

SIMULATION MODEL TAKES TOP HONOURS

Niel Pieterse, an alumnus of the University's Department of Chemical Engineering, walked away with the newly introduced South African Institute of Tribology (SAIT) Student Award on the occasion of its 2006 annual dinner.

After receiving his BEng degree in Chemical Engineering from UP in 2003, Niel pursued his postgraduate studies in biotribology, focusing specifically on developing a mathematical model of the lubrication of human hip joints. He presented a paper on this topic at the Third World Tribology Congress in Washington in 2005 and received his MEng (cum laude) in 2006. Niel is currently employed as a process engineer at Foster Wheeler South Africa.

The aim of his research was to study the characteristics of synovial joints, such as the hip joint, by making use of fundamental mathematical modelling techniques. To do this, he had to develop a dynamic hip joint model simulating the dynamic forces and joint movements during joint operation. Once available, the effect of the synovial fluid lubricant properties could be added by describing its behaviour as a component of the hip joint simulation model.

Niel developed a model based on fundamental principles, like the equations of mass and motion, and validated it experimentally with a hip-joint simulator. It was also shown that the effect of the lubricant properties can be studied by adding the relevant rheological equations. Although certain assumptions had to be made during development, the results are promising and a firm base has been set for subsequent research. In future, the model needs to be extended to simulate the continuous, multi-cycle operation of a human joint. ⚙️

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GIVING THE ENVIRONMENT A BREAK

by Frané van Zyl

The water level of the Cullinan diamond mine's slimes dam is above the legally permitted level. The challenge was to set this straight. A suitable treatment process had to be found, which would bring the quality of the water in line with the legislative discharge standards.

This would allow for 2 000 m³ of water to be discharged into the river daily.

Coagulation and membrane technologies were employed in the treatment of the diamond mine effluent. Coagulation, flocculation and reverse osmosis were considered, for instance, to improve the water quality. As a result, the optimum coagulant flocculant pair was found to be Magnafloc 1597 and Magnafloc 5250, as they achieved the lowest residual turbidity with the minimum dosage required. The turbidity decreased from well above 2 000 NTUs to below 2.5 NTUs. Costs could not be compared, since the costs are not fixed.

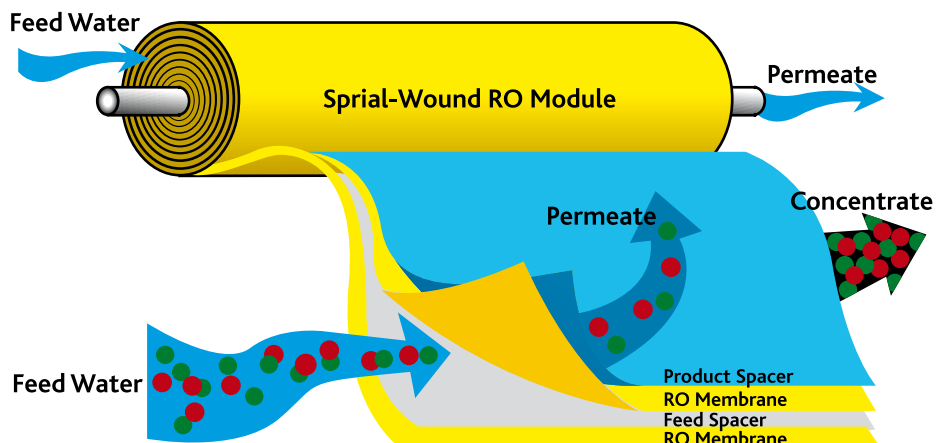
The reverse osmosis effluent conformed fully to discharge standards and is therefore a successful treatment method. The membrane became plugged, which indicates that cleaning or pretreatment



→ 1 A sample of the effluent before and after treatment

methods should be investigated. The estimated capital and treatment costs to treat 2 000 m³/day with spiral and tubular membranes show that a spiral membrane system is much more cost-effective than a tubular membrane system. ⚙️

Frané van Zyl is a graduate of the University of Pretoria's Department of Chemical Engineering.



→ 2 A typical spiral wound reverse osmosis module