Diane Hildebrandt

CURRICULUM VITAE

Professor
Department of Chemical and Biochemical Engineering
Rutgers, The State University of New Jersey

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SUMMARY

Prof Diane Hildebrandt is a Professor in the Department of Chemical and Biochemical Engineering at the Rutgers, the State University of New Jersey, USA. She obtained her B.Sc., M.Sc. and Ph.D. from the University of the Witwatersrand, South Africa. She has authored or co-authored over 210 scientific papers, including an invited paper in *Science*, and has supervised over 100 graduate students.

She was awarded the President's Award by the Foundation for Research and Development and the Distinguished Researcher Award by the University of the Witwatersrand in 1996. In 1997 she became the first engineer to be awarded the Royal Society of South Africa's Meiring Naude Medal. In 2000 she and a colleague were the first academics to be awarded the Bill Neale-May Gold Medal by the South African Institute of Chemical Engineers. In 2002 she was made a Fellow of the Royal Society of South Africa and also received the Vice Chancellor's Research Award of the University of the Witwatersrand. In 2003 she was elected as a member of the Academy of Sciences of South Africa. In 2005 she was recognized as a world leader in her area of research when she was awarded an A rating by the National Research Foundation of South Africa. In 2006 she was elected a Fellow of the Academy of Engineering of South Africa. In 2009 she won the Distinguished Woman Scientist Award from the Department of Science and Technology and the African Union Continental Scientific Award in the category Basic Science, Technology and Innovation. In 2010 she was awarded the ASSAf 'Science-for-Society' Gold Medal Award. In 2017 she was conferred the NSTF Research and Capacity Development award. In 2017 she was appointed as one of 100 Foreign Experts to advise the Government of Hebei, China. In addition, she was honoured to be chosen for the China National Talent Programme for Foreign experts in 2018 and she is the first African to be so honoured. In 2021 she and the team she led received the National Research Foundation Science Team award for their work on Biogas. She presented the prestigious Danckwerts Memorial lecture at the annual meeting of American Institute of Chemical Engineers in 2022.

Prof Hildebrandt was appointed to the Unilever Chair of Reaction Engineering from 1998-2004 and to the South African Research Chair of Sustainable Process Engineering at the University of the Witwatersrand, South Africa from 2005 to 2013. She has spent a sabbatical at Princeton University, USA.

Her research area is the design of energy efficient processes, with the view to reducing carbon dioxide emissions. She is particularly interested in how she can apply the results of her research to improving the lives of those who do not have access to energy and clean water. This involves working with multidisciplinary teams to understand the social, economic and technological barriers to the adoption of new technologies. Her approach to research is both academic and entrepreneurial.

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ACADEMIC QUALIFICATIONS

1978–1981	University of the Witwatersrand B.Sc. Chemical Engineering, with Distinction Degree awarded in December 1981
1982–1983	University of the Witwatersrand M.Sc. Chemical Engineering Dissertation: Predicting the Performance of an Evaporative Condenser Degree awarded in June 1984
1985–1990	University of the Witwatersrand Ph.D. Chemical Engineering Thesis: The Attainable Region Generated by Reaction and Mixing Degree awarded in June 1990

POSITIONS HELD

1982–1984	Professional Assistant Chamber of Mines Research Organisation Environmental Engineering Laboratory, South Africa
1984	Process Engineer Sastech, SASOL, South Africa
1985–1987	Senior Lecturer Department of Metallurgy Potchefstroom University for Christian Higher Education
1988–1998	Senior Lecturer Department of Chemical Engineering University of the Witwatersrand
1991 (June to Dec)	Assistant Professor (while on Sabbatical) Princeton University USA
1998–2004	Unilever Professor of Chemical Engineering School of Process and Materials Engineering University of the Witwatersrand
2005–2013	Professor and Director of COMPS School of Chemical and Metallurgical Engineering University of the Witwatersrand
2007–2013	SARChI Professor of Sustainable Process Engineering University of the Witwatersrand
2013–2017	Director MaPS, a Research Unit at UNISA, South Africa Professor of Chemical Engineering, School of Civil and Chemical Engineering.
2018–2021	Director IDEAS (Institute for the Development of Energy for African Sustainability), UNISA
2021 – 2023	Distinguished Professor of Future Energy, Joint appointment in the African Energy Leadership Centre, Wits Business School, &

