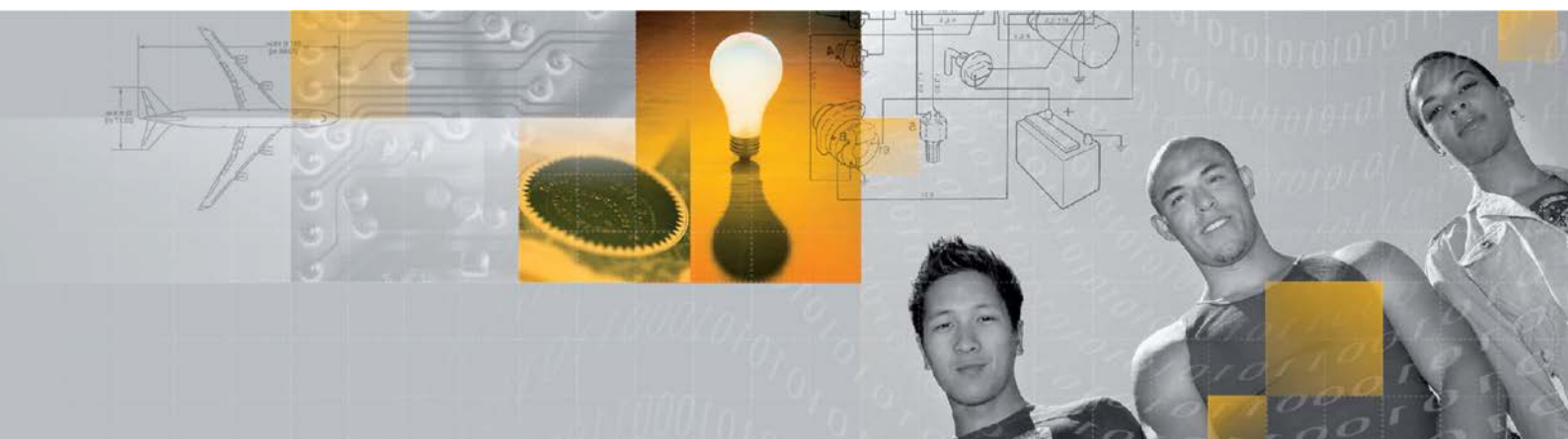
PhD and MEng Research Topics 2018

Department of Process Engineering, Stellenbosch University

Disclaimer: Limited bursaries are available for some of the following postgraduate positions, and is awarded depending on the profile of the candidate and at the discretion of the supervisor.



RESEARCH GROUP: BIORESOURCE ENGINEERING

Supervisor: **Dr NJ Goosen**	**Email:**	njgoosen@sun.ac.za
	Tel:	0218084105
	Office:	317.4
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Bioresource Engineering		
Research Field: Valorisation of biological feedstock, including food and agricultural residues		
General description of research field: The research mostly focuses on developing processing routes to obtain value-added products and energy from food and/or agricultural by-products. Enzymatic processing methods are a primary focus of many of the research projects and are investigated experimentally and by using modelling approaches. The results of the research regularly find application in integrated agricultural (and particularly aquaculture) contexts, and projects normally require a degree of interdisciplinary research.		

Research Topics:	MEng	PhD
1. Anaerobic digestion as driver of sustainable intensification of small-scale African farming systems		X
2. Biorefinery of South African seaweeds: developing sustainable foods and energy from marine resources	X	X
3. Integration of renewable energy into recirculating aquaculture systems	X	X
4. Mathematical modelling of enzymatic hydrolysis in bioprocessing	X	X
5. Improved utilisation of South African fish processing by-products through application of biotechnology	X	X

Additional information/requirements: Requires a willingness to work on interdisciplinary topics. South African citizens and permanent residents, and/or candidates that obtain own bursary funding (and adhere to entry requirements) will get preference.

