIs are met.

Effective asset management also facilitates predictive rather than costly, reactive maintenance, while automating water treatment plants effectively can reduce round-the-clock staffing to a single shift.

Challenges and solutions

There are many challenges that lie ahead. A lack of awareness as to the nature and scale of the water crisis – and the many benefits of reusing water, especially in water-scarce areas – persists. This is despite the efforts of the DWS, the Water Research Commission – which disseminates knowledge to the South African water utilities about the benefits of digitalisation – and initiatives such as Green Drop – the certification programme that recognises excellence in wastewater services management.

Regulations governing water practices and reuse differ from country to country, in respect of health and safety standards. As such, they can act as a significant barrier to reducing, reusing and recycling water. In South Africa, the Blue Drop, Green Drop and No Drop programmes delivered important incentives and awareness; however, the neglect of routine annual assessment has had a negative impact, particularly on wastewater management.

Another hurdle concerns the economics of water reuse. One of the main problems in the treatment of wastewater is that the removal of poorly degradable contaminants and micropollutants from surface water and groundwater requires advanced technologies that consume large amounts of energy. As a result, the revenues earned by utilities in South Africa often do not cover their operating costs.

Here, again, the most effective way to avoid increased tariffs or taxation is to improve the efficiency of water and wastewater treatment plants, reduce energy consumption, and lower operating costs.

Technology is the medium that can help water municipalities not only to meet minimum regulatory requirements set out by initiatives such the Green Drop programme but to exceed them.

Joyce Moganedi, sales manager: Power & Water at ABB Energy Industries in South Africa

The future of water provision in South Africa

It is clear that automation and digital solutions can help industry and agricultural businesses throughout South Africa to reduce waste, and more effectively reuse and recycle water in order to meet soaring industrial and domestic demand.

Through innovations such as its water management system, DCS, water flow meters, leak detection tools and wastewater treatment distribution network, ABB works side by side with water utilities to generate efficiencies, optimise water and wastewater plant performance, and reduce energy waste.

Alleviating water shortages and providing industry and people with clean, reliable supply begins with the sustainable and responsible use of existing resources. By leveraging its proven expertise in water industry projects, from India to Singapore and Oman, ABB is committed to making water scarcity in South Africa a thing of the past – and doing so in a smart, safe and sustainable manner. 3S

CLIMATE CHANGE: A CLOUD OF UNCERTAINTY OVER MINING

A key impact of climate change on mining is the new level of uncertainty that it brings to an already risk-laden sector – especially in terms of water management.

The risks of climate change do not disappear when a mine closes

According to Peter Shepherd, partner and principal hydrologist at SRK Consulting, one of the first questions a mine developer must ask is whether the site has access to enough water to sustain operations. The rule is straightforward: no water, no mine.

"The challenge now is that climate change has cast doubt on what we believe the future holds for rainfall patterns and temperature trends. We might be able to conduct the necessary technical water studies and establish that we have water available at this time, but will the water source be sustainable in the future?" questions Shepherd.

There is one thing worse than not finding enough water for a new mine development, and that is to find out – after the mine is built – that the water supply has reduced and become insufficient to sustain the mine.

"This uncertainty leads to many other questions that need to be asked. For instance, will the mine's infrastructure, employees and surrounding communities remain safe as the environment changes?" explains Shepherd.

An uncertain future

He highlights that storm frequency and intensity – as well as rainfall depth – are among the main parameters in mine water management that are vulnerable to climate change. Changes in temperature are also expected to continue, altering evaporation levels from storage dams, process dams and tailings facilities.

"The planning of any infrastructure has previously been done on the basis of historical rainfall sequences and levels. The fundamental risk that climate change introduces is that we can no longer merely rely on data from the past to accurately represent what will occur in the future."

Changing rainfall patterns could see more frequent, smaller rainfall events, which may increase the erosion of streams and affect mine infrastructure in new and destructive ways. If an effluent dam has been designed to deal with a one-day storm, the occurrence of two or three rainfall events – even if they are smaller than the traditional 1-in-50-year storms – may cause spillages and even environmental damage.

"We may need a change in design to cater for smaller events, such as low flow channels. Larger rainfall events occurring more often will require greater diversion channels, and dirty water dams will need to be adequately sized," says Shepherd.

Longer dry spells will also take their toll – a trend that Shepherd has already observed in the Rustenburg area over the past decade. It is likely that mines will require buffer dams, where water can be captured during the wet season, for use when water supplies run short.

Shepherd emphasises that the risks of climate change do not disappear when a mine closes, but rather place even greater responsibility on mine owners to ensure the safe maintenance of mining infrastructure after closure. This is especially relevant to large structures like tailings dams, whose integrity and safety can be affected if

Andrew van Zyl, director and principal consultant, SRK Consulting

management strategies are not adapted to suit altered weather patterns.

Adapting to climate change

As mining companies adapt their water management strategies to the demands of climate change, they are also working to reduce their role in the emission of greenhouse gases, which lies at the root of this phenomenon.

As a major energy user, the mining sector is making significant strides in reducing its carbon footprint, says Andrew van Zyl, director and principal consultant, SRK Consulting. Trends in this regard range from steadily reduced fuel consumption in mining trucks and changes in the shipping of mined bulk material, to increased on-mine energy generation from renewable sources.

"In just one year, from 2018 to 2019, global mining companies' investment in renewable energy rose fivefold. After committing to 900 MW of renewable energy capacity in 2018, mining companies announced a further 4 500 MW in projects the following year," says Van Zyl.

Most mines have proactively reduced their carbon footprints by improving energy efficiency through the use of modern equipment and technology across all mine functions. In South Africa, using hydrogen fuel to power mining haul trucks is being trialled in the hope that diesel could be replaced in this application.

Van Zyl notes that several local mines also intend to install their own renewable energy generating facilities as soon as there is a clear regulatory framework to facilitate these ventures.

"The mining sector's investment in renewable energy projects is an important opportunity as South Africa implements an Integrated Resource Plan that envisages a lower-carbon economy. The planned reduction in the use of coal to generate the country's electricity also has significant socio-economic implications," he says.

"With coal's share in South Africa's energy mix expected to drop from more than 80% currently to around 30% by 2050, the country needs to plan for a just transition from coal to other energy sources. Ongoing trends make it likely that the replacement of ageing coal infrastructure with renewables will be in the interest of the climate, and more economically attractive. Planning for this transition will maximise opportunity and can mitigate some of the negative impacts in areas currently dependent on coal," ends Van Zyl. 3S

Peter Shepherd, partner and principal hydrologist, SRK Consulting

Changing rainfall patterns could see more frequent, smaller rainfall events

WASTEWATER IS ALSO A SOURCE

- Tertiary filtration of municipal wastewater is underutilised
- Can provide industrial and irrigation waters
- Improves final effluent quality
- Protects natural resources by filtering contamination after wastewater treatment
- Well-operated wastewater plants provide an opportunity to reuse the water
- Greywater allocated for industrial use will free up more water for potable use
- Disc filtration can be implemented on every site without significant civil works

WASTEWATER TREATMENT

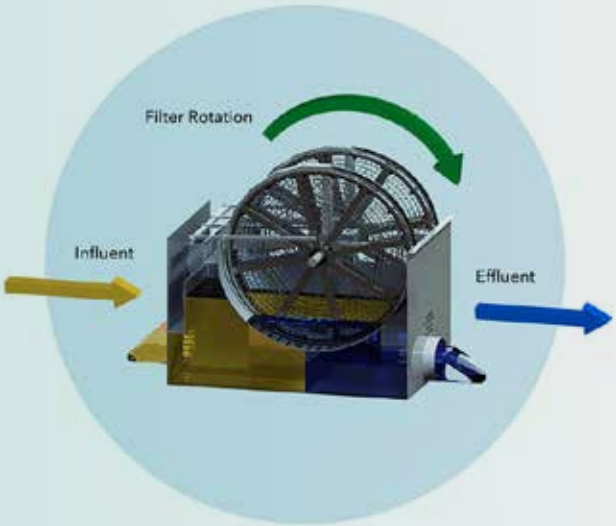
Primary treatment

Secondary treatment

Tertiary treatment

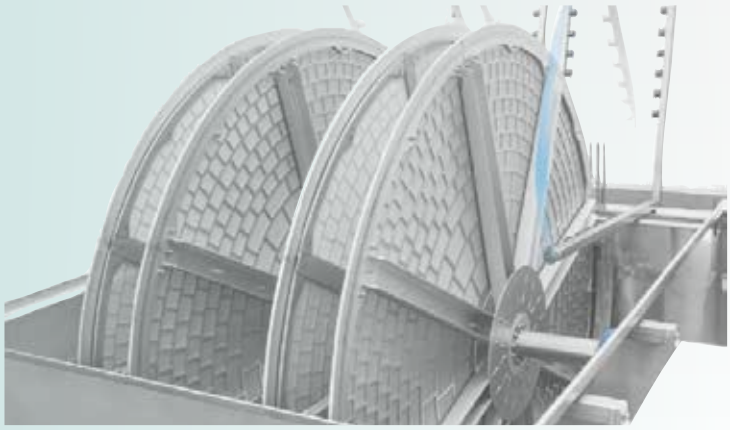
GRAVITY FILTRATION

- Gravity filtration assists with floc removal
- Gentle removal of solids



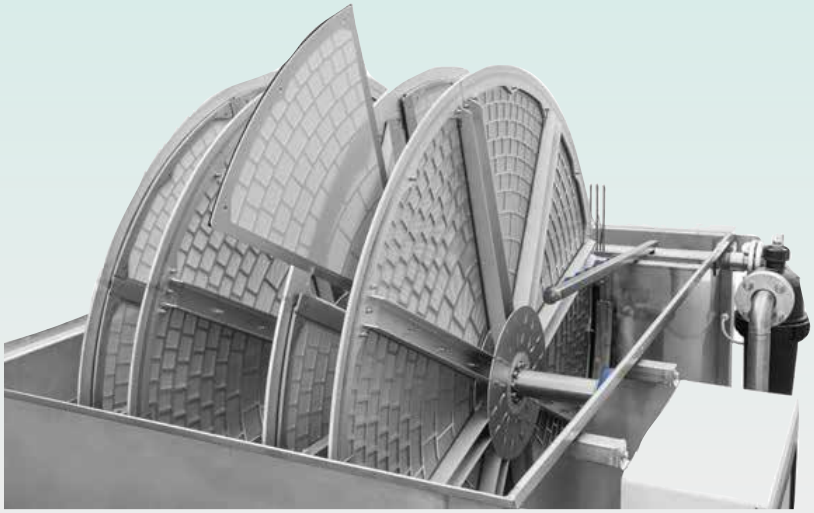
TANK MOUNTED INSTALLATION

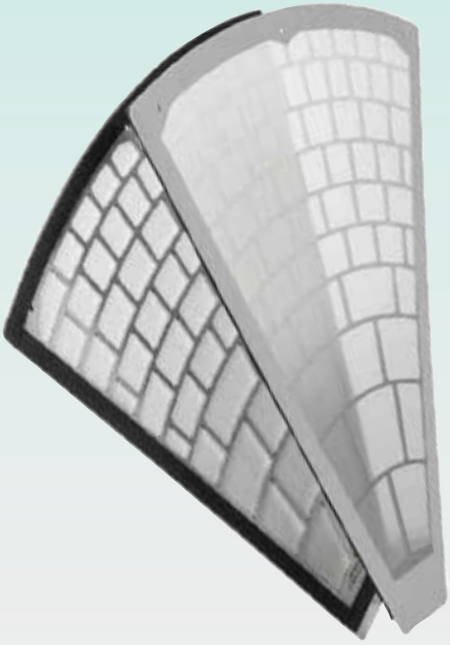
- Plug and play
- Pre-tested
- Small footprint
- Easy installation
- Guaranteed filtration



