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Transforming waste into energy, solving global environmental challenges

Engineering capacity development over the last 5-10 years, sponsored by Eskom

Kerry Haggard

Professor Diane Hildebrandt has achieved the ideal mix of chemical engineering research and its practical applications to find and implement effective solutions to global challenges such as energy shortage, carbon dioxide emissions, global warming and waste disposal.

"A theme that runs through my research is how to use carbon-containing wastes and convert them to fuel and electricity to supply energy and jobs to communities, while cleaning up the environment," she says.

"To this end my research focuses on all the key elements needed to make a waste to energy technology work, namely process synthesis, reactor and separation system synthesis, Fischer Tropsch [a set of chemical reactions that changes a mixture of carbon monoxide gas and hydrogen gas into liquid hydrocarbons such as gasoline] and biotechnology. In particular, we are researching the use of biological processes for biogas production and water clean-up."

Hildebrandt is director of the Material and Process Synthesis Research Unit and is a professor of chemical engineering at Unisa. She says she would like to be at the forefront of finding ways to supply Africa and the rest of the world with green, sustainable energy.

"We need to find ways of supplying energy to improve quality of life. However, we have to do this in a way that doesn't use fossil fuel as the earth can no longer absorb the CO_2 emitted by our profligate use of energy derived from fossil fuel.

"If, for example, we converted all the waste biomass produced annually to fuel, we could supply more than twice the world's current annual oil consumption in a green, sustainable way. This is an opportunity for Africa to develop new technologies, supply sustainable energy to its people and lead the way to a greener future."

The financial and environmental burden of building more power stations to generate electricity is prohibitive and governments in developing countries often cannot secure the funding to put this infrastructure in place or pay the loans back.

Hildebrandt heads up a group that researches how to help improve the quality of the lives of the poorest. The group was known as the Centre of Materials and Process Synthesis at the University of the Witwatersrand. In 2013 the group moved to Unisa and become known as the Materials and Process Synthesis Research Unit (Maps).

Professor Diane Hildebrandt, director of the Material and Process Synthesis Research Unit (Maps) and professor of chemical engineering at Unisa.

The team consists of 10 PhDs who help supervise 30 to 40 postgraduate students at any time. Hildebrandt has supervised and graduated more than 100 postgraduate students herself, of which most were either female or black.

The work done at Maps has resulted in pilot plants in China, Australia and South Africa. The research has shown that small, efficient, flexible XTL plants (where X stands for any carbon-containing feed) can be built with normalised capital costs, comparable to those of large more traditional plants.

Hildebrandt demonstrated the concept at COP17, where her team built a full-scale model of a waste-to-fuels plant that was able to fit in a shipping container. There was a lot of interest from both international and local governments.

"There are two aspects of my work that motivate me," she explains. "Firstly, making new discoveries is very exciting and rewarding. Secondly, I work with some of the best, the brightest and the most motivated of the young people in South Africa and Africa. This is a great honour and it gives me great joy. There is a moment, when supervising PhD students, when the student becomes the teacher. This is a magical moment and very rewarding."