Supervisor: **Dr ER Els**	**Email:**	rels@sun.ac.za
	Tel:	0218084486
	Office:	C207
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Bioresource Engineering		
Research Field: Cultivation of algae		
General description of research field: Improved and more cost effective method of cultivating algae with the aim of production of biodiesel.		

Research Topics:	MEng	PhD
1. Improved photobioreactor design.	X	
2. Cultivation of algae under conditions of high cell density.	X	
3. Extraction of lipids from algae.	X	

Additional information/requirements: South African citizens and permanent residents will get preference.

For eligibility criteria and application information, please contact Mieke de Jager (Postgraduate Manager) at miekedup@sun.ac.za.

RESEARCH GROUP: BIORESOURCE ENGINEERING

Supervisor: **Dr RW Pott**	**Email:**	rpott@sun.ac.za
	Tel:	0218082064
	Office:	
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Bioresource Engineering		
Research Field: Bioprocess Engineering		
General description of research field: The research is directed towards the development and enhancement of biological processes for optimal production and purification of a lipopeptide-based bioproduct. A wide range of biological processes is researched, including those using bacterial, fungal and enzymic biocatalysts, resting and active cells, batch, fed-batch and continuous strategies and free and immobilised configurations. The proposed research approach will be multidisciplinary in nature with interrelated components of lipopeptide production, purification and efficacy, mediated by chemical engineers, microbiologists, biochemists and biotechnologists. It is envisaged that by connecting specialists in the fields of engineering and life sciences, that a synergistic solution to this complex problem will be realised.		

Research Topics:	MEng	PhD
1. This research project will focus on the bacterial production and purification of novel antimicrobial agents effective against a wide variety of fungal agents affecting postharvest fruit. Lipopeptide molecules, produced by many *Bacillus* species, have been shown to exhibit antifungal activity. The research outlined in this proposal is primarily focused on optimising the separation and purification of lipopeptides produced in Bacillus spp.-based fermentations, to produce a standardised and consistent bio-fungicide product which would be effective in a wide range of physical and chemical environments.	X	X
2. Bacterially produced surfactant molecules (lipopeptides) offer promise as antimicrobial agents effective against a large number of pathogenic organisms, even those exhibiting antibiotic resistance. This work will be directed towards the preliminary development of a novel bioprocess for the simultaneous *in situ* production and separation of antimicrobial lipopeptides. The work is divided into two interconnected sections: upstream processing and downstream processing.	X	X

Additional information/requirements: Graduates with a BEng, BScEng or BScHons degrees are eligible to apply.

Supervisor: **Dr AFA Chimphango**	**Email:**	achimpha@sun.ac.za
	Tel:	0218084094
	Office:	C208
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Bioresource Engineering		
Research Field: Biomass processing		

Research Topics:	MEng	PhD
1. Co-extraction of hemicelluloses and phenolic compounds	X	X
2. Heat and mass transfer in postharvest cooling systems	X	

For eligibility criteria and application information, please contact Mieke de Jager (Postgraduate Manager) at miekedup@sun.ac.za.

RESEARCH GROUP: BIORESOURCE ENGINEERING

Supervisor: **Prof JF Görgens**	**Email:**	jgorgens@sun.ac.za	
	Tel:	021 808 3503	
	Office:	C407	
Faculty: Engineering	**Department:** Process Engineering		
Research Group: Bioresource Engineering			
Research Field: Biorefineries			
Research Topics:		**MEng**	**PhD**
1. Biorefineries for valourisation of processing residues from the paper and pulp industry		X	
2. Optimisation of digestor performance in the pulping industry		X	X
3. Multi-product biorefineries implemented in agro-processing		X	
Additional information/requirements: Multiple positions available within these research topics.			

For eligibility criteria and application information, please contact Mieke de Jager (Postgraduate Manager) at miekedup@sun.ac.za.