QUICK AND EASY FILTERING SECTORS

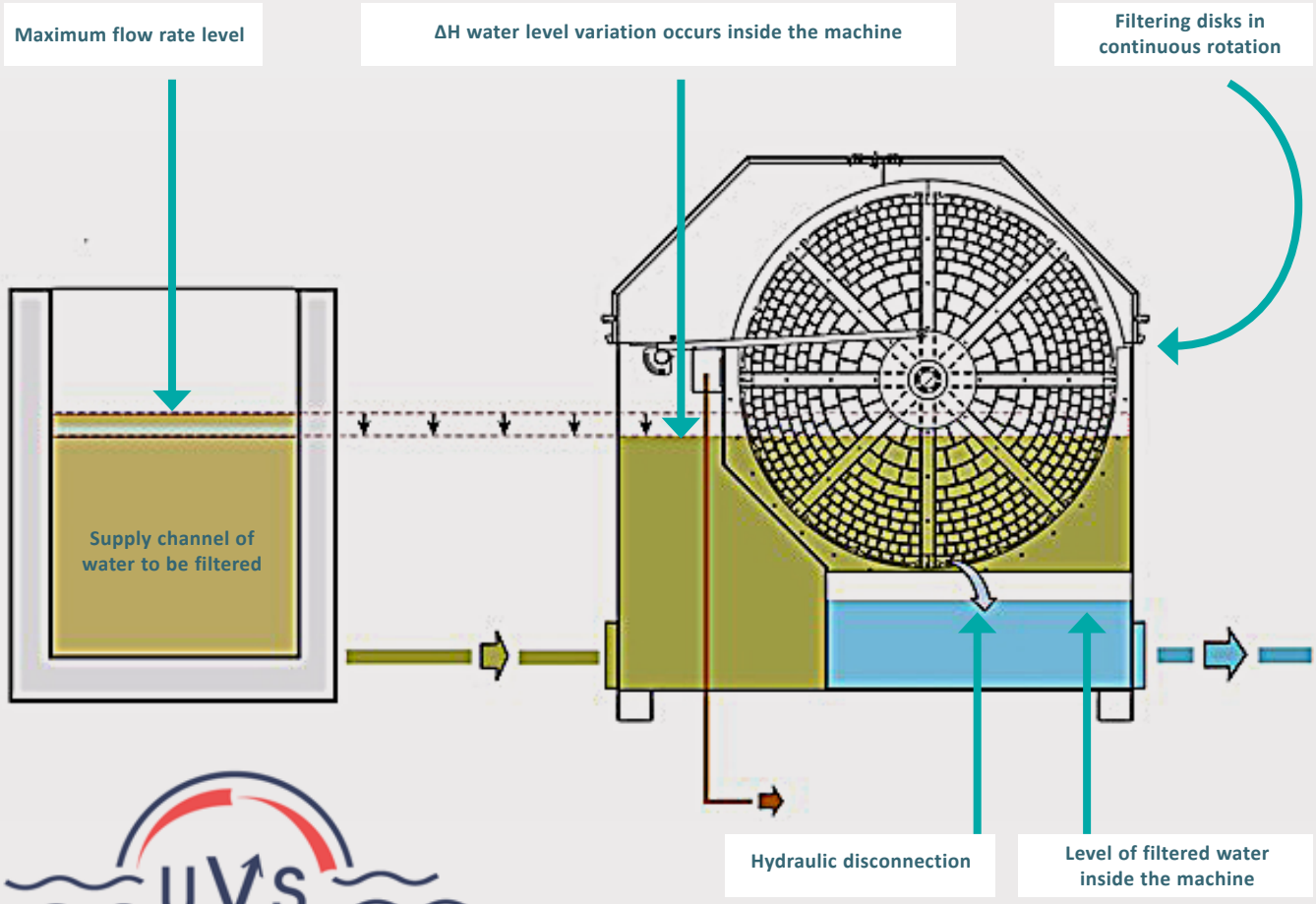
- Removable sector system made entirely of AISI 316L stainless steel
- Quickly removable and replaceable





IMPACTS ON THE INLET LEVEL

Working principle of Continuous-Dynamic Ultrascreen® Microfilter



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INSIDE SA'S LARGEST MBR PLANT

Overview of the newly upgraded Stellenbosch WWTW

Operating over capacity, the Stellenbosch Wastewater Treatment Works (WWTW) was putting the surrounding environment and community at risk. Stellenbosch Municipality undertook to upgrade the plant, and the result was the creation of what is currently the largest membrane biological reactor (MBR) WWTW in South Africa.

Effluent from the Stellenbosch WWTW flows into the Eerste River, which is essential for the Cape Winelands' agricultural and agritourism communities. In 2011, the WWTW was operating over capacity, dilapidated, struggling to meet effluent compliance, a hazard to the environment and a nuisance to the surrounding community, ultimately placing the livelihood of the communities surrounding the Eerste River at risk.

There was a critical need for the WWTW to be upgraded and its capacity extended to cater for flows from the town up until 2035. Stellenbosch Municipality therefore made the strategic and critical decision to upgrade the WWTW with a limited budget at hand. The rapid urban expansion of the town of Stellenbosch also placed additional pressure on the WWTW.

The main objectives were to increase capacity, improve the effluent quality and reduce the foul odour. Zutari, as consulting engineer, undertook the planning and design of the treatment works in 2014, as well as site supervision when construction began in 2015.

Designing a world-class plant

Zutari investigated various options to increase the capacity and upgrade the processes to ensure a high-quality effluent and mitigate odours, while ensuring the upgrade remained within budget.

Following various planning and design workshops, a project concept was co-created by Zutari and the Stellenbosch Municipality, comprising a fully automated plant embodying modern and reputable processing technologies that would ensure a high-quality effluent, robustness, as well as operational and maintenance efficiency.

The design process was structured to enable Stellenbosch Municipality to be an integral part of the blueprint during the planning and design stages. This enabled the municipality to be involved in technology selection, design, operation and maintenance considerations, as well as the aesthetic layout and appearance of the facility.

Membrane technology was selected in order to guarantee a high-quality effluent. The MBR process is an advanced wastewater treatment process that uses ultrafiltration membranes for liquid-solid separation, instead of conventional clarifiers. The design was also developed to maximise the use of existing infrastructure, and to seamlessly integrate the refurbished infrastructure into the new plant, thereby reducing the overall capital cost of the project.

The use of MBR technology was beneficial in terms of the small footprint of the bioreactor, particularly considering the spatial constraints of the existing site, and the production of high-quality effluent, which surpasses the standards prescribed in the water-use licence issued by the Department of Water and Sanitation.

The WWTW was designed to cater for a combination of domestic and industrial wastewater, as well as handle seasonal changes in the influent loading due

The new, state-of-the-art administration building surrounded by landscaping

PROJECT TEAM

Client: Stellenbosch Municipality
Consulting engineer: Zutari
Civil contractor: CSV Construction
Mechanical and electrical contractor: Veolia Water Solutions & Technologies South Africa
Architect: Alex Stewart and Partners
Landscaping architect: Planning Partners
Environmental consultant: Legacy Environmental Management Consulting
Health and safety agent: Safe Working Practice

Zutari's upgrade and extension of the Stellenbosch WWTW won first place at the 2020 CESA Aon Engineering Excellence Awards in the category 'Projects with a value between R250 million and R1 billion'

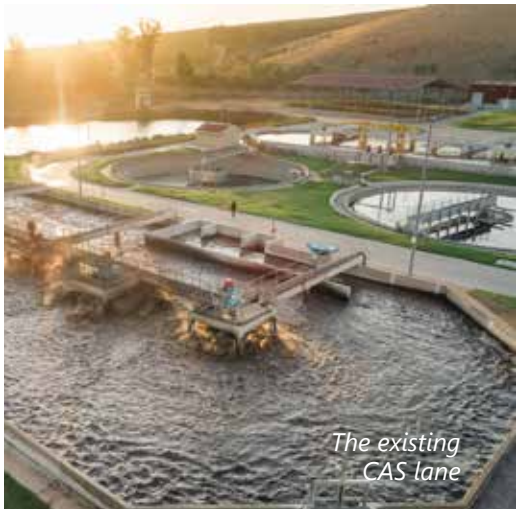
to the agricultural harvesting season, when organic loads increase by 25%. Varying key process parameters such as sludge age and concentration during the harvesting season ensures high-quality, compliant effluent.

A superior effluent quality also presents immediate opportunities for the reuse of treated effluent, which is in line with the municipality's water conservation and demand management strategy.

World-class technology

The project comprised an upgrade of the plant to a full biological nutrient removal process that is capable of handling up to 35 Mℓ/day average dry weather flow, as well as ensuring compliance with the National Water Act (No. 36 of 1998). This upgrade comprised a new inlet works, a new 27 Mℓ/day MBR lane that can handle a peak flow of 67.5 Mℓ/day, the rejuvenation of the existing plant


The new MBR lane


The existing CAS lane


The new inlet works

to an 8 Mℓ/day conventional activated sludge (CAS) plant with ultraviolet (UV) disinfection, and new sludge treatment facilities.

The plant's design included other innovative features, such as a sophisticated control system, odour eradication, energy-efficient technologies and context-driven, sustainable design.

By minimising pumping through the works and adopting energy efficient technologies, such as a fine bubble diffused aeration system in the MBR lane, which is 15% to 20% more energy efficient than traditional technologies, the plant offers significant energy savings.

UV disinfection technology was adopted for the effluent of the CAS lane, which is an environmentally friendly solution over the conventional chlorine disinfection method, and also disrupts and kills a wider spectrum of harmful microorganisms.

The plant was designed to be fully automated using a state-of-the-art distributed PLC system, necessary due to the complexity of the works and to ensure that the process control and operating efficiency is optimised. The Scada system controls all main process units to maximise the equipment run time and ensure optimal energy-efficiency on all processes.

In addition, the facility was designed in such a manner that it can be easily retrofitted with a direct potable reuse facility and biogas-to-energy facility, ensuring that the plant is future ready.

