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UCT civil engineering master's graduand breaks finish line in 18 months

University of Cape Town (UCT) graduand Daniel de Oliveira is one of hundreds of students who will be honoured at UCT's mid-year virtual graduation ceremonies between 12 and 19 July. He will receive his MSc Civil Engineering (cum laude) having completed his course in just 18 months, even though COVID-19 limited his access to laboratories.

His master's research examined a process to turn mine tailings into bio-bricks; the same biological chemical process that created the [world's first bio-brick from human urine in 2018](#) in his supervisor, Associate Professor Dyllon Randall's, laboratory. To complete his experiments in an intense four-and-a-half months, Daniel said he worked "Mondays to Sundays" in a mini microbiology laboratory he created in the Water Quality laboratory in the Department of Civil Engineering.

Waste not

Daniel's work is part of Randall's broader research project on converting waste into valuable, usable products. It's a promising development with potential for the circular economy; a model based on large quantities of cheap, easily accessible materials, such as urine and mine tailings. Mine tailings are the crushed, sand-like by-products left after minerals and metals have been extracted from ore. Their storage in stacks, pits and tanks creates serious ecological and health hazards.

On South Africa's mineral-rich Witwatersrand, mine dumps are familiar eyesores. The Johannesburg-born graduand said he'd always wondered whether the dumps could be put to use. After matriculating from St Benedict's College in 2014, he set out on an academic path that would one day try to answer that. Curiosity has always driven him, Daniel said.

It wasn't a linear journey. After two years studying chemical engineering at the University of the Witwatersrand, Daniel visited a friend at UCT. After an introduction to the Chemistry Mall on upper campus, he was sold. "My dream was always to come to Cape Town," he said.

The following year he joined his younger brother, Dominic, who was starting as a UCT undergraduate in civil engineering.

Building on a world-first

To make the solids from the mine tailings, Daniel used a natural process called microbial induced calcite precipitation (MICP). The loose tailings were colonised with bacteria that produce urease. The urease breaks down the urea in urine to produce carbonate ions. These carbonate ions then combine with free calcium ions in the solution and 'glue' the loose tailings together into any shape, such as a brick.

Graduating in record time

It wasn't all plain sailing. The COVID-19 disruption was massive and halted his laboratory work for three months. The second challenge was getting mine tailings, and the third, getting the process to work. "We knew the mine tailings would be toxic to our bacteria, but we didn't know how big an impact that would be," said Daniel.

But it was the fineness of the tailings that proved the bigger challenge.

"They were so finely packed that the bacteria were starved of nutrients and oxygen, which meant that the MICP could not occur throughout the material and hence, the material was not cemented."

Developing a new method to "grow" bio-solids using mine tailings involved additional research and development and plenty of experimental "tinkering", he said. Though he'd initially aimed to complete everything in a year, Daniel still managed a coup.

"It's what I enjoy. I've always been driven by curiosity – you make better discoveries that way – and I was motivated to get into the lab and get it down and done."

First in family

Besides his academic achievements, Daniel has also quietly notched up another milestone: He is the first in his family to graduate from university. The July graduation, even in its virtual format, will be a De Oliveira family affair, not only for Daniel but Dominic too, who is graduating in civil engineering, the same field as his older brother.

Daniel is now eyeing a PhD in the biomedical field, aiming for a research career. "If you put your mind to it, you can achieve anything you want at UCT," he said. "The lecturers are always there to help you. There was always encouragement from people in all departments. Everyone was willing to pitch in with ideas. It's a very welcoming and easy place to learn. It's a community that does come together."

Story by Helen Swingler, UCT News



Daniel de Oliveira

Photo: Felix Dlangamandla

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