RESEARCH GROUP: EXTRACTIVE METALLURGY

Supervisor: **Prof C Dorfling**	**Email:**	dorfling@sun.ac.za
	Tel:	021 808 3674
	Office:	C305
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Extractive Metallurgy		
Research Field: Hydrometallurgy		
General description of research field: Development and modelling of hydrometallurgical processes for metal recovery from low grade /secondary resources		

Research Topics:	MEng	PhD
1. Recycling of rare earth elements	X	
2. Dynamic modelling of hydrometallurgical processes	X	
3. Metal recovery from printed circuit board waste	X	
4. Investigating base and precious metal leaching mechanisms	X	X

Supervisor: **Dr L Auret**	**Email:**	lauret@sun.ac.za
	Tel:	0218084495
	Office:	C213
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Extractive Metallurgy		
Research Field: Process Monitoring and Systems		
General description of research field: Process monitoring of industrial processes is a necessary process control task, aimed at the detection of detrimental abnormal events or other sub-optimal process operation. Machine and statistical learning approaches to process monitoring are attractive due to the increasing availability of more, and more frequent, process measurements; the increasing power and ease of application of statistical techniques; and the difficulty associated with developing fundamental process models for complex processes.		

Research Topics:	MEng	PhD
1. Process monitoring with Bayesian methods	X	X
2. Process monitoring with machine learning methods	X	X
3. Dynamic modelling, control and modelling of fully automated process plant	X	
Additional requirements: Students with good coding skills (MATLAB/Python) will be given preference.		

Supervisors: **Prof SM Bradshaw** **Prof G Akdogan** **Dr N Snyders**	**Email:**	smb@sun.ac.za
	Tel:	X 4493
	Office:	C 310
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Extractive Metallurgy		
Research Field: Hydrometallurgy, pyrometallurgy, waste valorisation and mineral processing		
General description of research field: Development and modelling of processes for efficient and sustainable extraction of valuable metals from primary and secondary resources		

List of Research Topics:	MEng	PhD
1. Extraction of rare earth elements from discard coal and ash	X	
2. Effect of screen material and aperture design on screening performance	X	X
3. Modelling of screens using CFD		X
4. CFD modelling of reaction, mass, momentum and heat transfer in heap leaching	X	X

For eligibility criteria and application information, please contact Mieke de Jager (Postgraduate Manager) at miekedup@sun.ac.za.

RESEARCH GROUP: EXTRACTIVE METALLURGY

Supervisor: Dr M Tadie	Email:	mtadie@sun.ac.za
	Tel:	021 808 4053
	Office:	Annexe 317.3
Faculty: Engineering	Department: Process Engineering	

Research Group: Extractive Metallurgy

Research Field: Electrowinning of metals and flotation

General description of research field: The electrowinning research focus aims to optimise process outputs such as product quality and energy consumption through computational and experimental methods. The research focus in flotation is on using mineral surface properties to understand and optimise mineral recovery with a focus on the platinum and nickel mining industry.

List of Research Topics:	MEng	PhD
1. Simulation and investigation of the effect of solution properties on copper deposition	X	
2. Influence of semi-conductor properties on reagent suite optimisation		X
3. Effect of nickel and ferrous mineral associations on their recovery by flotation	X	

For eligibility criteria and application information, please contact Mieke de Jager (Postgraduate Manager) at miekedup@sun.ac.za.

RESEARCH GROUP: SEPARATION TECHNOLOGY

Supervisor: **Prof AJ Burger**	**Email:**	ajburger@sun.ac.za
	Tel:	021 808 4494
	Office:	C410
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Separations Technology		
Research Field: Thermodynamic Modelling and characterisation of selected mass-transfer processes		
General description of research field: Separation processes such as distillation, absorption and adsorption rely on certain driving forces (i.e. deviation from chemical potential equilibria) and other mass transfer criteria (surface area, film behaviour, mixing behaviour, etc.), which are, amongst other, reliant on the physical characteristics of the fluids. Research projects in this field will thus focus on related aspects.		