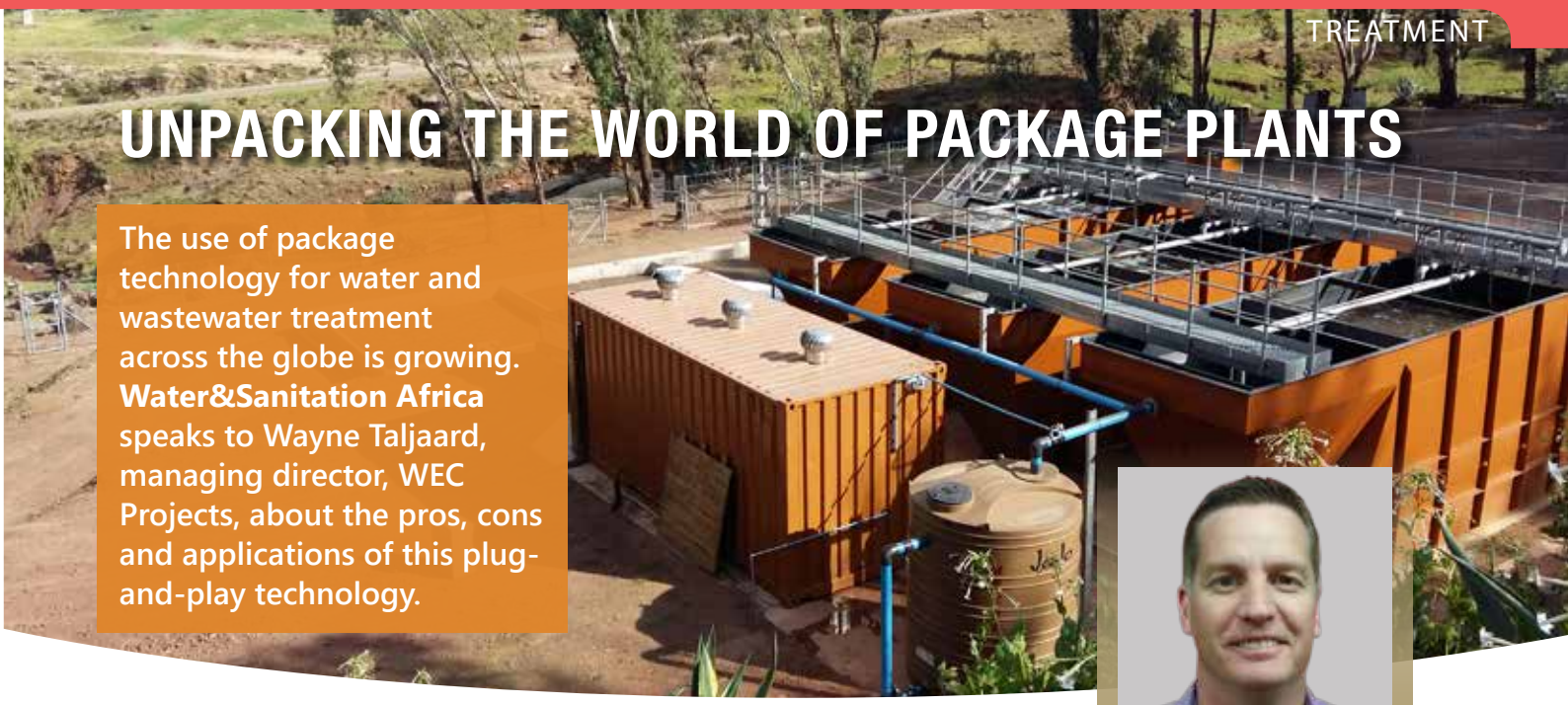
The construction process was implemented in two phases, with Phase 1 commissioned in March 2019, comprising the inlet works, MBR lane, administration building, generator building and sludge treatment facilities. Phase 2 comprised the existing CAS lane commissioned in April 2020. The upgrade will cater for flows from the town up until 2035, allowing for further development and economic growth in the area.

"This project is a testament to the technical skills in the South African water industry, where municipal authorities, in partnership with consulting engineers and contractors, can provide solutions that are innovative, sustainable, operator-centric and community-focused," says Neeren Govender, client director: Water, Zutari.

The state-of-the-art infrastructure facility has significantly improved the state of the Eerste River and the quality of water available for users, while placing Stellenbosch at the forefront of wastewater treatment in Africa. Not only is the project ensuring that wastewater is treated to the highest of standards, but it also ensures resilience of the town's future water supply, while boasting the status of being the largest MBR WWTW in South Africa. 3S

UNPACKING THE WORLD OF PACKAGE PLANTS

The use of package technology for water and wastewater treatment across the globe is growing. Water&Sanitation Africa speaks to Wayne Taljaard, managing director, WEC Projects, about the pros, cons and applications of this plug-and-play technology.



Wayne Taljaard, managing director, WEC Projects

South Africa has many communities that are difficult or impossible to connect to the grid. How can small-scale package treatment plants assist in bringing services to these communities?

WT Package plants exist for both sewage and water treatment. I believe the most obvious need for these plants lies in sewage treatment, but WEC is becoming increasingly involved in the supply of package water treatment plants, including those for reuse.

In terms of water treatment, package plants offer an ideal solution for the treatment of water from local boreholes, rivers or dams to potable standard. From these plants, water can be distributed as needed.

When it comes to wastewater, networked sewers are difficult or impossible to run in many settlements due to a lack of planning, housing layouts and difficult terrain. In these instances, the opportunity for decentralised facilities becomes viable. Package plants provide opportunities to 'segment' regions and treat catchment areas that are easy to combine.

However, in doing this, it remains vital to ensure dignity for the communities in question. WEC's NEWGEN multi-user toilet system offers many real advantages here. Although this is not a true package plant, it is an ingenious treatment solution to a challenging problem of not having a sewer network and the obvious benefit of realising a recycled water stream and other positive by-products.

Like the NEWGEN system, package plants also offer many potential opportunities for reuse applications.

Do package plants present an opportunity to assist existing large-scale water and wastewater plants that need additional capacity?

Definitely – particularly because they can be installed and operational in significantly less time. Couple this with their modular nature and you expand capacity without having to build large infrastructure that must take unknown or uncalculated future growth and demand impacts into consideration.

They can also address an immediate need to improve discharge quality, which, for treatment works operating over capacity, often exceeds the required discharge specification and pollutes our water resources.

What are the benefits of package plants compared to traditional, large-scale plants?

Package plant options for water and wastewater treatment offer a range of benefits. Each package plant is fully customisable to any client or site requirement, easily mobilised to these sites and offers significantly faster delivery. They also offer better scalability through their modular approach and have lower EIA requirements.

Are the any notable challenges or downsides?

Aside from the unit cost per Mℓ/day treated being higher, package plants are not always able to achieve full nutrient removal due to capacity and configuration. This is especially the case with lower-performance competitor products.

Not all package plants are created equal and this – together with a notable lack of available skills – often leads to inappropriate or poor-quality package plants being installed. This is compounded by the fact that the barriers to entry are low for competitors and ultimately contribute to a poor market perception of package plant performance – despite the fact that there are many good companies offering quality solutions.

How do we ensure that package plants remain compliant?

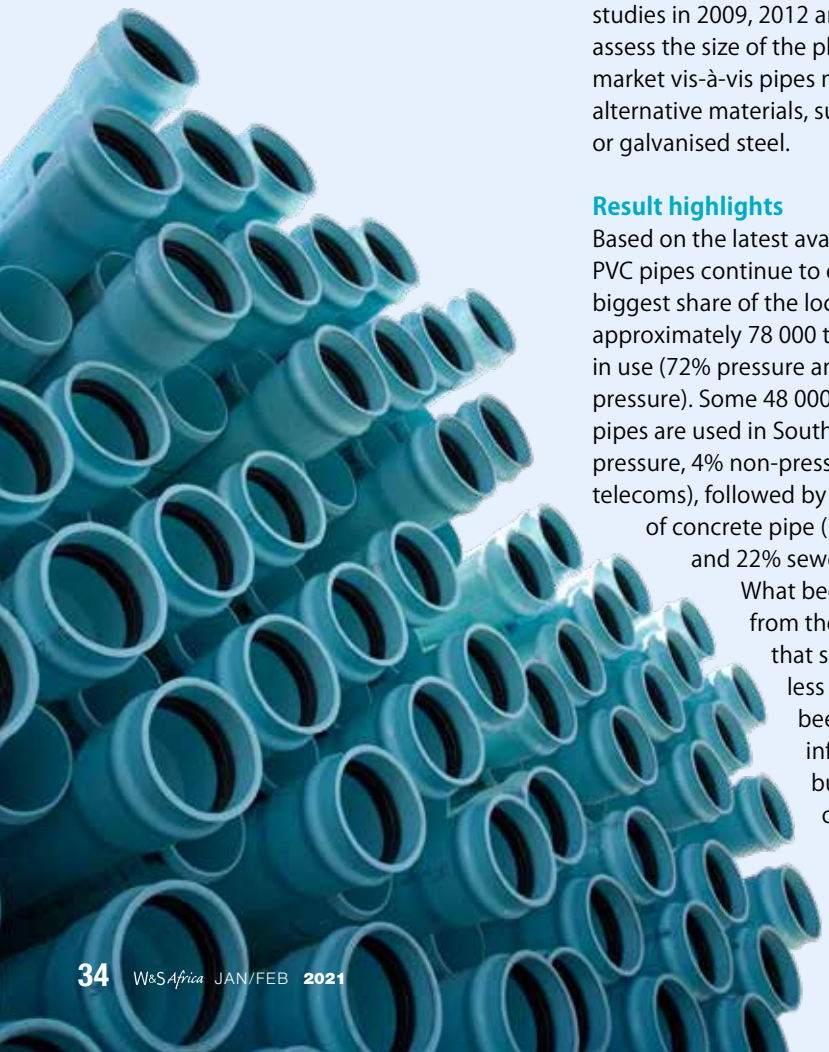
To achieve this, we need industry regulation and technology approval through regulation. Unfortunately, the registration and monitoring of installed packages by an authority such as the Department of Water and Sanitation is currently non-existent.

Are there other applications particularly suitable to package plants?

The result of areas not being connected to a municipal sewer network or overloaded centralised treatment systems, means there is an obvious demand in the municipal space. However, other industries are facing similar challenges. Consequently, there is also a real demand in the mining sector, the construction industry, housing estates, property developments, lodges and tourism venues, and the industrial sector. 3S

SA PIPE MARKET SHRINKS BY 15%

The Southern African Plastic Pipe Manufacturers Association (SAPPMA) has released the findings of a qualitative and quantitative survey into the plastic pipe market, which shows a decline in infrastructure investment in recent years.



This year's survey was the third quantitative survey conducted by LHA Management Consultants for SAPPMA, following on from previous studies in 2009, 2012 and 2017, to assess the size of the plastic pipes market vis-à-vis pipes made from alternative materials, such as concrete or galvanised steel.

Result highlights

Based on the latest available data, PVC pipes continue to enjoy the biggest share of the local market, with approximately 78 000 tonnes currently in use (72% pressure and 28% non-pressure). Some 48 000 tonnes of HDPE pipes are used in South Africa (84% pressure, 4% non-pressure and 12% telecoms), followed by 220 000 tonnes of concrete pipe (78% stormwater and 22% sewer).

What became clear from the research is that significantly less funding has been invested in infrastructure and building projects over the past six years – causing the pipe market to shrink by an alarming 15% since 2014. Although South Africa recorded average GDP growth of 0.8% per annum during the same period, the amount of money that was invested in building and construction projects as a percentage of GDP had declined sharply.

"Reliable infrastructure is desperately needed in our country to ensure the supply of clean drinking water, uninterrupted sewage services, and the provision of electricity, telecommunications and gas services to communities around South Africa. We are very concerned that the pipe infrastructure provision is declining on a per capita basis. This is a clear indication that the taxpayer's money is not being spent where it is supposed to go – despite the promises made by politicians," reports Jan Venter, CEO of SAPPMA.

SAPPMA brand holds strong

According to Venter, the survey was also important for SAPPMA to gauge how its brand is perceived in the market place, as well as whether decision-makers are aware of SAPPMA's mission and activities. In order to do this, LHA conducted interviews with municipalities, contractors, consultants and other decision-makers around South Africa.

"We wanted to hear from the industry on whether our training, communication and efforts to maintain standards are making an impact on the ground. We were also eager to find out from them if any gaps exist and what we could do to offer more technical support or information to the decision-makers," says Venter.

A total of 80% of the respondents indicated that they were very familiar with SAPPMA and its role in the plastic pipe industry, with 20% stating they were only vaguely familiar. SAPPMA scored high for delivering technical support (84%), professionalism (82%), neutrality (80%), and quality assurance (80%). More than half of the respondents (54%) indicated that they give preference to (or only use) suppliers that are accredited members of SAPPMA, and/or carry the SAPPMA logo, albeit with some exceptions. A third (33%) confirmed that they use SAPPMA members exclusively.

Looking ahead

Valuable and insightful feedback was received from the respondents, which SAPPMA will use to set its agenda and priorities for the next few years.

"It is clear that there is a need for ongoing training, communication and skills transfer in the industry. Our annual PIPES conference, quality workshops and technical manual play important roles in this regard. We will continue educating engineers and other decision-makers about pipe selection, pipe standards and pipeline design through these platforms, but will also be offering roadshows to the various provinces once the Covid-19 pandemic is over and life has returned to normal," says Venter.

