



**DEPARTMENT OF
PROCESS ENGINEERING**

**POSTGRADUATE RESEARCH
TOPICS 2019**



BIORESOURCE ENGINEERING

Supervisor: Dr Robbie Pott	Email: rpott@sun.ac.za	Tel: +27 (0)21 808 2064	
Research Group: Bioresource Engineering			
Research Field: Bioprocess Engineering			
General Description (field of research): The research group covers topic in applied microbiology, bioprocess engineering and reactor design, focussing on a cross disciplinary approach to problem solving.			
List of Research Topics	PhD	MEng	Funding
1. Novel antimicrobial agents from bacteria – lipopeptides as antifungal agents			TBC
2. <i>In situ</i> extraction of products for bioprocesses – reactor design and testing			TBC
3. Use of outdoor reactors for cultivation of microalgae and photosynthetic bacteria for hydrogen production			WRC sponsored project
4. The use of seaweed extracts for soil amendment - biofertilizers, water retention aids and slow release fertilizers			TBC
5. The use of Biosurfactants in froth flotation for mineral recovery			TBC
Notes regarding funding: Funding yet to be confirmed.			
Prerequisites / Requirements: Graduates with a BEng, BScEng or BScHons degrees are eligible to apply.			

Supervisor: Prof Johann Görgens	Email: jgorgens@sun.ac.za	Tel: +27 (0)21 808 3503	
Research Group: Bioresource Engineering			
Research Field: Bio-energy / fuels, chemicals and electricity from biomass in biorefineries			
General Description (field of research): Biofuels production by biological and thermochemical processes. Co-production of bio-energy with high-value chemicals and electricity.			
List of Research Topics	PhD	MEng	Funding
1. Fermentation process development and scale-up with advanced yeasts, for conversion of paper wastes into bio-ethanol	X	X	Funding available for all projects – subject to negotiation between supervisor and candidate
2. Fermentation process development and scale-up with advanced yeasts, for conversion of spent sulphite liquor from hardwoods into bio-ethanol		X	
3. Techno-economic and environmental comparison of alternative route for hydrogen production from water or biomass		X	
4. Techno-economic assessment of alternative energy products from paper wastes	X	X	
5. Valorisation of lignin residues from a bio-energy process through combined enzymatic degradation and pyrolysis	X	X	
Prerequisites / Requirements:			
For PhD enrolment: MSc, MScEng or MEng in Chemical Engineering, Biochemistry, Biotechnology or Microbiology. For MEng enrolment: BScEng, BEng, BScHonsEng or HonsBSc in Chemical Engineering, Biochemistry, Biotechnology or Microbiology.			

Supervisor: Dr Annie Chimphango	Email:	achimpha@sun.ac.za	
	Tel:	+27 (0)21 808 4094	
Research Group: Bioresource Engineering			
Research Field: Biomass processing and nanotechnology			
General Description (field of research): Multidiscipline research aimed at obtaining maximum value from biomass waste by developing efficient fractionation and modification methods in biorefineries to produce high value productions with applications that can advance efficient use of resources			
List of Research Topics	PhD	MEng	Funding
1. Beneficiation of Agro and forest residues: Developing advanced methods for fractionation and functionalization of biomass and biopolymers using “green” methods in a biorefinery set up.	X	X	2 positions (1 PhD, 1 MEng)
2. Integrated agricultural and food systems: Techno-economic and sustainability analysis of integrated agricultural /food system and renewable energy. Emphasis on using systems approach and systems dynamic modelling and modelling of postharvest systems to advance food security	X	X	2 positions (PhD only)
3. Functional foods and biopolymers: Developing suitable and efficient processes for extraction of bioproducts from agro-residues with nutraceutical and health benefits e.g. emulsifiers, additives, coatings, films	X	X	2 positions (1 PhD, 1 MEng)
4. Biomaterials and biocomposites: Developing processes for “green” modification of biopolymers into advanced biomaterials and biocomposites of nano- micro- scale for novel industrial applications such as slow delivery devices, sorbents, encapsulation matrices and intelligent and functional food packaging films	X	X	2 positions (1 PhD, 1 MEng)
Notes regarding funding: Bursaries and projects are student-specific and are to be negotiated. Students are also encouraged to find own funding.			
Prerequisites / Requirements: Students should have an engineering or science background. PhD students should possess a master’s degree in related field of research.			