	Molecular Sciences Institute, School of Chemistry, University of the Witwatersrand, Johannesburg, South Africa
2023 – present	Professor, Department of Chemical and Biochemical Engineering, Rutgers, The State University of New Jersey, USA

LIST OF AWARDS

1996	▪ President's Award, Foundation for Research and Development ▪ Distinguished Researcher Award, University of the Witwatersrand
1997	▪ Meiring Naude Medal, Royal Society of South Africa
2000	▪ Bill Neale-May Gold Medal, South African Institute of Chemical Engineers
2002	▪ Fellow of the Royal Society of South Africa ▪ Vice Chancellor's Researcher Award, University of the Witwatersrand
2003	▪ M. Joshua, co-supervised by D. Hildebrandt, D. Glasser, D. Rubin and N. Crowther, awarded NACI prize for the most innovative research by a postgraduate student at a South African university in 2003
2005	▪ Awarded A rating by the NRF. This award recognizes that I am considered a world leader in my field of research by my peers ▪ Elected to the Academy of Sciences of South Africa
2006	▪ Elected to the Academy of Engineering of South Africa
2009	▪ Distinguished Woman Scientist Award of the DST South Africa ▪ African Union Scientific Awards; 2009 Continental Awards for the category Basic Science, Technology and Innovation ▪ The Academic and Non-Fiction Authors' Association of South Africa (ANFASA) grant for preparing the book *Membrane Process Design using Residue Curves.*
2010	▪ Finalist in the 10XE Competition run by AIChE ▪ Finalist in the NSTF Individuals Awards ▪ Winner of the NSTF NGO Award ▪ Winner of the ASSAf 'Science-for Society' Gold Medal Award
2017	▪ Winner NSTF Research and Capacity Development Category ▪ Appointed as one of the 10 Foreign Experts to advise the Government of Hebei in the first round of 100 Foreign Experts program.
2018	▪ Chosen for the China National Talent Programme for Foreign experts in 2018.

2019
- Text book Attainable Region Theory: An Introduction to Choosing an Optimal Reactor was recipient of the 2019 Most Promising New Textbook Award from the Textbook & Academic Authors Association (TAA).

2020
- Awarded the Hebei Province Provincial Award Friendship Award in 2020, which is the highest honour granted to foreign experts to recognise their contribution to China's development and progress in technology and education.
- Finalist of the China National Friendship Award of 2020, which is the People's Republic of China's highest award for "foreign experts who have made outstanding contributions to the country's economic and social progress"

2021
- Winner of the NRF Science Team Award

2022
- Invited to give the Danckwerts Lecture at AIChE Meeting 2022

INTERNATIONAL COLLABORATION

I have collaborated with a number of research groups and centers over the years. In 1995, I initiated an undergraduate enrichment program with Prof Scott Fogler of the University of Michigan. This program continued for 20 years until 2015. In this program, each year chemical engineering students at the University of the Witwatersrand from disadvantaged backgrounds would spend two months working in Prof Fogler's laboratory during their summer break in December and January. Over around 20 years approximately 20 students participated in this program. From 2002 to 2005 I was a Visiting Professor of Process Synthesis at University of Twente, The Netherlands. I taught Design to TWAIO students. Since 2018 I have collaborated with Zhijiang College of Zhejiang University of Technology, China. During 2018 and 2019 I was a Visiting Distinguished Professor and a Visiting Director of Keqiao Green Energy Materials Joint Laboratory, Zhejiang College of Zhejiang University of Technology and I visited in-person on a number of occasions. Since 2017 I have collaborated with Hebei University of Science and Technology, China. During 2017, 2018 and 2019 I was a Visiting Distinguished Professor, Hebei University of Science and Technology, China and Visiting Director of the International Joint Research Laboratory of New Energy, Hebei University of Science and Technology and I visited in-person on a number of occasions. Since Covid I have not been able to visit China but I have continued the collaborations remotely with the above Chinese universities. The collaborations include joint students and joint projects. We have worked on renewable and sustainable energy systems and reduction of carbon dioxide emissions.