Recognising the importance of educating future engineers with practical and relevant information about plastic pipe materials, SAPPMA has begun engaging with the University of Pretoria's Department of Civil Engineering to include basic technical info into the curriculum for the third-year students.

Slow recovery

Unfortunately, Venter is not optimistic about the possibility of a quick recovery for his industry. "We know from experience that implementation and roll-out take long. Even if the decisions are taken and approved today to invest in new infrastructure or to upgrade the existing pipe networks, it will still take several months before we start seeing the impact and results," he warns.

"What is more concerning to us is that we have also not yet calculated the full impact of the Covid-19 pandemic on the country's economy, infrastructure spend and, therefore, also on the pipe industry. Optimistic expectations are that South Africa's GDP will only recover to 2019 levels by 2023. Rapid recovery is therefore highly unlikely, and we are preparing ourselves for a bumpy ride," Venter concludes. 3S

WASH PROJECTS CRUCIAL TO CURBING COVID-19

WASH (water, sanitation, and hygiene) projects play a critical role in reducing the spread of the SARS-CoV-2 virus. Government and policymakers now have a greater motivation to pay more attention to such projects because a simple action like handwashing is a key tactic in preventing the spread of many deadly illnesses.

JG Afrika is a South African firm of engineers and environmental scientists who have executed a number of leading WASH projects on the continent. Robyn Tompkins, the firm's WASH specialist, says that most governments and policymakers have realised that improved WASH can have a profound positive impact on public health and the environment.

"As far back as 2011, a WHO study, *Water, sanitation and hygiene interventions and the prevention of diarrhoea*, notes that water supply interventions can reduce the incidence of diarrhoea, for example, by 5%, water quality interventions by 19% (after 12 months), sanitation interventions by 36%, and handwashing interventions, alone, by a staggering 47% for handwashing with soap," Tompkins explains.

WASH projects focus on preventing human contact with pathogens and involve the safe confinement, collection, treatment and disposal of human excreta, as well as the associated hygiene-related practices.

Tompkins and her team are about to work on faecal sludge management pilot project in Polokwane, Limpopo. This is a collaboration between the South African Department of Water and Sanitation, the Polokwane Municipality and the USAID Resilient Waters Program. JG Afrika is a subcontractor to lead consultant, Chemonics International on the programme, with Tompkins fulfilling the role of the Senior Advisor: WASH.

The project is an extensive undertaking that entails using tools such as a faecal waste flow diagram and city service delivery assessment, as well as the WHO's Sanitation Safety Plan. "We will improve sanitation management by creating a platform and develop a broader urban resilience toolkit in the context of the circular economy in Polokwane. A faecal sludge management strategy for South Africa will be generated based on information provided by the platform and other projects. There is a growing realisation that we cannot use the same resources we have in the past. We need new and innovative ideas to deal with a growing challenge, especially in Southern Africa – where we are caught between inadequate sanitation facilities and a high risk of climate change, which will impact on the resources that we do have," explains Tompkins.

New and essential sanitation technologies

Modern sanitation technologies provide resource-efficient solutions to some of the challenges associated with WASH. They are often implemented quicker and more cost-effectively and are becoming increasingly available to developing economies.

For example, an innovative app facilitates community members in locating and booking the services of the nearest private drainage operators. This drives the uptake of these services among low-income residents, as has been the case in Dakar, Senegal. Collection services were previously unaffordable for many residents of the city and they would, therefore, manually remove the waste themselves or pay someone to do this

on their behalf – with the contents often illegally emptied in the open environment. Working on the same premise as Uber, residents use text messages to order the services of private drainage operators who have registered on the system and compete on auction to claim a desludging request. The app's GPS technology has allowed the Senegalese government to collect valuable information to improve evaluation and monitoring for sanitation planning.

India is a world leader in new sanitation technologies, where decentralised sanitation systems have a profound positive impact on the living conditions of low-income communities. A case in point is a system treating about 50 kℓ/day of the total wastewater from Kachhpura slum in Agra, India. This cost-effective solution is simple to maintain and has reduced biological-oxygen demand by 61%, chemical-oxygen demand by 64%, and total dissolved solids by 94%. There is immense potential to also adapt it for areas in Africa.

New thinking around sanitation can go even further by also focusing on producing many end products from faecal sludge. Tompkins says that studies undertaken in Senegal, Ghana and Uganda have demonstrated that the following end products can be derived from processing faecal sludge: dry sludge as fuel for combustion; biogas from anaerobic digestion of sludge; protein derived from sludge processing for use as animal feed; dried sludge as a component in building materials; and treated sludge as a soil conditioner or organic fertiliser.

WASH projects focus on preventing human contact with pathogens and involve the safe confinement, collection, treatment and disposal of human excreta, as well as the associated hygiene-related practices

Local technology

In South Africa, faecal sludge from VIP (ventilated improved pit) toilets is extruded to produce pellets using Latrine Dehydration and Pasteurisation (LaDePa) technology, which was developed by eThekwini Water and Sanitation and Particle System Separation. As part of a pilot phase, these dried and pasteurised pellets will be sold as an agricultural product. Furthermore, Durban recently harvested black soldier fly *(Hermetia illucens)* larvae, which eat human faecal waste to reduce its volume, after composting with a combination of food and matter of a faecal origin for further processing into a branded nutrient product for the agricultural market.

This new thinking around sanitation has the potential to create immense opportunities for increased private sector participation – not to mention local livelihoods. 3S

R10 BILLION TO ELIMINATE PIT TOILETS AT SCHOOLS

South Africa's protracted school sanitation crisis, which comes with an estimated R10 billion price tag to eradicate pit latrines, has prompted a call to action for corporates, non-government organisations and ordinary citizens to help restore the dignity of the country's most disadvantaged learners.

Laying down the challenge on World Toilet Day on 19 November, Unilever and its brand Domestos shone the spotlight on the country's not-so-secret shame: tens of thousands of learners at close to 4 000 state schools are still being deprived of their fundamental human right to water and sanitation.

"If there is any hope of realising the government's target of eliminating pit latrines at the country's schools by March 2022 – only about 16 months from now – we are all going to have to step up our efforts," says Henry Muchauraya, marketing director: Home & Hygiene, Unilever.

SAFE

In August 2018, President Cyril Ramaphosa announced the Sanitation Appropriate for Education (SAFE) plan to eradicate these pit latrines across all schools in the following two years. During the 2019 State of the Nation Address, he reaffirmed the commitment, but increased the implementation period by a year.

At the time, the SA Human Rights Commission (SAHRC) commented that the responsibility for raising the

requisite R10 billion for the roll-out, which the government said it hoped to raise with the assistance of the private sector, might rightly lie with business. While the SAHRC was adamant that an unequivocal commitment from government was needed, it suggested that recourse to the private sector may be justified, "given the role business must play in positively impacting society".

Domestos supported this cause by raising R500 000 through sales on World Toilet Day 2019 to build new toilet facilities in a school. In 2020, Domestos funded new toilet facilities at five schools in the Eastern Cape and two schools in KwaZulu-Natal.

Urgent action needed

Three of the four main reasons learners fail to attend school are sanitation related, and include intestinal worms, upper respiratory tract infections, and diarrhoea. Sanitation is critical to children, from both an educational and health perspective. The eradication of pit latrines must therefore remain a top priority for everyone in South Africa.

In addition, records show that four children have tragically died in school pit latrines in South Africa since 2014.

Out of almost 25 000 schools nationwide, the almost 4 000 schools with pit latrines are primarily in the Eastern Cape, KwaZulu-Natal and Limpopo. A total of 61 schools in the Eastern Cape have no toilets at all and 1 585 have pit latrines, while 1 379 pit latrines remain in use at KwaZulu-Natal schools.

The health risks are evidenced in WHO statistics, which show that more than 800 000 people in low- and middle-income countries die annually as a result of inadequate water, sanitation and hygiene. Poor sanitation is believed to be the main cause of more than half of these deaths.

From an education perspective, the range of impact on learning, according to the Water Research Commission's *2017 School Sanitation Management Handbook*, includes learners missing classes while waiting for toilets or leaving school to relieve themselves, girls staying home during their menstrual cycles, and threatening or humiliating experiences in the pit toilets compromising children's ability to thrive at school.

"Working in collaboration to find workable solutions for school sanitation in the country is critical and cannot be done in isolation. Working together with the Department of Basic Education and other corporate partners – including Norcros, Designdex, Italtile, Plumblink and Envirosan – has enabled the impact we have been able to make so far. PPC and Spar have come on board to assist in building more toilets in the new year," says Muchauraya.

He appeals to company heads across the spectrum to join forces to drive the realisation of universal access to safe sanitation and clean drinking water.

In 2015, the WHO estimated the global economic costs associated with productivity losses due to sanitation-related deaths and illnesses at US$222.9 billion (R3.5 trillion) – or 75% of South Africa's expected 2020 GDP. "This is money that could have been much better spent on infrastructure, education, hunger alleviation programmes, safety measures, good governance mechanisms, and other priorities outlined in the Sustainable Development Goals," he says. 3S

Nelson Mandela Bay continues to battle low dam levels after it became the first major South African city to reach 'Day Zero'. **Danielle Petterson** speaks to Barry Martin, director: Water & Sanitation at Nelson Mandela Metropolitan Municipality (NMBM), about how the municipality is responding.

Nelson Mandela Bay BATTLES DAY ZERO

Nelson Mandela Bay's water woes date back several years. In August 2018, the dams supplying the city had dropped to a collective 17%. Some relief came from a mini flood that raised dam levels to around 54%. But the levels have been consistently dropping ever since and, at the time of writing, sit at around 22% – bolstered slightly by recent spring rains.

"We are not in a good space and we are very concerned about the state of our dams going forward," says Martin. "We have reached the end of our rainy period, which typically runs from September to November and the National Weather Service does not predict above-normal rainfall for the upcoming period, which means we do not expect a significant increase in our dam levels."

The period from December to the end of February is the hottest of the year, typically bringing with it increased demand. This is of major concern, as the city's daily consumption continues to exceed the restrictions put in place by the Department of Water and Sanitation (DWS).

According to Martin, there is currently a deficit of around 40 Mℓ/day in the Algoa Water Supply System, necessitating augmentation from the Nooitgedacht water scheme; however, this means that there is no reserve in the event of any operational glitches, such as power interruptions, mechanical failures or pipe bursts, and this sometimes results in intermittent supply. "For all intents and purposes, Day Zero has arrived," says Martin.

He believes the city's inability to meet water restrictions can be partly attributed to the Covid-19 crisis, which has necessitated increased water consumption, particularly by the healthcare sector, to meet hygiene requirements.

In response to the situation, NMBM has implemented a wide range of drought response interventions that include reducing losses, managing consumption and augmenting supply.

Reducing losses

In terms of non-revenue water (NRW), the municipality currently experiences physical losses of just under 30%.

Leak repair remains a priority and, in 2020, NMBM introduced a multimillion-rand water leaks project along with a commitment to achieve a tight turnaround time of 24 hours for the attendance of pipe bursts. Internal and external teams have been employed to address major and minor leaks, achieving in excess of 16 000 repairs in the last few months of the year.

NMBM is also working closely with the Department of Education and the Department of Public Works to address leaks at schools and reduce water wastage. This is bolstered by a proposal by the local business chamber to assist with water-loss reduction at schools in order to offset water consumption by the business sector.

The municipality has also implemented a pressure management programme to further reduce losses and currently has 70 pressure stations running.

Council has approved a loan of more than R400 million over the next three years for pressure management and pipe and meter replacement. According to Martin, these interventions form the first part of an approximately R1.5 billion plan to reduce physical water losses to around 15% over the next 10 years.

