

## RESEARCH SUMMARY

# Application of membrane filtration to the closure of white water systems in newsprint mills

D. Naicker

*B.Sc. Chemical Engineering, UKZN*

*Supervisor: Dr. Bruce Sithole (CSIR), BSithole@csir.co.za, 031 242 2325*

*Co-supervisors: Mr. M.G. Ntunka (UKZN) and Prof. V.L. Pillay (University of Stellenbosch)*

With our growing population, natural resources such as water are fast becoming scarce. Various countries including South Africa are experiencing water shortages and, if not addressed, the shortages could lead to drastic repercussions in the near future. In order to ensure sustainable development, measures to reduce the exploitation of the environment and natural resources need to be investigated and implemented. The pulp and paper industry, newsprint mills in particular, consume large quantities of water in their production processes. Processing alone requires approximately 85% of water resulting in the production of large volumes of effluent from these mills. One method to reduce consumption of fresh water in newsprint mills is system closure, in particular the closure of white water systems. Closure refers to the amount of white water that is recycled or reduction in the amount of fresh water consumed in the manufacturing process.

The proposed study will investigate the application of membrane filtration to the closure of white water systems in newsprint mills. The project comprises of three main aspects namely (1) simulation of system closure in the laboratory and investigating the concentrations of contaminants that accumulate in the white water as the loop is closed, (2) investigating the viability of membrane filtration for system closure and finally (3) determining the effect of system closure on product quality.

The Rapid-Kothen paper machine was used to simulate an industrial water circulation process. Different degrees of closure was simulated i.e. recycling of the water 10 and 20 times. An operating consistency of 0.3% was used. The filtrate was collected in a beaker

and used to dilute a fresh feed stock to the desired operating consistency before transfer to the paper machine. A sample was kept after several cycles for analysis in order to determine the contaminants that have accumulated and their concentrations.

The membrane filtration stage of the project will involve the use of ultrafiltration (UF) using polymer membranes. For the UF part of the project, a stirred cell will initially be used to establish the appropriate membrane molecular weight cut-off (MWCO) to achieve the best retention of contaminants. Once a suitable membrane has been chosen, the stirred cell will then be used to determine the optimum operating conditions. A two-level factorial design was chosen. Three factors will be investigated namely temperature, pressure and feed concentration, at a high and low level in order to determine the optimum operating conditions that will provide the appropriate retention of the contaminants. Once the optimum operating conditions have been established a pilot plant consisting of a tubular membrane module will be used to conduct ultrafiltration of the white water. Since UF will not be capable of removing metal ions present such as Ca, Mg, Na, Cl, Al and SO<sub>4</sub>, NF will be used for this purpose in the pilot plant part of the study.

The effect of system closure on the product quality will be determined by manufacturing hand-sheets at different levels of closure. The different levels of closure will be achieved by varying the amount of fresh water used in the manufacturing process. Properties of the hand-sheets such as tear and tensile index, moisture, burst etc will then be tested and the effects of the levels of contaminants noted.



## MEET THE RESEARCHER:

### Devi Naicker

AREA OF RESEARCH	Application of membrane filtration to the closure of white water systems in newsprint mills.
HOME TOWN	Chatsworth, Durban, South Africa
INTERESTS OR HOBBIES	I enjoy reading, cooking and baking. I am a Sunday school teacher at my local church.

Devi matriculated from Southlands Secondary school in Chatsworth and thereafter pursued a BSc in Chemical Engineering at the University of Kwa-Zulu Natal. In her final year, she was motivated by her lecturer Mr. M.G. Ntunka to apply for a bursary that was advertised by the CSIR, which she felt would be a great opportunity to broaden her knowledge. Once at the CSIR, Devi was drawn to the pulp and paper industry as a “highly interesting and challenging” application of her knowledge gained so far. Her research into water usage was motivated by wanting to make a positive difference in society. “Water is essential to our everyday lives,” she explains. “Shortages of this necessity is a reality in many countries. Research on ways to reduce consumption and recycle water can help alleviate this global issue.”

Devi hopes that her research will enable those in the pulp and paper industry to better understand system closure, the advantages and main concerns as well as the different technologies that can be used to achieve system closure. “The project as a whole has many positive implications for the pulp and paper industry,” Devi explains. “Since South Africa is a country that is experiencing water shortages, a better understanding of system closure and technologies to implement it in more mills across the country is vital in order to reduce fresh water consumption and the proposed project will enable the paper industry to do exactly that.” From an economic

point of view system closure will result in reduction in the costs incurred to treat waste streams. “Coupled with global warming and the vast amounts of fresh water consumed on a daily basis by many industries including the paper industry, it is likely that access to fresh water will be threatened in the near future and projects like this will equip industries with the technology and knowledge necessary to move forward under such circumstances.”

Her research has not been without challenges, however, as she has experienced a bit of difficulty obtaining pulp samples from the mill due to the large quantity of samples required for the research. Even so, she continues to feel that the pulp and paper industry is “interesting and challenging and poses various opportunities to broaden your skills as an engineer”.

However, Devi mentions that the pulp and paper industry is often labeled as a ‘declining industry’, due to what she refers to as advancements in technology and the internet that make newspapers, newsletters and even account statements available online. In order to make the pulp and paper industry more attractive to young engineers such as Devi, she believes that the industry needs to market itself more. “We should start by promoting the pulp and paper industry at a school level to invoke an interest in the younger generation. More workshops and short courses should be made available to teach people about the basics of the industry and the manufacturing processes,” says Devi. “People need to be reminded that paper is still a necessity.”

Devi has found her experience at CSIR thus far to be “highly inspirational, motivating and exciting”, also having helped her to improve her problem solving and analytical skills. Following the completion of her research, she would like to be placed in the industry at a pulp and paper mill but, being a quick learner, she feels that she could adapt to any area that offers possible employment.

If you are interested in Devi's research and its potential applications for your own company, please contact Bruce Sithole at CSIR's Natural Resources Centre in Durban. ■