

TUT introduces world first in toxic water treatment



Frederick Oosthuizen (right) checks the ice which is produced by the HybridICE Technology. In principle it is a method of utilizing refrigeration energy to freeze out the water in a solution with dissolved chemicals.

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In a world first, a cost-effective, comprehensive solution for treating toxic wastewater, regardless of its chemical composition, was launched at the Tshwane University of Technology's Soshanguve Campus last week. The HybridICE® Freeze Crystallisation technology system that will revolutionise the water treatment industry is a method of using refrigeration energy to freeze out the water in a solution with dissolved chemicals. In this way, the waste heat from the refrigeration process is used to recover the contaminants as solids.

HybridICE® is the first operational freeze crystallisation plant ever realised in which the water is completely separated from the toxic waste as solid ice.

"In developing the HybridICE® we have successfully pioneered a unique method to freeze out clean ice crystals. In return, the manipulation of the ice crystal enables us to recover pure water as a usable product from any toxic brine stream," said Frederick Oosthuizen, who developed the technology in collaboration with Prof Jannie Maree, Chairperson of the Rand Water Chair of Water Utilisation at TUT.

He added that the development of the HybridICE® Technology started in Germany in early 2007. "Towards the end of 2008 we were fortunate to meet Prof Maree, who is a renowned water specialist in this country. His activities and engagement with the project contributed positively towards the building of the first commercialised 25m³/day HybridICE® Freeze Crystallisation plant, which was installed at TUT's Soshanguve Campus. For more than half a century, experts around the world have been working tirelessly to understand and realise such a technology, but without success. Until very recently, this method was not even regarded as viable."

Oosthuizen explained why the technology is so unique and cost-effective. "In principle, this technology is a method of using refrigeration energy to freeze out the water in a solution containing dissolved chemicals. The water component is frozen out from

a contaminated aqueous stream that contains dissolved chemicals and is recovered as pure ice. This treatment process requires NO addition of chemicals.”

He added that when a water solution freezes, the ice crystals reject the solute. “The dissolved substances increase in concentration, allowing an operating factor ranging from 1 to 40 in the remaining water.”

According to Oosthuizen, the commercial applications of the HybridICE® Freeze Crystallisation Technology are unlimited and will create thousands of job opportunities in the country. “I am committed to make this an all-South African project in order to benefit as many people as possible in our communities.”

“Our first objective was to deal with polluted and toxic brine streams, mainly produced by membrane technologies, typically from reverse osmosis and other industrial wastewaters, through freeze desalination. This technology enables us to create water of the purest quality, equivalent to glacier water quality. Treating water is not an art; dealing with the pollution created as a result of water treatment is the real engineering challenge. This we have not achieved yet.”

“In 2012, we will start to build a novel water-treatment technology system for desalination and the treatment of acid mine drainage (AMD). We aim to treat any industrial wastewater at a cost of less than R7 per m³,” Oosthuizen said. “We will then apply our already developed HybridICE® technology to deal with the brine stream that is produced, making this a truly comprehensive method for treating toxic waters.

“Interestingly, we have already achieved treatment cost of merely R15 per m³ for industrial waste water and brine stream treatment, which is a factor 10 cheaper than any other known method.

“Water scarcity is an imminent global challenge and TUT certainly has the expertise to play a vital role in developing more cost-effective, sustainable technical solutions to solve this problem in South Africa,” said Dr Prins Nevhutalu, DVC of Research and Innovation. “TUT is one of the pioneers in water treatment in the country, with a Water Care course that was introduced as far back as 1996. The University is proud of its strengths and expertise in water technology. Our experts include research professors Maggy Momba from Microbiology, who is involved in numerous projects on wastewater treatment, Jonathan Onkonkwe from Organic Chemistry, who is also a fellow of the London Chemical Society, and Jannie Maree, Rand Water Chair in Water Utilisation, who is involved in the THRIP (Technology and Human Resources for Industry Programme) projects on mine water treatment.”

“Apart from the development of brine treatment through the HybridICE® technology, TUT has also been involved in developing other innovative solutions and patents for water treatment. The limestone neutralisation of free acid, a CSIR patent, has already been fully implemented, while a TUT patent for the removal of iron (II) with limestone is expected to reduce alkali cost in Gauteng from R94 to R49 million per year,” Dr Nevhutalu added.

Prof Pieter Marais, Dean of the Faculty of Science, said this project represents the pinnacle of what a university of technology should do. “We must find effective, sustainable solutions to real-world problems. With the steadily increasing demand for desalination technologies it is estimated that half of all installed desalination capacity world-wide is treated by reverse osmosis. The waste brine streams from the application of membrane technologies are classified as industrial wastewater. A critical issue is how to deal effectively with the brine streams resulting from the use of reverse osmosis, as the current methods are environmentally unacceptable. These hazardous streams are environmental threats in the making, as they are predominantly being fed into evaporation ponds. The current treatment processes are energy-intensive and extremely costly to operate. Simply dumping or hiding the brine streams is no solution.”

“The HybridICE® Freeze Crystallisation Technology is a sustainable and cost-effective method for treating hazardous brine streams resulting from the application of reverse osmosis. With the HybridICE® Freeze Crystallisation Technology, the cost of treatment can be reduced to as much as ten times lower than the cost of any other treatment method currently available,” Prof Marais said.



Prof Jannie Maree (right) explains how the HybridICE Technology functions.