Augmenting supply

Currently, the municipality brings in around 160 Mℓ/day from the Nooitgedacht system to bolster water supplies. Water from this system is used to fill reservoirs overnight to ensure there is enough water stored to meet the daily demand. "It's a fine balancing act to transport water across the metropolitan areas to bring water to customers where it is needed," says Martin.

The final phase of the Nooitgedacht low-level water scheme project is currently under way and involves the extension and upgrade of the Nooitgedacht Water Treatment Works (WTW). While this is being finalised, a temporary treatment facility has been set up to treat around 35 Mℓ/day.

Once complete, Nooitgedacht Phase 3 will add 40 Mℓ of treatment capacity – bringing NMBM's total water treatment capacity to 210 Mℓ/day. The R440 million project is funded by the DWS and is expected to be completed by July 2021.

The municipality has also identified strategic areas in which to drill boreholes. This includes the large-scale Coegakop Wellfield, as well as several smaller boreholes along the Churchill Pipeline, which will supply approximately 50 Mℓ/day together. Work has already begun on the Coegakop project, which is currently on track for completion in 2022. Once commissioned, the Coegakop Wellfield and WTW will be the largest biofiltration plant in South Africa, adding 15 Mℓ/day to the city's water supply.

Martin reports that the procurement process is currently under way to appoint contractors for the smaller borehole projects, which are anticipated to come on-stream in June 2021.

Furthermore, a barge equipped with submersible pumps has been floated on Impofu Dam where, at just 18.8%, the water level has dropped below the lowest intake point. This is allowing NMBM to abstract around 30 Mℓ/day that would otherwise not be available.

Managing consumption

NMBM is executing a broad campaign to educate consumers on water conservation and build awareness of the municipality's drought interventions. This includes radio slots, advertisements, social media and webinars.

The municipality has also installed more than 780 flow restrictors and just under 20 000 automatic flow metering devices to limit the flows and pressures to high water consumers. Flow restrictors are being rolled out to all households that consume more than 30 kℓ of water per month.

"We still have some households consuming more than 50 kℓ per month, which is what three households should use on average. With the amount water we have available, we simply cannot allow this to continue," says Martin.

Long-term water security

"The DWS has no plans to build new dams in the Nelson Mandela Bay region, and the available surface water supply is fully licensed. We therefore have to rely on other sources moving forward, which include groundwater, desalination and recycled wastewater," says Martin.

The environmental authorisation of the Coega Special Economic Zone (SEZ) requires that it use recycled water for all non-potable requirements. NMBM has therefore allocated treated wastewater from its biggest plants for this purpose.

The Coega Development Corporation has also been given grant funding for the construction of a permanent desalination plant at the Coega SEZ. The first phase of 15 Mℓ/day should be operational by 2022, which will significantly reduce demand on municipal supply.

Long-term planning also includes the establishment of a permeant desalination plant for the city. "Given that we are in a water-deficit equation, moving forward, a desalination plant will form a baseload for our water demand," says Martin. This plant would run at full capacity 24/7 and supply 30 Mℓ/day to 60 Mℓ/day to form a base supply for the city. The remaining water needs would be met by surface water and groundwater supplies.

"Given the effects of climate change and the lack of available rivers to build new dams, behaviour change and using water sparingly must become a permanent way of life for Nelson Mandela Bay residents," Martin concludes. 3S

Barry Martin, director: Water & Sanitation, NMBM

Alex McNamara, programme manager: Climate & Water at the National Business Initiative

THE WATER SECTOR: from risk to value

The water sector offers substantial opportunities to tackle inequality, poverty and unemployment in South Africa – and the private sector can be a powerful partner in this regeneration, writes **Alex McNamara**.

The stark reality is that water requires urgent action in South Africa. Drought and poor water service delivery are already constraining economic growth and hampering livelihoods. Only 64% of South Africans have reliable water access. In 2017, the National Business Initiative (NBI) described this water context as having all the facets of a perfect dust storm – a description that still holds true.

The current situation is clearly not heartening, especially at a time when our economy faces massive upheaval due to the novel coronavirus and its aftermath. But we should remember that times of upheaval are also sources of newfound resilience and changed mindsets.

As the NBI, we have assisted in two declared disasters in recent times: the severe water shortages faced in the Western Cape in 2018 and the current Covid-19 pandemic. We have noted in both that a crisis can quickly galvanise partnerships and build lasting bridges between business, government and civil society. And these lasting bridges are critical when the dust settles, and the new growth begins.

The NBI's Covid-19 response, which focuses on providing people in high-density settlements with safe access to handwashing facilities, often for the first time in their lives, has been backed by AECI, Astron Energy and the Grundfos Foundation, and undertaken in collaboration with Business for South Africa and the City of Ekurhuleni.

We have seen companies using their transport fleets to help deliver water to isolated rural communities that the municipality struggles to reach. We have also seen the provision of pro bono technical assistance from firms, support in the development of new groundwater sources through equipment and manpower, and the large-scale donation of sanitiser to municipal service delivery teams.

We witnessed similar private sector responses during the Western Cape drought, with companies reducing operational water usage, donating significant volumes of water, and assisting all spheres of government with disaster planning and preparedness.

The role of companies

For companies, the work related to water security begins within the factory fence, by reducing their consumption, increasing water recycling, and ensuring that discharges are minimised and of an acceptable standard. But operational improvements are just the start of the journey.

True water risk mitigation and value creation can be found in supporting improved catchment management

and city- or community-level water partnerships. Sectors in South Africa such as food and beverage, retail, banking, forestry, chemicals, and mining have already played a key role in supporting their supply chains and operations in water-stressed areas, while enhancing their relationships with customers, communities and regulators.

The NBI has been an important aid and ally. Through our member-based capacity-building programme, we have provided businesses with a means to learn from national and global water experts, and – probably most importantly – from one another. Through the CDP (formerly the Carbon Disclosure Project), we have assisted companies to ask the right questions and effectively disclose their water practices to their investors.

We have also served as a partner in implementation. You will find excellent examples of corporate water leadership and disclosure from companies such as AB InBev, Distell, Exxaro, Mondi, Tongaat Hulett, and Woolworths on the NBI's water page. These company efforts are to be commended, but they alone will not address the substantial risks facing the South African water sector.

To address these, the risks must become opportunities, and the value at risk must become value created.

Unlocking finance and investment

Closing the water funding gap in South Africa will require two main things: the raising of municipal water revenues and the attraction of private-sector capital. Improved billing, collections, credit control and customer service have the potential to raise municipal revenues substantially.

The NBI, for its part, has commenced with a new programme referred to as Technical Assistance, Mentorship and Development (Tamdev), supported by business, to enhance the capacity of the state. A key focus is to assist municipalities in enhancing their financial management and procurement capacity. Tamdev uses a network of retired engineers, accountants and managers; although a relatively new programme, it has already made good strides in the Eastern Cape, Limpopo and Gauteng.

Leveraging private sector expertise and finance through long-term public-private partnerships (PPPs) provides a further means to revitalise water investment. In the NBI's work on water PPPs under Kopano ya Metsi, we argued that PPPs can, if well designed, create a channel for private capital to flow into the sector, thereby supplementing government spending and freeing up public sector resources for other purposes.

In assessing the PPP potential at municipal level, we identified that 28 South African municipalities demonstrate good PPP potential in one form or another. South Africa's water PPP track record, while limited, is largely very successful. Both the long-term Mbombela and iLembe concessions and the more institutionally focused Joburg Water Management Contract provide a source of encouragement.

Where PPPs are not viable, it will remain important to focus on strengthening municipal water delivery and financial management, but also to blend water-related government grants with private finance, in a way that effectively quadruples the funds that are available.

Opportunities for new growth

Water and sanitation are also filled with opportunities for job creation, small business development, and large-scale commercial industry. One of the biggest commercial opportunities lies in tackling water leakage within municipal reticulation networks. Staggeringly, about 40% of all potable water is lost through leaks before it even reaches the consumer. This lost water is estimated at a R9.9 billion opportunity at present. Companies such as Sasol, Anglo American and AB InBev have all taken concrete steps to help realise the strategic and financial value of water leakage for municipalities.

Another key opportunity lies in wastewater. Revenue options include treatment charges, the use of nutrients in fertilisers, the generation of biogas, and opportunities for water reuse. Current examples of large-scale water reuse, specifically the eMalahleni Water Reclamation Plant and Durban Water Recycling Project, provide different examples of how industry can both support and benefit from water reuse projects.

The sanitation economy – ranging from the extraction of high-value chemicals to the development of animal feed, the sale of innovative sanitation solutions, and sanitation-derived biogas – is an area unlocking commercial interest in Africa and Asia, including in pockets of South Africa.

In addition, looking more closely at the decline of our natural capital holds the tantalising prospect of finding ways to finance improved land and catchment management, through the restoration of degraded landscapes and the use of cleared alien vegetation. These ideas are not new, and many have been supported by government for some time, but the scale of the opportunity seems far bigger in a post-Covid-19 world.

The future thus holds an exciting prospect. Out of the current pandemic and its accompanying water crisis emerges an environment in which new relationships have been formed, and a realisation that collective will is needed in the face of adversity. Resilience, renewal and new growth are at work. 3S

The full article appears in the 23rd edition of the Trialogue Business in Society Handbook*, which can be downloaded for free at https://trialogue.co.za/publications.*

COMBATING ALIEN VEGETATION

Environmental management that includes alien vegetation control is vital to ensuring a sustainable water future in South Africa. In line with this, Bosch Munitech is currently combating the spread of water hyacinth in a KwaZulu-Natal river.

"South Africa is currently facing a major environmental problem, where invasive alien plants brought into the country, either intentionally or unintentionally, are aggressively spreading and taking precious water and space from our indigenous plants," explains Zaheer Ismail, project manager: Environment, Bosch Munitech.

"Many alien plants consume more water than local plants and are depleting our valuable underground water resources. Added to this, dense alien vegetation provides fuel for veld fires, causing damage to the soil structure beneath. Invasive alien plants are also a major threat to biodiversity in catchment areas, potentially disrupting the delicate natural balance in ecosystems. In South Africa, there are now approximately 383 invasive plant species that must be urgently controlled to prevent further damage."

In addressing this threat, Bosch Munitech is working closely with botanists and other environmental specialists, offering various services to assist with alien invasive plant management. "Together, we develop alien invasive species management plans for specific projects, including environmental management or fire risk settings. These management plans involve the identification of the types of species in the area and recommendations are provided as to which control and management methods are best suited for the eradication and management of alien vegetation," says Ismail.

Although alien invasive species can be managed in various ways, including manual and mechanical, biological (beetles and viruses) or chemical (herbicides) methods, Bosch Munitech opts for environmentally friendly manual, mechanical and biological methods.

An example of this is an ongoing project on a river in Durban, KwaZulu-Natal, where Bosch Munitech is successfully controlling the spread of water hyacinth through a combination of manual and biological management methods.

Manual control

The manual removal of alien vegetation typically involves hand-pulling invasive plants, like water hyacinth, from the water surface, using a pitch fork and treble hooks. Because this method is labour-intensive, it is only effective for limited areas of infestation. Another problem with manual control is that vegetation removal from deep water, like canals, requires additional equipment such as rafts or boats, as well as various safety precautions.

In the current Durban river project, Bosch Munitech's recommendation was to clear a pocket of water hyacinth from the river directly in front of the area where a specially designed and manufactured net was installed. Pitch forks and treble hooks were used to manually pull the hyacinth to the sides of the river. The plants were then moved to the stockpiling location, where they were left to dry before being transported to areas of rehabilitation, to be used as a mulch fertiliser.