List of Research Topics:	MEng	PhD
1. Thermodynamic modelling with SAFT-type equations of state	X	X
2. Separation of alkanes and oxygenates by adsorption	X	
3. Characterisation of packing material and/or demisters in distillation columns	X	X

Additional information/requirements: The selection of an appropriate postgraduate project by a specific student should consider the skills set and experience of the student, the specific interest of the student, project costs and bursary costs. This process is student-dependent and I do not believe in advertising bursary amounts without connecting a specific project with a specific student. Therefore, if you are interested in research related to the topics above, please make an appointment for a proper discussion.

Lecturer: **Prof CE Schwarz**	**Email:**	cschwarz@sun.ac.za
	Tel:	021 8084487
	Office:	C307
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Separation Technology		
Research Field: Supercritical fluid extraction or fractionation of plant materials		
General description of research field: The separations technology research group has a keen interest in supercritical fluid processing. Current and previous staff have over 25 years of experience in this field and are leaders in supercritical fluid processing research in South Africa. Supercritical fluid processing is ideally suited to the processing of plant materials, especially for high-value products that are temperature sensitive.		

Research Topics:	MEng	PhD
1. Supercritical fluid extraction and/or fractionation of South African plant materials	X	X

For eligibility criteria and application information, please contact Mieke de Jager (Postgraduate Manager) at miekedup@sun.ac.za.

RESEARCH GROUP: WASTE VALORISATION

Supervisor: **Dr TM Louw**	**Email:**	tmlouw@sun.ac.za
	Tel:	021 808 4051
	Office:	C317.2
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Waste Valorisation		
Research Field: Mathematical modelling of bioprocesses in waste valorisation		
General description of research field: (1) Synthetic biology seeks to optimise engineered biological processes by selecting for specific mutualistic interactions. Co-culture systems have tremendous potential in industrial applications by completely removing certain limitations inherent in monocultures. Mathematical modelling can help us understand the complex interactions leading to interesting dynamics (including population instabilities) associated with co-culture. (2) Biological wastewater treatment processes are often operated sub-optimally due to a lack of information and understanding of the process. This problem can be addressed through the development of advanced mathematical models, parameter estimation tools, and low-cost instrumentation. Special emphasis is given to Anaerobic Digestion (AD) and constructed wetlands (CW)		

Research Topics:	**MEng**	**PhD**
1. Simulating yeast/algae interactions in a membrane co-culture reactor	1	
2. Investigation into the co-culture of cyanobacteria and methanotrophs for biogas valorisation	1	
3. Advanced mathematical modelling and parameter estimation for AD modelling		2
4. Development of low-cost instrumentation for use in AD monitoring	2	
5. Monitoring and modelling of an existing CW for industrial wastewater treatment	1	

Additional information/requirements: A strong interest in fundamental mathematical modelling of biochemical processes.

Supervisor: **Dr RW Pott**	**Email:**	rpott@sun.ac.za
	Tel:	0218082064
	Office:	
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Waste Valorisation		
Research Field: Bioprocess Engineering		
General description of research field: The research is directed towards the development and enhancement of biological processes for wastewater treatment and valorisation. Using novel photobioreactor configurations, and phototrophic bacteria, various waste streams can be treated and valuable products created.		

Research Topics:	**MEng**	**PhD**
1. Hydrogen production from organic wastes using photofermentative bacteria.	2	
2. Development of a novel photobioreactor for the analysis of co-culture kinetics and effects	1	

Additional information/requirements: Graduates with a BEng, BScEng or BScHons degrees are eligible to apply.

For eligibility criteria and application information, please contact Mieke de Jager (Postgraduate Manager) at miekedup@sun.ac.za.

RESEARCH GROUP: WATER

Supervisor: **Prof AJ Burger**	**Email:**	ajburger@sun.ac.za
	Tel:	021 808 4494
	Office:	C410
Faculty: Engineering	**Department:** Process Engineering	

Research Group: Water

Research Field: Desalination and water treatment processes

General description of research field: Water treatment requires a solid understanding of the various inorganic, organic and biological content of the water and technologies for removal of related components from the water. It spans a very wide range of treatment options, including membrane desalination and filtration.