INVITED SPEAKER

1994	▪ Invited to present a paper at FOCAPD (Foundations of Computer-Aided Process Design), Snowmass, Colorado
1996	▪ Invited guest speaker at Grenville High School Honours Evening
1997	▪ Plenary lecture at PSE'97/Escape'7 (Process Systems Engineering and European Symposium on Computer Aided Process Engineering), Trondheim, Norway
	▪ Plenary lecture at AIChE (American Institute of Chemical Engineers) Annual Meeting, Miami
	▪ Invited to give a talk at the Grahamstown Science Festival
1999	▪ Invited to be on the discussion panel at the Workshop on Women in Engineering, Cape Town
	▪ Invited to present seminar at University of Sydney
2004	▪ Plenary lecture at SAIChE (South African Institution of Chemical Engineers) Conference at Sun City
2006	▪ Plenary lecture at International Homogeneous Catalysis Conference, Sun City, South Africa, August 2006
2008	▪ Invited to present paper at First World Coal-to-Liquids Conference, Paris, France
2008	▪ Invited to present paper and chair a day at First World Coal-to-Liquids Workshop, Singapore
2009	▪ Invited to present plenary paper at FOCAPD, Colorado, USA, July 2009
	▪ Plenary speaker, World Congress, Montreal
2010	▪ Invited speaker 3rd World CTL Conference, Beijing
2012	▪ Invited speaker NEPIC International Bio-resources Conference, Newcastle, UK
2014	▪ Invited Speaker for FOCAPD 2014, USA
	▪ Invited Speaker for South African Process Optimisation Symposium, Johannesburg
2015	• Invited to be part of the panel that prepared the report: The state of Green Technologies in South Africa for the ASSAF; launched on the 28 January 2015
2017	• Invited by IEA to participate in workshop on use of Process integration to mitigate global warming. Resulted in Report from the IEA Expert Workshop in Berlin on April 4 – 5, 2017, of which I was one of 15 invited experts who contributed to this report
2019	▪ Invited Speaker 2019 Zhejiang College, China

PROFESSIONAL ACTIVITIES

1996–2000	Awarded P Rating by NRF (National Research Foundation)
2000–2004	Awarded B2 Rating by NRF
2001–2005	Member of the International Advisory Board on Homogeneous Catalysis to Sasol
2002	Elected Fellow of the Royal Society of South Africa
2003	Elected as member of Academy of Sciences of South Africa
2003–	Member NRF Rating Committee for Engineering.
2005	Awarded A Rating by NRF
2006	Fellow of the SA Academy of Engineering
2007	Advisory Board of First Coal-to-Liquids Conference, Paris, France 2008
2009–2014	Awarded B1 Rating by NRF
2012–2015	Board Member of SANEDI
2013–2023	Member of the University of Johannesburg Council
2015–2017	Board member of TIA
2016–	Awarded B1 Rating by NRF
2021-	Advisory Panel: Chemical Engineering Science
2023-	Member of AIChE

OVERVIEW OF LEADERSHIP POSITIONS

I founded the Centre of Materials and Process Synthesis (COMPS) at the University of the Witwatersrand in 2005. The purpose of the Centre was to provide Industry with a one-stop-shop to solve problems. To this end, I coordinated with researchers across the University so that we had a team of skills covering almost all disciplines in Science and Engineering. When approached by Industry, I could assemble a team of experts to work on solving the problem. Where necessary we brought in experts from other Universities, local research organisations or from overseas to make sure that the team had the required skills to solve the problem. I set up a team of consultants who would coordinate the work and manage the projects. This approach was extremely successful in terms of solving Industrial problems and also at growing research capacity at the University.