Biological control

Alien invasive plants like water hyacinth thrive and spread in an exponential manner, partly due to the lack of natural enemies, like browsers or pathogens, that exist in their native land.

Biological control agents, like insects, mites or other pathogens, can be introduced to remove an alien plant's competitive advantage and to reduce its vigour to a level comparable to that of the natural vegetation. Biocontrol agents attack specific parts of target plants, such as leaves, stems or roots, or the reproductive parts, like flowers, fruits or seeds.

In Durban, Bosch Munitech is releasing control agents into the netted area of the river on a monthly basis and will continue to do so until the target population of control agents is achieved.

These biocontrol agents are received from the South African Sugar Research Institute, which has introduced a mass rearing programme for weed biocontrol agents. 3S

Why the sector needs self-regulation

The Collins Dictionary defines regulation as the controlling of an activity or process, usually by means of rules. All over the world, local and international regulations exist to govern the various aspects of water from protection to use, conservation and management.

By Ayesha Laher*

At first, water quality regulation focused exclusively on monitoring water quality results to inform decision-making and enforce regulations. The water quality determinants and limits were based on scientific evidence available to the water fraternity, in particular the World Health Organization (WHO), which provides guideline limits for contaminants that may occur in water. Most countries use their own limits based on local conditions. In general, poor countries have lower limits, while developed countries will have stricter ones.

Paradigm shift

In May 2000, the water quality regulation space underwent a paradigm shift, when bacterial contamination of municipal water in Walkerton, Ontario, resulted in the worst public health disaster involving municipal water in Canadian history. At least seven people died and 2 300 became ill.

A public inquiry examined the events and delineated the causes of the outbreak, which included the contamination of groundwater from upstream sources, improper practices and systemic fraudulence by the public utility operators, the recent privatisation of municipal water testing, the absence of criteria governing the quality of testing, and the lack of provisions made for the notification of results to multiple authorities. For the first time, external factors that were seemingly unrelated to water quality were implicated as reasons for the ultimate water quality failures. This led to the foundation of the water safety plan (WSP) concept, introduced by the WHO in 2004, which offers a more proactive and holistic approach to drinking water quality management – from catchment to consumer – using the basic concepts of risk management: identify, assess, control and review risks in a continuous cycle. Instead of monitoring water quality parameters, the focus is on the identification, mitigation and monitoring of risks that may negatively impact water quality.

Perhaps the greatest benefit of the WSP was a change in mindset from 'monitoring to verify the safety of water' to 'monitoring to detect contaminants/risks, as potential for contamination is always present'. This places the responsibility of continuous monitoring and the management of risks on the water services institution, as there is always the potential for new emerging risks.

The simplicity of the WSP concept has resulted in its adoption by more than 93 countries worldwide, and

Incentive-based regulation was not only successful in improving water quality compliance, but it also embedded a sense of pride and accountability in water services institutions

nearly 70 countries have policies or regulations pertaining to this approach.

As a WSP for single supply systems can easily be integrated into provincial, national and basin levels, the UN has advocated that the WSP be used as a tool to monitor the implementation of SDG 6.1 (safe and affordable drinking water) and SDG 6.3 (proportion of bodies of water with good ambient water quality).

The verification and validation steps in the WSP methodology allow for water services institutions to verify the quality of water against their own legislative requirements, thereby facilitating self-regulation.

Once the cycle of continuous risk identification and management is adopted – plan, do, check and act – self-regulation becomes embedded within the institution and thus reduces the need for punitive regulations by governments or national departments.

South African context

The Department of Water and Sanitation (DWS) is mandated to regulate water services in South Africa as per the Water Services Act (No. 108 of 1997). The two conventional approaches for regulation are:

1. Compliance monitoring – based on norms and standards
2. Punitive regulation – enforcement.

The initial regulatory function of the department was focused on compliance monitoring through the introduction of the Electronic Water Quality Management System (eWQMS) in 2007 as a means to improve drinking water quality management and provide access to information for regulatory functions.

The biggest limitation of the eWQMS system was that it focused only on water quality compliance, which promoted reactive management, rather than the proactive, preventative management of failures. What was required was a more holistic approach to regulating the overall performance of a water supply system that could prevent both current and future water quality failures.

In response to the adoption of the risk-based WSP concept, the department prepared the Drinking Water Quality Framework for South Africa, based on a risk management approach from catchment to consumer. In 2008, the updated version of this framework included the concept of incentive-based regulation and risk-based regulation to allow for proactive management and regulation of drinking water quality in South Africa.

The Blue and Green Drop certification programmes for water and wastewater regulation and management were introduced as a method of incentive-based regulation drawn from legislated norms and standards, as well as international best practice.

Incentive-based regulation is unique in that it is a conscious use of rewards (and penalties) to encourage performance excellence and continuous improvement. While incentive-based regulation is mandatory, its appeals to the sense of pride and accomplishment of the water services institution to generate a culture of continuous improvement and accountability within the organisation.

Using clearly outlined legislative requirements to define a scorecard that evaluates excellence in water and wastewater management is the most effective method for a water services institution to self-regulate its performance, with regular internal audits that will drive improved compliance.

The success of these programmes was clearly visible with remarkable improvements in drinking water quality management. At the height of the Blue Drop programme in 2012, the average national Blue Drop score was 87.6%, compared to just 51.4% in 2009 when Blue Drop was launched. The 2012 Blue Drop results translated directly to an improvement in drinking water quality compliance, as this component accounts for 30% of the total Blue Drop score.

Incentive-based regulation was not only successful in improving water quality compliance but it also embedded a sense

At the height of the Blue Drop programme in 2012, the average national Blue Drop score was 87.6% – compared to just 51.4% in 2009, when Blue Drop was launched

of pride and accountability in water services institutions that pushed them to continuously strive for compliance.

However, since the formal audit programme was dropped by the DWS in 2014, the reporting of water quality compliance and overall water quality has decreased considerably, with only Gauteng achieving 99% microbiological compliance in November 2020. Some water services institutions, such as ERWAT, have continued with internal Green Drop audits as a method of self-regulation to ensure effective water services regulation.

Self-regulation

This idea of self-regulation is being adopted in all spheres of life. As we are faced with dwindling resources, global warming and plastic pollution that threatens to destroy our oceans and rivers, we are all examining our lives and self-regulating to improve the situation. From recycling waste to reusing greywater, planting trees, switching to solar energy or eating less meat, everyone is asking themselves how they can make things better. The rise of environmental warriors like Greta Thunberg and Leonardo DiCaprio unites people to change their behaviour and self-regulate their actions.

Where a lack of enforcement has negatively affected the environment, many civic organisations are taking the lead in preserving and restoring our water resources. In South Africa, Fresh.org and Armour mobilise communities on a weekly basis to clean up rivers and use innovative options such as crowd funding to pay unemployed people to clean them. 'Citizen science' is the new buzzword, with ordinary people conducting water quality testing and highlighting the deterioration in water quality, prompting governments to enforce regulation. Regulation has moved out of the law books and everyone has the ability not only to report non-compliances but also to implement actions to reduce risks to our water resources.

The Covid-19 pandemic has elevated the need for self-regulation in all spheres of life to ensure the protection of everyone. If we do not protect ourselves, we endanger the lives of everyone around us. Safe water takes centre stage and is the first line of defence against the pandemic. It is time for our water services institutions to take responsibility for the quality of water produced, regardless of regulation, because it has a direct impact on health and our ability to fight the pandemic.

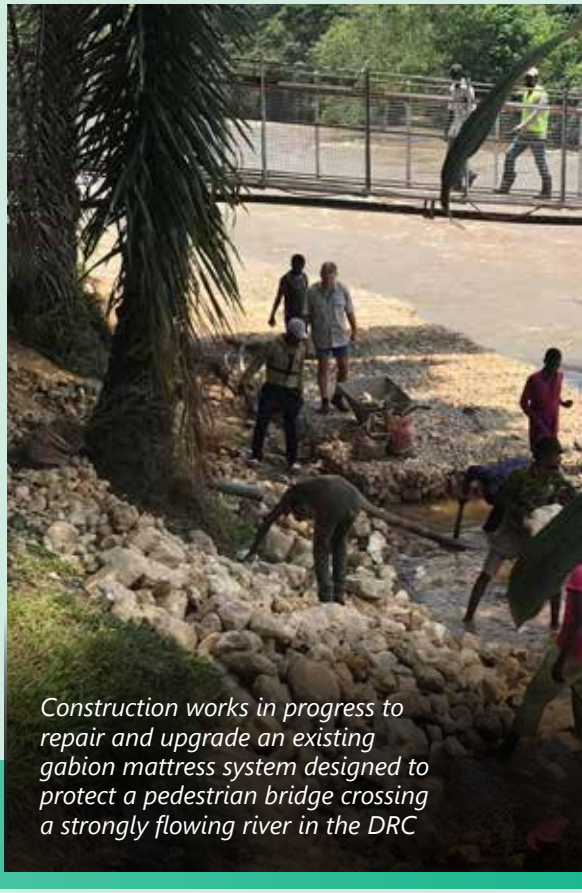
This is an opportune time for our water services institutions to embrace self-regulation through internal Blue and Green Drop audits to ensure the delivery of safe drinking water to all and the protection of our water resources. 3S

***Ayesha Laher** *is a director at AHL Water (ayesha@ahlwater.co.za).*

FLEXIBLE AND PERMEABLE RIVER PROTECTION

The increasing incidence and severity of extreme flood events, combined with rising stormwater velocities, constantly threatens to undermine riverbank protection systems. These challenges necessitate environmentally engineered countermeasures, says Louis Cheyne, managing director, Gabion Baskets.

By Alastair Currie



Construction works in progress to repair and upgrade an existing gabion mattress system designed to protect a pedestrian bridge crossing a strongly flowing river in the DRC

RIVER EROSION REPAIR WORKS IN THE DRC

Riverbanks and riverbeds are typically composed of soft underlying materials, like clayey soils and black turf, which are especially prone to erosion. In addition to localised damage, this can also contribute to downstream impacts like excessive sedimentation build-up in dams.

"In developing the best river erosion system design, the goal is to work *with* the hydraulic forces rather than against them," Cheyne explains. "In this respect, gabion systems provide the best approach, since they are essentially wire-framed structures filled with rocks that together enable some degree of permeability. The extent of this will be site dependent. For example, in mass gravity gabion retaining wall structures, erosion protection blankets are often included to minimise fines loss."

The double-twisted hexagonal woven steel mesh used to construct gabion baskets and mattresses is designed to flex, which is important for the structures' longer-term integrity. Selecting a Class A galvanised wire specification is equally important to counter abrasion and corrosion.

Galfan and PVC

In especially demanding conditions, Galfan coated wire is recommended where high levels of pollution are present. This is an increasingly common factor within urban river systems exposed to industrial waste and untreated effluent.

Galfan is composed of a higher-grade steel coated with a zinc-aluminium layer. The use of Galfan is equally recommended for fast-flowing, turbulent river courses. Here, higher levels of oxygenation occur as the rapidly flowing water swirls around gabion structures. In the case of both Class A and Galfan wire, a PVC coating can also be applied to achieve additional protection.