Supervisor: Dr Neill Goosen	Email:	njgoosen@sun.ac.za	
	Tel:	+27 (0)21 808 4105	
Research Group: Bioresource Engineering			
Research Field: Valorisation of biological feedstock, including food and agricultural residues			
General Description (field of research): The research focuses on developing processing routes to obtain value-added products and energy from biological raw materials. Environmentally friendly processing routes are preferred e.g. enzymatic processing methods. Most positions are for experimental studies, although modelling approaches are sometimes used (see details below). Research projects in this group are often conducted in collaboration with other scientific disciplines, and therefore create ample opportunity for postgraduate candidates to work in an interdisciplinary environment and to learn new skills.			
List of Research Topics	PhD	MEng	Funding
1. Protein and starch recovery from potato processing by-products (experimental)		X	1 position
2. Optimisation of high-value polyphenolic recovery from South African seaweeds (experimental)	X	X	Multiple positions
3. Biorefinery of South African seaweed: Life Cycle Assessment and techno-economic evaluation (modelling)	X	X	Multiple positions

4. Improved utilisation of South African fish processing by-products through application of biotechnology (experimental)	X	X	Multiple positions
5. Development of environmentally friendly and cost effective lime pellets for use in the agricultural industry (experimental)		X	1 position
Notes regarding funding: Most positions include bursary funding; please enquire via e-mail or make an appointment for a more detailed discussion of projects.			
Prerequisites / Requirements: Most projects require 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.			

EXTRACTIVE METALLURGY

Supervisor: Prof Guven Akdogan	Email:	gakdogan@sun.ac.za	
	Tel:	+27 (0)21 808 4931	
Research Group: Extractive Metallurgy			
Research Field: Waste Processing			
General Description (field of research): Process development and modelling for recycling and extraction valuable metals from EOL and waste resources.			
List of Research Topics	PhD	MEng	Funding
1. Characterisation of C&D waste from Western Cape and extraction of valuable metals	X	X	
2. Extraction of gold from waste tailing dams		X	
3. Recycling Lithium Ion batteries (LIBs) and extraction of critical metals	X	X	
4. Supply chain modelling and end-of-life (EOL) management of Lithium Ion batteries in SA	X	X	
5. European Li-ion battery recycling and flow analysis Co, Li, Ni, Mn	X	X	
6. Development of closed-loop supply chain modelling for spent LIBs for a reverse-supply network	X	X	
7. Plastic degradation mechanisms and distribution in marine environment	X	X	
8. Characterisation and extraction of REEs from waste coal dumps		X	
Prerequisites / Requirements: Eligible South African / permanent resident graduates with BEng, BScEng or BScHons degrees having strong interest in waste processing technology.			

Supervisor: Prof Christie Dorfling	Email:	dorfling@sun.ac.za	
	Tel:	+27 (0)21 808 3674	
Research Group: Extractive Metallurgy			
Research Field: Hydrometallurgy			
General Description (field of research): Development and modelling of hydrometallurgical processes for metal recovery from low grade / secondary resources.			
List of Research Topics	PhD	MEng	Funding
1. Recycling of rare earth elements		X	To be confirmed
2. Metal recovery from printed circuit board waste using alternative leaching reagents	X	X	To be confirmed
3. Techno-economic evaluation of metal recycling processes		X	To be confirmed
4. Investigating base and precious metal leaching mechanisms	X	X	To be confirmed

Supervisors: Prof Steven Bradshaw (contact academic) and co-supervisors	Email: smb@sun.ac.za	
	Tel: +27 (0)21 808 4493	
Research Group: Extractive Metallurgy		
Research Field: Process monitoring for mineral processing applications		
General Description (field of research): Statistical and machine learning techniques applied to real-world case studies for more cost effective and sustainable operation of mineral processing circuits		
List of Research Topics	PhD MEng Funding	
1. Learning appropriate process interventions from process data		X I Bursary, R 100 000 p.a. to be confirmed
2. Utility and interpretation of root cause analysis diagrams		X I Bursary, R 100 000 p.a. to be confirmed
3. Furnace temperature profile monitoring		X I Bursary, R 100 000 p.a. to be confirmed
Prerequisites / Requirements: Strong programming skills (MATLAB and/or R). Strong technical and analytical skills.		

SEPARATIONS TECHNOLOGY

Supervisor: Prof André Burger	Email: ajburger@sun.ac.za	
	Tel: +27 21 808 4494	
Research Group: Separations Technology		
Research Field: Thermodynamic modelling and characterisation of selected mass-transfer processes		
General Description (field of research): 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	PhD MEng Funding	
1. Thermodynamic modelling with SAFT-type equations of state	X X	Bursaries and projects are student-specific and are to be negotiated.
2. Separation of alkanes and oxygenates by adsorption	X	
3. Characterisation of packing material and/or demisters in distillation columns	X X	
Prerequisites / 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.		

