Water management: a lecture, a book and a collaborative effort

On February 28, 2019, professor Thokozani Majozo of the University of the Witwatersrand delivered a lecture on Water management: social and technological perspectives, a book written as a collaborative research project based on studies from 53 contributors who looked at water issues in 19 countries.

stemming from a water management conference held at Wits in 2016 and funding and support from the British Council, Thokozani Majozo from SU’s University of the Witwatersrand, and Prof. Mohammed Fadl Al-Azam from Cairo Iqbal M Mujtaba from Bradford University in the UK: University in Egypt. The authors have transformed case studies from 19 countries and 53 contributors into a 30 chapter, 571 page reference manual on water issues in the world’s. It was Boutros Boutros-Ghali who first said: ‘The next war in the Middle East will be fought over water, not politics’ says Majozo in introducing the Social Perspectives topic of the book. He highlighted several ongoing conflicts around the world, many of them relating to rivers shared by more than one country. The dispute on India’s Caubery River between Tamil Nadu and Karnataka continues to this day, which is one of many if not all the people and the disagreement has been going on for centuries,” Majozo said, before adding examples of other water disputes related to rivers: the Okavango; the Mekong; the Rhine; Syr Darya dividing Kazakhstan, Kyrgyzstan, and Uzbekistan; and the Incomati which is shared amongst South Africa, Swaziland and Mozambique.

Desalination technology is second of the book’s themes. It shows a slide comparing the relative costs of different technologies taken from commissioned operational plants: Multi Stage Flash at 1.5 US$/m³ in Singapore and 2.74 at the Sall plant in Qatar; multi-effect Distillation in California at 0.46 US$/m³; Thermal Vapour Compression multi-effect in Qatar at 2.46; and, by far the most common, Reverse Osmosis (RO), for which Majozo cites three plants built at costs of 0.53, 1.1 and 0.50 US$/m³, respectively.

While describing how RO technology works, he points out that the technology uses high pressure to force pure water permeate through the RO membranes, separating out brine concentrate (retentate) for disposal. “Generating RO pressures takes energy, though, so although currently cheapest, other technologies may be more beneficial in the long term,” he points out.

Water Treatment also features in the book. Of note is the search for cheaper, more effective for activated carbon, currently used in 10% of water treatment facilities as an adsorbent for ammonia and nitrate. Several contenders have been found, including Ivy and strawberry leaves, which tend to be waste materials so they can be sourced easily and used in the production of activated carbon. Water Hyacinth can be used as a direct replacement for activated carbon to give good adsorption from a fast growing and problematic plant waste,” says Majozo.

The Water Networks chapters in the book discuss water reduction case studies from Bradford. Given the task of reducing water use at specific sites, Iqbal Mujtaba and his team applied a technique called Water Cascade Analysis to systematically identify and implement savings solutions. "Any chemical process or facility has a point where mass transfers are optimised. By routinely highlighting these points wherever fresh water is involved, water usage can be minimised. Of the cases analysed by Bradford, 80% of the options were actually implemented,” Majozo reveals.

Closer to home, he ends with a discussion on the Water Energy Nexus and his work at Wits. "South Africa is constrained by both energy and water. We are the 29th driest country in the world, out of 194 countries. Yet we need to find a way to get water and water to get energy,” he says.

Food is the third aspect of the nexus. “People need to plant crops to get food and create need water which means using pumps that require energy,” Majozo explains. “Also, though, chemicals almost always come into play in some way or another. In the 19th Century, predictions were that world population would be limited to about 2.5 billion people, but by the 20th the population was almost twice the number of 5 billion. Why was the prediction so wrong? In 1918 we discovered amonia, which led to fertilisers that doubled crop yields. So, a chemical change of the food supply aspect of the Nexus,” he relates.

Describing current research interests in this area, he says that his team is looking at the relationship between water and energy use. “At a typical plant, fresh water for cleaning, heating, cooling and process reactions is consumed and wastewater is created. ’Treating the effluent and reusing it can bring down water use and associated costs, but additional energy is required to do this, which increases the energy costs.”

“We are trying to come up with systematic methods of identifying the point of minimum total cost between the rising energy costs and the falling water costs, that is, the sweet spot or the optimum operating point for water reuse. We want to use this idea to do case studies to optimise water use by identifying water streams and recycling opportunities—with and we have had some significant successes. At an old power plant, for example, which was designed to use 1.8 kWh of water, usage has climbed over the years to 3.01 kWh. Through applying the model we were able to reduce usage back down to 2.11 kWh, and we calculate that we can get it back to 1.9 with a much lower cost.”

Before the intervention, plant usage was sitting at 119 Mℓ/yr, which is approximately 3/4 of the daily use of the City of Cape Town. Reduction in water use there therefore, a valuable and necessary exercise. “Whenever more electricity is needed, however, we need to accept the associated water cost, and vice versa,” Majozo says.

Mohamed Fadl Al-Azam from Cairo University delivered a lecture on Water management: social and technological perspectives, a book written as a collaborative research project based on studies

South African Chemical Engineering Congress: SACEC 2020

1st to 3rd July, Wits University

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The call for abstracts on the below topics is open, with a submission deadline set for Sunday 30th June 2019. Submission categories include:

1. Environmental Process Engineering,
2. Reaction Engineering,
3. Separation Technologies,
4. Process and Materials Synthesis,
5. Metallurgical Process Engineering and Coal Technology,
6. Chemical Engineering Education,
7. Other.

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Most Promising New Textbook Award (College)

The Textbook & Academic Authors Association (TAA) has announced the 2019 Textbook Award winners, which include Attainable Region Theory, An Introduction to Choosing an Optimal Reactor, which is published by Wiley and co-authored by David Ming, David Glasser, Diane Hildebrandt, Benjamin Glasser and Matthew Metzger. Attainable Region Theory is one of 10 publications to receive the Most Promising New Textbook Award, which recognises excellence in addition textbooks and learning materials.

The book discusses how to effectively interpret, select, and optimise reactors for complex chemical processes. It provides a valuable and necessary exercise. “Whenever more electricity is needed, however, we need to accept the associated water cost, and vice versa,” Majozo says.

The Gauteng chapter of SAIChE IChemE kicked off 2019 with an event titled Big Data. An interactive session was held on SAIChE IChemE member and Gauteng branch chairperson, Carl Sandrock, delivered a seminar focusing on Big Data Analytics, Industry 4.0, and the Internet of Things.

As a hot topic in Big Data and Data Analytics, much of the talk was about the development and use of Neural Networks and how technology companies make use of the science behind neural networks to work on breakthroughs in solving problems. Carl Sandrock presented at SAIChE IChemE Gauteng’s Big Data networking event.

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The Gauteng chapter of SACEC 2020 event titled Big Data.

This was just the first of many events planned by SAIChE IChemE Gauteng for 2019, which include: the AGM in April; SAAFOST at DrinkTec in July; Engineers Without Borders in August and; in October; an interactive session on the Circular Economy: “Look out for the details and we look forward to welcoming you at our next event.”

Fakir concludes.