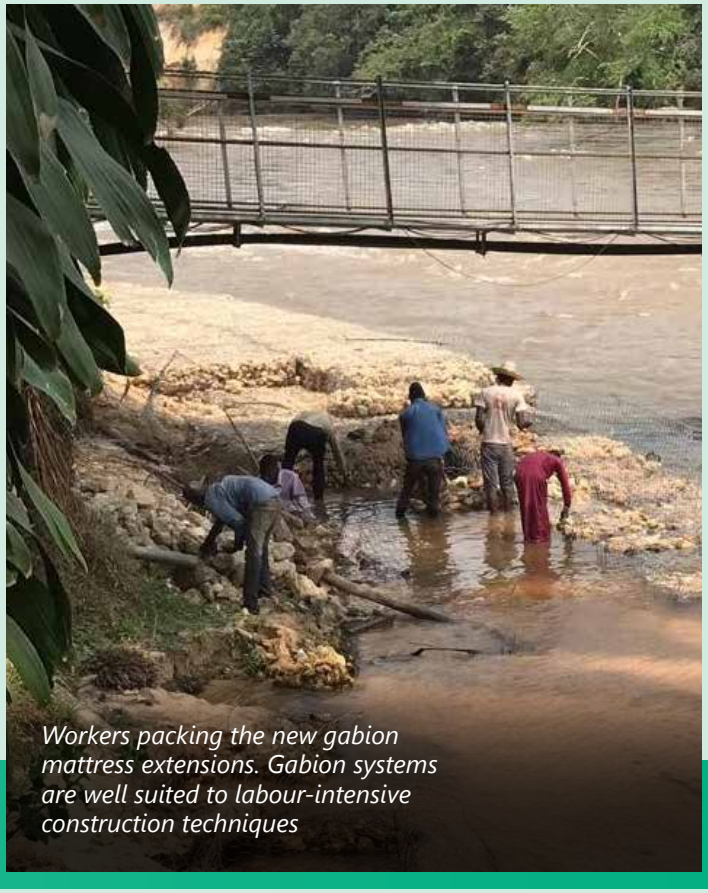
Typically, the woven mesh used for baskets and mattresses is 2.7 mm and 2.2 mm respectively; however, some clients specify a 2.7 mm wire thickness for both products, for added overall system durability.

"Thanks to the simplicity of gabion construction techniques, you can place or 'float' the baskets and mattresses directly on to the riverbed," Cheyne continues. "This would obviously not be the case for a precast or in situ concrete structure, which will always need a reinforced foundation, ideally placed on the bedrock. As an alternative approach, we have seen concrete retaining block wall structures built on top of gabion baskets, founded on an apron mattress in the river, which then proves optimal."

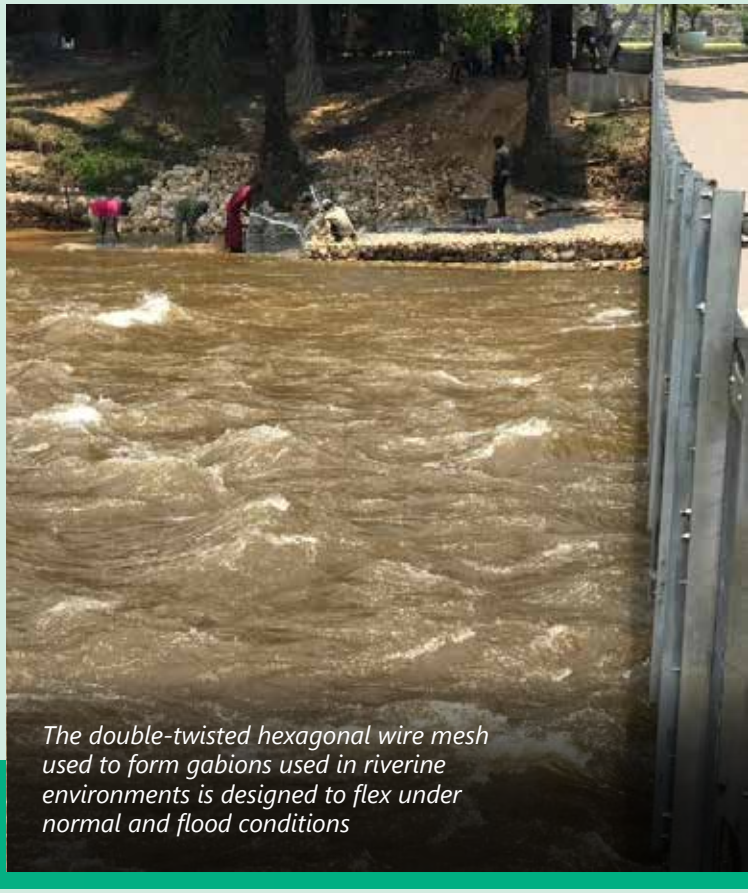
Configuration and applications

Gabions are well suited to river diversion structures, longitudinal protection walls, culvert in- and outlets, low-level bridge crossings and weirs. Bridge abutments are another popular application. On smaller bridges, the abutments can be constructed entirely using gabions. And for larger bridges where the abutments are constructed in concrete, gabion baskets can be constructed around their base to form a protective layer against erosion and impacts from flotsam, especially during flood conditions.

"Mattresses are especially ideal for river channel linings and can be installed up to a maximum slope of 45 degrees, as long as they are anchored at the top," says Cheyne. "They also



Workers packing the new gabion mattress extensions. Gabion systems are well suited to labour-intensive construction techniques

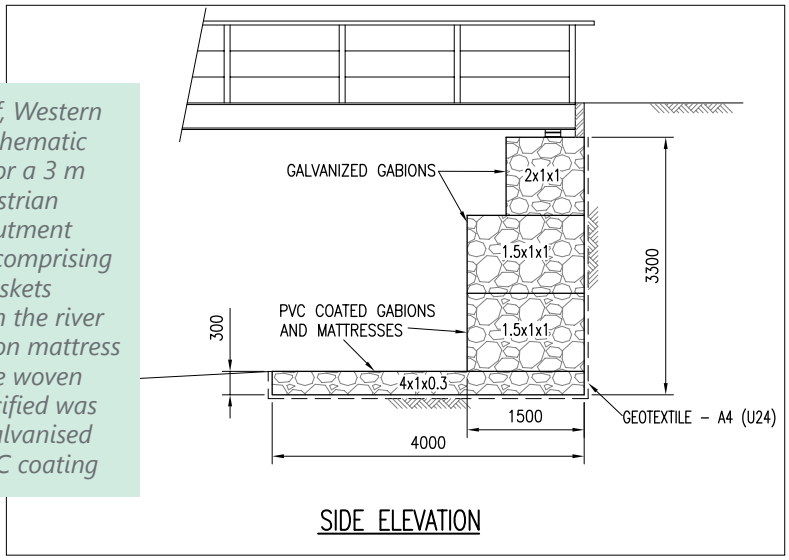


The double-twisted hexagonal wire mesh used to form gabions used in riverine environments is designed to flex under normal and flood conditions

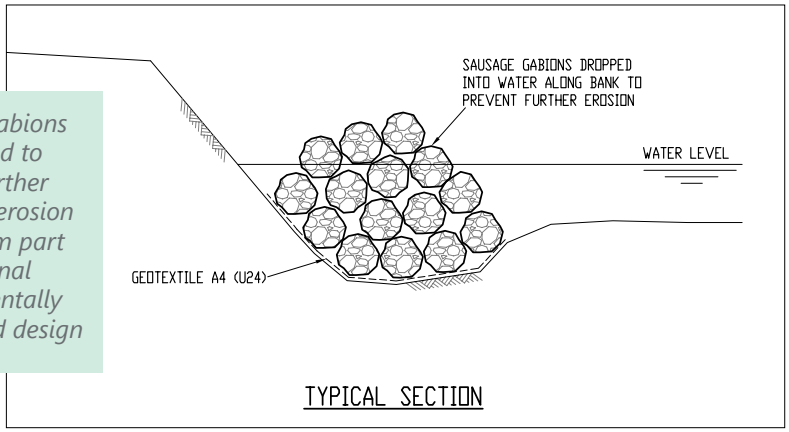
serve a vital role when used in conjunction with gabion walls to minimise the risk of scouring around the toe of the structure. We recently supplied woven wire mesh systems for a client in the DRC where strong river currents made this a top priority."

Potential impact is another reason why Cheyne strongly advises against using welded mesh. Another reason is that welded mesh, which is primarily designed for architectural and building cladding applications, is intended to be rigid. It will not flex, which will usually result in premature failure in a river course. In contrast, woven mesh gabions can move, settle and bend without compromising the overall, environmentally engineered design. Woven mesh also has a much higher tensile strength.

"The hydraulic forces generated by rivers should never be underestimated. That is why a detailed site assessment should always be undertaken to ensure the best solution. Once designed and installed correctly, these gabion systems should last for decades," Cheyne concludes. 35



Bainskloof, Western Cape: a schematic drawing for a 3 m high pedestrian bridge abutment structure comprising gabion baskets founded in the river on a gabion mattress apron. The woven mesh specified was Class A galvanised with a PVC coating



Sausage gabions can be used to prevent further riverbank erosion or can form part of an original environmentally engineered design

South Africa: before, during and after the Covid-19 pandemic | Part 4

Part 1 of this series mainly describes how South Africans experienced life since democracy until Covid-19 arrived. Parts 2 to 4 update our Covid-19 experience. Parts 3 and 4 look at how we must plan for our future now. We cannot wait until Covid-19 has faded away to overcome the unacceptable shortcomings of the last 26 years. **By Derek G Hazelton**

Derek G Hazelton, Pr Eng., FWISA, founder and manager of TSE Water Services

The number of new Covid-19 cases per day has seen a steady increase since November 2020. While this was initially attributed to risk management and compliance fatigue, South Africa has now officially entered its second wave. Evidence strongly suggests that the current second wave is being driven by the new Covid-19 variant announced by Minister of Health Dr Zweli Mkhize on 18 December. According to the minister, preliminary data suggests that the variant may be more transmissible but that, looking at the current deaths information, there are no red flags related to its severity.

Mkhize has also been reported as saying that more young people are testing positive, that they have not been adhering to the rules, and that a larger proportion with no comorbidities are presenting with severe illness. "We are no longer asking young people to only think of others; they must think of themselves too because they are now equally at risk of dying," he said.

As recorded in figures 1 and 2, the number of new cases per day by the end of 2020 had marginally exceeded the maximum number recorded during the first wave and the number of deaths per day had outstripped the maximum number of deaths by 19%. These figures indicate an ongoing exponential growth in both the number of new cases and the number of deaths per day, with no significant sign of abatement.

Figure 3 shows that Europe's second wave – which was far more severe than its first – is abating. Provided we improve our adherence to good risk-management practices, our second wave should also abate, but it appears that the pandemic is likely to continue until it eventually fades away, perhaps after a third or even a fourth wave or until an effective vaccine is universally available.

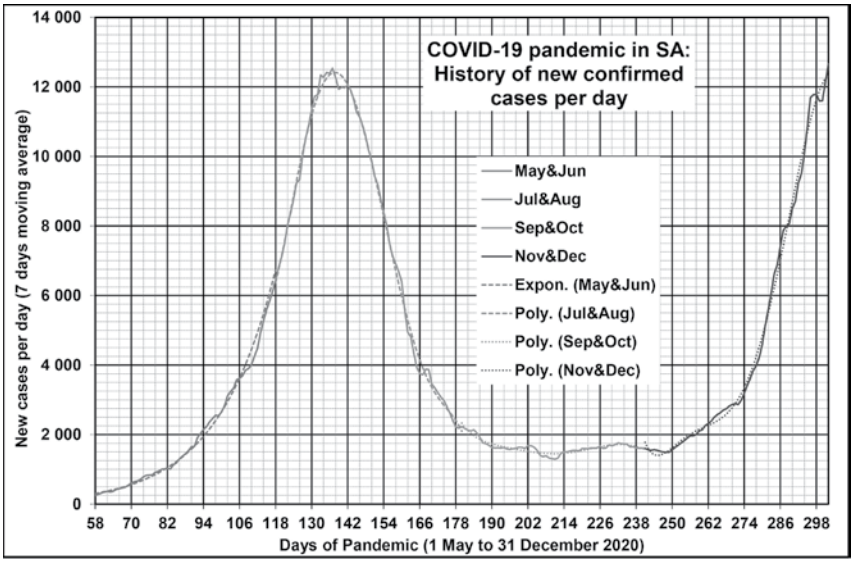


FIGURE 1 History of new confirmed Covid-19 pandemic cases per day in South Africa, 1 May to 31 December 2020

The adjusted Alert Level 3 lockdown

In response to the second wave, President Ramaphosa announced the adjusted Alert Level 3 lockdown that took effect on 28 December 2020. The move aims to limit super-spreader events further and to ease the pressure on hospitals and health workers while keeping the economy as open as possible.