List of Research Topics:	MEng	PhD
1. Mine water treatment and the manipulation of precipitation of sparingly soluble salts in multi-stage desalination	X	X
2. Techno-economic evaluation of desalination options in the Western Cape	X	
3. Sequential batch anaerobic digestion of effluent and related modelling	X	X
4. Wet air oxidation of effluents from pharmaceutical manufacturing	X	

Additional information/requirements: The selection of an appropriate postgraduate project by a specific student should consider the skills set and experience of the student, the interest of the student, project costs and bursary costs. This process is student-dependent and I do not believe in advertising bursary amounts without connecting a specific project with a specific student. Therefore, if you are interested in research related to the topics above, please make an appointment for a proper discussion.

Supervisor: **Dr TM Louw**	**Email:**	tmlouw@sun.ac.za
	Tel:	021 808 4051
	Office:	C317.2
Faculty: Engineering	**Department:** Process Engineering	

Research Group: Water

Research Field: Mathematical modelling of micropollutant removal

General description of research field: Micropollutants (MP) originating from pharmaceuticals, illicit drugs, personal care products, etc., have been found to persist in water systems. Methods for the detection and removal of MP is a new and very active field of research. A fundamental understanding of the processes can be aided through the development of mathematical models. Special attention is also given to biofilm modelling.

Research Topics:	MEng	PhD
1. Stochastic modelling of MP distribution and persistence in Western Cape water systems		X
2. Modelling of Hybrid Activated Sludge Process for MP removal	X	
3. Modelling of carbon-based electrochemical oxidation technology for MP removal	X	
4. Investigating the role of manganese oxidising bacteria in biofilm growth on the Blyde River Irrigation system	X	
5. Developing a biofilm model for the growth and persistence of *Mycobacterium tuberculosis*		X

Additional information/requirements: A strong interest in fundamental mathematical modelling of biochemical processes.

For eligibility criteria and application information, please contact Mieke de Jager (Postgraduate Manager) at miekedup@sun.ac.za.

RESEARCH GROUP: WATER

Supervisor: **Prof VL Pillay**	**Email:**	pillayvl@sun.ac.za
	Tel:	021 808 4728
	Office:	C212
Faculty: Engineering	**Department:** Process Engineering	
Research Group: Water		
Research Field: Water and wastewater treatment and reuse with a strong focus on membrane technology		
General description of research field: The lack of water of adequate quality is rapidly emerging as a major constraint to both community development and the development of the industry. This is exacerbated by climate change, which seemingly has thrown previous rainfall patterns out the window. Hence, innovative approaches are urgently required for providing potable water from existing sources and remediating wastewaters to possible reuse standards. Remediating industrial wastewaters also offers the advantage of recovering very valuable organic and inorganic chemicals that can be used as feedstock for other chemical processes.		

List of Research Topics:	MEng	PhD
1. Development of a woven fabric microfiltration membrane module for potable water provision and wastewater treatment.	X	
2. Optimisation of gravity driven membrane processes	X	
3. Development of a Donnan Dialysis process for the recovery of Al and Fe flocculants	X	
4. Evaluation of ultrafiltration and microfiltration as a replacement technology for potable water production in the Western Cape	X	
5. Development of a membrane-based process for treatment and valorisation of fishing industry effluent.	X	
6. Development of a membrane-based process for the treatment and valorisation of canning industry effluents	X	

Additional information/requirements: The above projects are all focussed on achieving a real practical outcome, rather than investigations into basic science. Hence, the candidate needs to have strong practical engineering skills, in addition to being able to understand and apply current theory.

For eligibility criteria and application information, please contact Mieke de Jager (Postgraduate Manager) at miekedup@sun.ac.za.