Supervisor: Dr LJ du Preez	Email: ljpg@sun.ac.za	
	Tel: +27 (0)21 808 9904	
Research Group: Separations Technology		
Research Field: Characterisation of Mass Transfer Processes		
General Description (field of research): Mass transfer processes such as distillation, absorption, stripping and adsorption are key industrial operations for separation and purification of feed and product streams. These processes are often energy intensive and, therefore, require detailed performance characterisation in order to optimise the energy efficiency of their operation.		
List of Research Topics	PhD MEng Funding	
1. Hydrodynamic behaviour characterisation of tray and packed distillation columns		X Bursaries and projects are student-specific and are to be negotiated.
2. Mass transfer performance characterisation of packed distillation columns:	X	X

<ul style="list-style-type: none"> • Reaction kinetics and reactive absorption studies for effective interfacial mass transfer area determination • Physical absorption and desorption studies for mass transfer coefficient determination 			
3. CO ₂ sequestration via reactive absorption into amine solutions		X	
4. Separation of alkanes and alcohols via adsorption including life cycle analysis of adsorbents		X	
5. Monomer fraction measurements with FTIR for use in SAFT thermodynamic model development and evaluation		X	
Prerequisites / Requirements: BEng (Chemical) degree and a strong interest in separation technology, especially mass transfer technologies.			

Supervisor: Prof Cara Schwarz	Email:	cschwarz@sun.ac.za	
	Tel:	+27 21 808 4487	
Research Group: Separations Technology			
Research Field: Supercritical fluid extraction or fractionation of plant materials			
General Description (field of research): 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.			
List of Research Topics	PhD	MEng	Funding
1. Supercritical fluid extraction and/or fractionation of South African plant materials	X	X	Bursaries and projects are student-specific and are to be negotiated.
Prerequisites / 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.			

Supervisor: Dr Jamie Cripwell	Email:	cripwell@sun.ac.za	
	Tel:	+27 (0)21 808 4108	
Research Group: Separations Technology			
Research Field: Thermodynamic Modelling & Thermophysical Property Measurement			
General Description (field of research): Accurate predictions of binary phase equilibria are traditionally the measures against which thermodynamic model performance is tested. However, with the introduction of fundamental models like SAFT, focus is shifting towards a more holistic and balanced approach to thermodynamic model development. Measurements of thermophysical properties (such as density and speed of sound), thermodynamic excess properties and equilibria in multicomponent mixtures, are facilitating the growth of the next generation of thermodynamic models.			
List of Research Topics	PhD	MEng	Funding
1. Phase equilibria in ternary mixtures		X	
2. Using liquid density and speed of sound measurements to improve thermodynamic model predictions	X	X	
3. Expanding the scope of application of the SAFT- γ Mie group contribution model	X	X	
Notes regarding funding: Funding and bursaries will be negotiated on an ad hoc basis			
Prerequisites / Requirements: Graduates with a BEng or BScEng are eligible to apply			

WASTE VALORISATION

Supervisors: Prof Cara Schwarz and Prof Hansie Knoetze	Email:	cschwarz@sun.ac.za	
	Tel:	+27 (0)21 808 4487	
Research Group: Waste Valorisation			
Research Field: Production of fuels and other valuable products from waste tyre derived oil			
General Description (field of research): The waste valorisation research group at Stellenbosch University is has opportunities in the focus area of valorisation of tyre derived oil. Tyre derived oil is obtained through the pyrolysis of spent tyres. There is a large stockpile of spent tyres in South Africa and a significant environmental drive exists to process these tyres into useful products. The tyre derived oil contains a range of fuel fractions and a wide array of valuable products. In order to obtain the best possible products in the most economical and environmentally friendly manner, further research on the pyrolysis process, the separation process and integration thereof is required.			
List of Research Topics	PhD	MEng	Funding
1. Improving the pyrolysis process to obtain tyre derived oil	X	X	Bursaries and projects are student-specific and are to be negotiated.
2. Fractionation of tyre derived oil	X	X	
Notes regarding funding: Funding is dependent on the profile of the candidate.			
Prerequisites / Requirements: Previous experience in separation processes is an advantage but not a requirement.			

WATER TECHNOLOGY

Supervisor: Dr Tobi Louw	Email:	tmlouw@sun.ac.za	
	Tel:	+27 (0)21 808 4051	
Research Group: Water Technology			
Research Field: Mathematical modelling of environmental systems			
General Description (field of research): The natural environment is characterised by complex physical, chemical, and biological interactions existing over multiple time and length scales: from seasonal effects in reservoirs to phenotype switching in microbial biofilms. Mathematical modelling provides a unique perspective on these processes.			
List of Research Topics	PhD	MEng	Funding
1. Computational Fluid Dynamics of the Loskopdam reservoir to assess seasonal effects in aluminium availability		X	Bursary possibilities to be discussed with candidates
2. Investigating the role of manganese oxidising bacteria in biofilm growth on the Blyde River Irrigation system		X	Bursary possibilities to be discussed with candidates
Prerequisites / Requirements: A strong interest in fundamental mathematical modelling			