In addition we used this work to apply for THRIP funding. This project became the largest THRIP project and was used by THRIP as an example of how to run a project.

In addition the money raised by this work was used to support under- and postgraduate students, purchase research equipment and so on. This had the result of increasing the research outputs of all researchers involved in this project and there was significant increase in the University of the Witwatersrand's research outputs as a results of this work.

The University decided that they would take over the role of coordinating with Industry and running projects and to this end the team of Consultants was moved out of COMPS and formed the staff of the newly formed Wits Commercialization office.

COMPS continued working with Industry but our focus changed towards involvement in developing new processes. This work has been described in the previous section. My main interest at this point was in developing sustainable processes and this was done by applying my research to the development and design of new and more efficient processes. I am particularly interested in processes that convert waste to energy as this solves two problems, namely removing waste out of the environments while supplying people with energy. As head of COMPS I was able to lead this work and to meet with governments, other Universities and research organisations locally and internationally to drive this research and process development. This work was funded by both international and local groups.

I joined UNISA in 2013 as Director of the Materials and Process Synthesis (MaPS) research group. The purpose of this unit was to develop processes that use waste or underutilised resources. The group has successfully set up infrastructure, including a waste to energy pilot plant at NECSA, has attracted postgraduate students both locally and internationally, and has set up networks for collaboration with both local and international researchers. In addition we are working with local and international companies and governments to develop and apply waste to energy solutions. The Research unit become the Institute for the Development of Energy for African Sustainability in 2017.

In 2018 I was appointed as a Visiting Director of the International Joint Research Laboratory of New Energy, Hebei University of Science and Technology. The aim of this laboratory is develop sustainable processes. The laboratory is funded by the Chinese government and hosts 15 Chinese postgraduate students using the facilities at Hebei for their research and who are registered for their degrees at South African Universities under my supervision.

In 2020 I was appointed as a Visiting Director of the Keqiao Green Energy Materials Joint Laboratory, Zhejiang College of Zhejiang University of Technology. The aim of the research in this laboratory is to develop new materials for green energy applications.   The laboratory is funded by the government of Keqiao and hosts Chinese postgraduate students who use these facilities for their research and who are registered for their degrees at South African Universities under my supervision

OTHER

- Session chairperson at the 8th Meeting of SAIChE – 1997
- Reviewer for various international chemical engineering journals
- AR method developed with co-workers appeared in book: Systematic Methods of Chemical Process Design by L.T. Biegler, I.T. Grossman and A.W. Westerberg, Prentice Hall PTR, New Jersey, 1997, Chapters 13 and 15
- Session co-chair at Distillation and Absorption 1997
- Session co-chair at ISCRE 15 in 1998
- External examiner for S. Hauan, Trondheim, Norway, 1998
- Invited to organise and chair a session at AIChE Annual Meeting, Dallas, 1999
- Features editor for *Chemical Technology* from 1997 to 2004 , the journal endorsed by SAIChE
- Chair at 1st World CTL Workshop, Singapore, 2008
- Our activity included in International Energy Authority (IEA) list of leading groups working on "Process Synthesis", 1997
- Prof. Scott Fogler (USA) paid for a postgraduate student to visit him to incorporate our work in his website for subsequent incorporation in his CD ROM and book (*Elements of Chemical Reaction Engineering*), currently the most used teaching book on Chemical Reactor Theory (1997). Some of the material now appears in the third edition of his book (1998)
- Invited to present talk on our work on Attainable Regions as a key enabling technology at an NSF sponsored workshop on Hybrid Technologies for Waste Minimisation in Colorado in July 1999
- AR method appears in Chapter 8 of book *Chemical Reactor Analysis and Design,* by James B. Rawlings and John G. Ekerdt, Nob Hill Publishing LLC, 2002
- AR method appears in Chapter 6 of book *Product and Process Design Principles,* by Warren D. Seider, J.D. Seader and Daniel R. Lewin. Wiley, New York, 2003
- Invited to write paper on CTL for *Science*
- Invited to write Perspectives article for the *AIChE Journal*
- One of 600 international dignitaries invited by President Xi Jinping to attend a celebration at the Hall of the People for 70th Anniversary of the CEP of China

