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George Ekama (1949–2023): A man of faith, humility and integrity and a world leader in wastewater treatment

Professor George Ekama, a distinguished leader in the field of wastewater treatment, passed away on 19 February 2023, at the age of 73. While his presence is sorely missed, his impact in the lives of colleagues and students, and in the field of wastewater treatment endures.

George was born on 17 June 1949, in Hilversum, the Netherlands. His family immigrated to South Africa in the 1950s, leaving the devastation of post-World War II Netherlands behind them for a new life in South Africa. Like his grandfather, father, and older brother, George was drawn to engineering. Unlike his family members though, he chose civil engineering and earned his bachelor's degree with honours from the University of Cape Town (UCT) in the early 1970s. He then worked on site for a few years – to pay back the bursary he had received as a student – for contractors building the container quay at the Cape Town harbour. He enrolled for evening classes at the same time, which is when he met Prof. Gerrit Marais, who was leading research on biological nutrient removal in wastewater treatment processes in his laboratory at UCT. How to remove nitrogen and phosphorus by biological means was a crucial question in sanitary and environmental engineering at the time as South Africa was faced with rampant algae growth in rivers, dams and lakes. Chemical nutrient removal was the norm, but unsuitable in the context of South Africa because of its impact on the salinity of surface water, already a problem from acid mine drainage. At the completion of his contract at the harbour, George joined Marais' group as a master's student to contribute to addressing the nationally and internationally significant question of biological nutrient removal from wastewater. He then upgraded to a PhD in Engineering which was awarded in 1978. George worked as a research officer at UCT from the late 1970s, funded by research grants from the Water Research Commission and others until he was promoted to Professor of Water Quality Engineering in 1991. He held this position until his formal retirement in 2017. However, for George, retirement meant less admin and therefore more time to spend on research, until a severe stroke in 2020 brought that to an end. Throughout his career, George researched, taught, supervised and published on the treatment of wastewater, both municipal and industrial, specialising in biological nutrient removal and wastewater treatment modelling. He became a leading figure in the international field.

George was a well-established world leader in the wastewater treatment field. His research was part of the original biological nutrient removal modelling research which developed at UCT in the 1980s and was incorporated into the famous IWA (International Water Association) Activated Sludge Models. These models have had a profound impact on biological nutrient removal research worldwide. George received numerous accolades for his work over the course of his career. In 2006, he received a National Research Foundation (NRF) A1-rating in recognition of excellent and impactful research in his field. He was one of very few environmental engineering professors listed on Thomson Reuter's 2002–2013 Highly Cited Researchers website. He was a major contributor to and editor of the IWA bestselling book *Biological Wastewater Treatment: Principles, Modelling and Design* (2008). This book has been a global success with the first edition translated into Spanish, Chinese, Russian and Arabic and a second edition published in 2020¹ now openly accessible. George was the recipient of the IWA Project Innovation Award in 2012. In 2013, he was awarded the South African Order of Mapungubwe Silver by the President for outstanding research and contribution to society. In 2017, the Academy of Science of South Africa (ASSAf) named him among the 53 scientists across all fields as 'Legends of South African Science'. And George was listed as a Water Research Commission 'Legend' in 2021. While George never sought credit, fame or accolades, his work was recognised as exceptional, both locally and internationally. He attributed his success to providence, going to work every day, working hard, and paying attention to detail.

He would be quick to add that he did not work alone – he worked as part of a team. At UCT he joined and later led the Water Research Group in the Department of Civil Engineering. Under his leadership the Water Research Group achieved global acclaim and recognition for excellent research. He co-authored over a hundred peer-reviewed journal articles during his career and was a contributor to and editor of books which continue to be read and cited across the world. Foremost among these are several publications forming the foundation of the IWA Activated Sludge Models.

He built strong international collaborations in research and teaching too. From the 1990s onwards, he regularly visited Hong Kong where he taught and supervised students at the Hong Kong University of Science and Technology. He developed strong ties with the Delft University of Technology and the UNESCO-IHE Delft Institute for Water Education where he taught specialist courses each year through the 2000s and 2010s. He spent sabbaticals at Virginia Tech in the USA and the University of Padua, Italy. He was a regular participant at international workshops, symposia and conferences.

George often described what he did as 'cleaning dirty water'. Wastewater treatment has long been recognised as crucial for public health. George recognised the significance of his research in our everyday lives, combined with the fact that not only how we use water but also how we treat wastewater has an enormous impact on the environment. George's enduring faith, commitment to serving society and stewarding the environment were the foundations of his work.

George was known for his intellectual depth, his wisdom, and his dedication to his students. Over the course of his career, George supervised numerous master's and doctoral students to graduation. His students are sought after by academic and industry employers, locally and internationally. He had a remarkable ability to see the

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potential in others, and to encourage and support them in achieving their goals. Memorably, he was known to say that students are like a tube of toothpaste: you have to squeeze them to see what is inside. He was patient and tireless in his efforts to help his students and was always available to offer advice and reassurance. These same qualities shaped his approach to mentoring early career academics.

George was a keen marathon runner throughout his career. In running he applied the same discipline, perseverance and exceeding organisation which he demonstrated in his work, as well as his attention to detail and love of recordkeeping – recording and plotting his mileage in training, and graphing entire fields' finishing times on green graph paper. He completed numerous marathons around the Western Cape, a handful of Two Oceans ultramarathons, and one Comrades marathon. But he will likely be remembered by colleagues and former students for arriving on campus each day out of breath and sweating, brown backpack on, having run to Upper Campus from his home in Claremont. Later in his life the running became less frequent; instead, he drove up to campus on his much-cherished cherry-red Vespa.

Although a civil engineer by training, George became a foremost expert in a specialised area of biochemical reaction engineering. Remarkably, this was achieved without any systematic exposure to the discipline, as taught to chemical engineering students. Rather, it was the result of practical experience in the laboratory, in working with treatment plants, and in teaching. Equations 4–5 in Ekama and Brouckaert² provide a vivid glimpse into his approach to scientific discovery. They express an important stoichiometric relationship for organic material found in wastewater, in a particularly elegant and intuitively satisfying way. He had evidently built up the equations by

considering many practical applications, because he did not know how to derive them from first principles. After explaining their practical significance and application, he made the following comment: “These rules reveal a remarkably consistent order – there is always much beauty when creation reveals its secrets.” For him, scientific discovery was exploring a tiny corner of the mind of God, a concept which can provide inspiration to all scientists.

His life and work were celebrated at the 8th IWA Water Resource Recovery Modelling Seminar (WRRmod2022+), held in Stellenbosch, South Africa, in January 2023. In spite of the limitations caused by his stroke, George was present at the gala dinner, held in his honour, to receive acknowledgement and appreciation from some of his former students together with local colleagues and members of the international community of water and resource recovery modelling.

Professor George Ekama's impact on the field of wastewater treatment was monumental. He will be remembered as a man of faith, humility and integrity.

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