

Chemical Engineering Professor wins NSTF Award



Professor Thokozani Majozi, Department of Chemical Engineering, Faculty of Engineering, Built Environment and Information Technology (EBIT), has won one of the major NSTF Awards. The NSTF Category B Award recognizes the contribution of an individual through research and its outputs over the last 5 – 10 years.

His research has led to the development and application of novel techniques in batch and continuous chemical process integration.

“A batch process is any process defined by a predetermined sequence of discrete events. It is like a predefined ‘cooking’ recipe where timing is of the essence,” explains Majozi. “Unlike continuous processes, these processes never attain steady-state, where time is completely overridden.”

Professor Majozi has made significant contributions in the area of process integration. He developed a mathematical technique for wastewater minimisation and heat integration in multipurpose batch chemical plants that are characterised by complex recipes. Included is the development of a robust framework for the synthesis of cooling water systems and steam system networks.

“In any chemical plant there are cooling and heating streams that serve as heat sink and heat source, respectively. Consequently these are part of the chemical process and a steady supply is needed of both streams to keep the process going,” says Majozi.

In the past, the cooling and heating networks were considered separately. Says Majozi: “No-one had looked at the process as a whole, but we have seen the benefit of engaging with a comprehensive integrated system.”

While both the heating and cooling networks are complex in their own right, integrated they are even more complex. He believes that this is the reason research on integrated systems was avoided in the past, even though the traditional discrete methodology is suboptimal.

The creation of methods and tools to analyse the systems in a more systematic fashion will now mean an optimised plant.

The technique developed for batch plants is based on a state-sequence-network recipe representation that yields structurally efficient mathematical models, while the synthesis methods rely on an insight-driven graphical platform. Typically, the techniques have been successfully applied in multinational industries with more than 20% savings in freshwater use and wastewater generation.

“It is an overriding ambition to see these methods accepted as a standard. The chemical industry is one of the biggest contributors of pollution due to the poor design of processes. I recognise that we are fundamentally changing the thinking of industry and that it will take time to accept new techniques,” says Majozi.

According to the chemical engineer researcher, in South Africa there tends to be more resistance from industry to accept academic work whereas this is not the case in other countries. He sees it as a puzzle to be solved.

Majozi also believes that the optimisation skills should be part of the undergraduate studies as these are the individuals who will be designing future plants: “While a fully-fledged batch processing programme is available in other countries, this is not the case in South Africa.”

“At some point every scientist must ask how they are improving the lives of the people they serve. We can only make an impact if new developments and information are accepted,” says Majozi. “Currently academic work is too isolated and academics need to bridge the gap.”

It was pure serendipity that Majozi went into chemical engineering. “I was top of my class in the bridging year and, having heard that chemical engineering was the most difficult, decided to follow that path,” says Majozi. “While I have found that the level of difficulty is not true, it was very good choice. I must give credit to the bridging year for the engineering exposure that it gave me.”

However, working with batch processing was a highly informed choice. When Majozi worked within industry after his first degree, he saw a glaring gap in the field of batch processing. He consequently completed his masters and PHD research on this topic and has since continued in the field.