While most of the Alert Level 3 regulations are a reasonable response to the second wave, the blanket prohibition on all social gatherings ignores many essential human basic needs. However, it is not the regulations themselves, but our social distancing, avoiding crowds (especially indoors), mask wearing, hygiene practices and other basic infection control measures that will slow down the infection rate.

Covid-19 vaccines

Similar previous pandemics have generally been overcome without vaccines, and it is recommended that we conduct our lives in a manner that assumes a vaccine will never become available.

Notwithstanding this recommendation, we have a right to be informed of the steps being taken by our government to procure and roll out a safe and effective vaccine against Covid-19. To date, we have received too little information, although we have been promised announcements in the coming weeks. However, the current lack of information leaves us concerned that there is insufficient planning, and an inadequate sense of urgency in making a vaccine

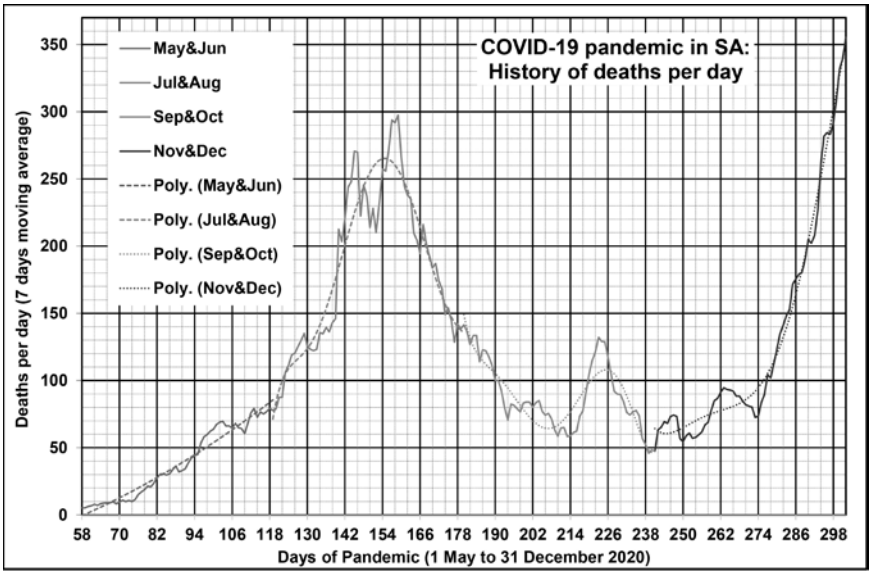


FIGURE 2 History of Covid-19 pandemic deaths per day in South Africa, 1 May to 31 December 2020

available timeously, even to frontline healthcare workers.

Until recently, we were told that some vaccines would be available by the end of the first quarter of 2021. That has now changed to the end of the second quarter. At what rate vaccines will be made available thereafter is unknown. Thus, for now, we have no idea when vaccines will help us to materially reduce the number of new infections, beyond prioritised groups. This means that, even after vaccines become available, to control the pandemic, we will have to keep up our non-pharmaceutical risk-reduction practices relentlessly for a considerable unknown period. A small piece of good news is that new Covid-19 variants are unlikely to affect the effectiveness of vaccines.

The economic recovery baseline

In Part 1 of this series, I briefly described how the poor state of service delivery, the record levels of unemployment, the poor economic state of state enterprises and many municipalities were combined with a slowly worsening situation when the first Covid-19 case was confirmed on 5 March 2020. To give our county time to get its public and private health services in order, the government quickly implemented harsh Alert Level 5 lockdown from 27 March to 30 April. At the time, no one foresaw the severity of increased widespread destitution due to the economic contraction the lockdown would cause.

We are thus in a recession comparable to what South Africa and the world experienced in the 1930s. That is the baseline from which we need to start planning and implementing our economic recovery now, even while we are experiencing our second wave of Covid-19. Thus, the government and indeed all who live in South Africa need to do everything in their capacity to prudently, but imaginatively, stimulate the economy

Tito Mboweni's supplementary budget

On 24 June 2020, Minister of Finance Tito Mboweni delivered his supplementary review. This was government's first indication of how it was planning our post-Covid-19 future. Distressingly, the review singles out the debt situation, rather than the increased suffering of the poor. The review stresses that this debt must be stabilised. Consequently, it makes few recommendations with respect to reviving the economy. Instead, it plans ongoing austerity measures. These will reduce the tax revenue further in a vicious downward spiral and the record levels of unemployment will get worse.

But in 2014, National Treasury made a presentation on South Africa's long-term fiscal choices. Slide three of that presentation, reproduced in Figure 4, showed the gross national debt from 1914 to 2013. From 1928 to 1932, during the depression, the National Party under Barry Hertzog allowed the debt to grow from 88% to 125% of GDP as it invested wisely and successfully to overcome the depression. As a result, the average annual GDP growth rate from 1932 to 1946 was 8%.

Through the resultant broad-based growth, and the improvements in social services, the *poor white problem* was overcome. Even black South Africans benefited, although not to the same extent, as their wage share increased from 11% to 17%. Thus, Mboweni needs to learn from his own department's presentation and history. In times of deep recession, rather than stabilising debt, one needs to focus on how the country can be changed to overcome the weaknesses that are blocking it from improving the quality of life of its people.

Additionally, to minimise rising debt and its costs, South Africa needs to curb tax evasion, and make better use of all available funds through, for example, increased prescribed assets and exchange control, and making maximum use of the Reserve Bank.

Economic recovery and improving our quality of life

Mboweni's supplementary budget was followed by Ramaphosa's Economic

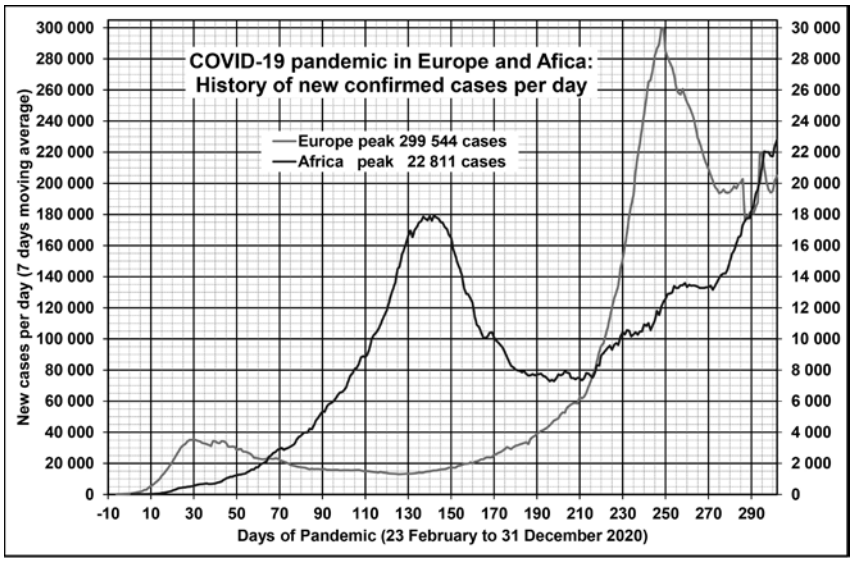


FIGURE 3 History of new confirmed Covid-19 pandemic cases per day, in Europe and Africa, 23 February to 31 December 2020

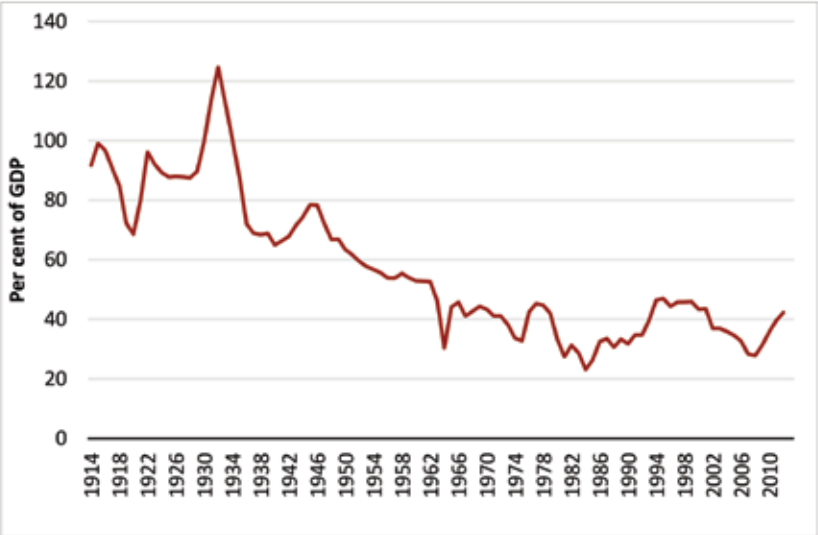


FIGURE 4 Gross national debt over 100 years

Reconstruction and Recovery Plan on 15 October and the Medium-term Budget Policy Statement on 28 October. They both put too much stress on debt stabilisation and too little emphasis on the reforms necessary to increase the ability of government to spend money effectively and to prioritise that spending to the maximum benefit of society, but especially of the currently poor. Generally, these two documents also lack a sense of urgency. Dear Mr President, you urgently need to broaden your attention beyond Covid-19, and get government and society working together, as described in Part 3 of this series of articles, to improve our quality of life.

First, people cannot continue to be allowed to go hungry. The Minister of Social Development, Lindiwe Zulu, must be enabled to implement a comprehensive plan to ensure that everyone living in South Africa has a basic income. Legislation also needs to be passed to allow everyone to open a bank account that attracts no charges. All government grants can then be paid into such accounts.

Thereafter, South Africa must focus on ensuring that the four other priorities set out in Part 3 of this series are implemented sustainably, through growth specifically designed to achieve these aims. Without such a focus, neither sustained growth nor the long-term reduction of our debt is feasible.

Such a focus will require our politicians to change many of their attitudes. The first relates to their love of large, grandiose projects by which they can be remembered. But a larger number of more modest projects, including the rehabilitation of existing infrastructure, for the same expenditure, will generate more jobs, benefit more people, reduce inequality and are more likely to be environmentally friendly.

Likewise, maintenance is not exciting, but the maintenance, monitoring, management and equitable cost recovery related to existing infrastructure is as important, beneficial and more cost-effective than building new infrastructure. With new infrastructure projects, these aspects also need to be considered effectively from initial design right through to handover.

With the overall level of inefficiency and ongoing corruption currently existing in practically all national and provincial government departments and state-owned enterprises, in many municipalities, and even in many private enterprises employed by government, to succeed in implementing a correctly focused reconstruction and recovery plan will require major reforms in all these organisations. Leaders and all levels of workers need to work as teams, to deliver value for money and to operate ethically. Improved staff appointment criteria, performance monitoring and ongoing training will be required to achieve the necessary outcomes.

For all aspects of spending and human capital reform, government needs to democratically develop and prioritise clear plans with timelines, monitoring and ongoing corrective action. Once plans are finalised, lead implementers need to be carefully chosen, placing a strong emphasis on subsidiarity.

With proper people-focused development and the necessary structural reforms, South Africa can succeed in doing what it failed to do in its first 25 years of freedom. 35

For more information, contact Derek Hazelton on tsewater@icon.co.za.

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