TEACHING

COURSES TAUGHT

Thermodynamics	3rd year Chemical Engineers and Metallurgists

Reactor design	4th year Chemical Engineers 3rd year Metallurgists B.Sc. (Hons) Chemistry major students Graduate students, Princeton University 3rd year students, University of Hebei
Transport phenomena	3rd year Chemical Engineers and Metallurgists
Hydrometallurgy	4th year Metallurgists
Chemical Engineering Principles	3rd year Chemical Engineers
Residue Curves for Distillation	4th year Chemical Engineers 3-day Continuing Engineering Education Course 5-day MSc course 3-hour course for SAIChE
Reactor Synthesis	3-day Continuing Engineering Education Course 5-day MSc course 3-hour course for overseas market
Process Synthesis	3-day Continuing Engineering Education Course 5-day MSc course 5-day TWAIO course (the Netherlands based postgraduate qualification) 3-hour course for AIChE and SAIChE 3-day course for AIChE and IChemE
Basic Chemical Engineering for Chemists	3-day Continuing Engineering Education Course
Carbon Trading Seminar	1-day course jointly presented with PricewaterHouse Coopers
Design	4th year Chemical Engineers
Energy Value Chains	PGDip and MBA students at Business School

ADDITIONAL RESPONSIBILITIES

1988	Organising the Department of Chemical Engineering, University of the Witwatersrand, seminar programme
1989, 1990	Committee member of the Wits Branch of SAIChE; Responsible for school liaison
1989, 1990, 1992, 1995-1996	School liaison and public relations for Department of Chemical Engineering. Initiated a competition to interest school pupils in the PWV area in chemical engineering as a career in 1989. This was organised and run jointly by SAIChE and the Department of Chemical Engineering. In 1991 and 1992 I organised the departmental open day in order to show the research efforts of the department to the public. In 1993, this concept was taken up by the Faculty of Engineering and a Faculty Open Day was held annually from 1993–1995.
1993	Organised the Faculty Open Day
1993–1996	Department of Chemical Engineering safety officer; responsible for reorganising the laboratories and controlling postgraduate students and undergraduates in the laboratories to improve safety and increase equipment life
1994	Member of the organising committee for the 7th National Meeting of SAIChE
1993–1998	Judge for the regional and national Expo School Science Competition
2005–2013	Co-director of the Centre of Material and Process Synthesis
2001–2003	Coordinator of undergraduate curriculum development for Chemical Engineering degree
2003–2008	Coordinator of postgraduate MEng degree introduced in 2004
2013 - 2019	Academic responsible for Engineers without Borders – UNISA

2015- 2018 Academic responsible Green Energy for Africa Flagship (GEAR) – UNISA

2015-2019 Stream Leader for the Annual Interdisciplinary Academy offered to Unisa Doctoral students and Postdoctoral fellows

OVERVIEW OF RESEARCH AND INDUSTRIAL PROJECTS

MOTIVATION

One of the largest challenges facing the world is how to continue to supply energy to society, while decreasing the emissions of carbon dioxide. We have to decrease these emissions, if we are to reduce the impact of global warming. The effects of global warming are putting severe pressure on communities, and the predications are that the poorest will be most adversely affected. Some of the forecasts suggest that these pressures will lead to civil unrest and war – not an inheritance that we wish to leave to our children. It is essential that we solve this problem timeously while meeting the energy needs of society.

We have many people, both in South Africa and other developing countries, that do not have access to energy and who need accessible energy in order to improve their standards of living. Governments need to plan to supply this increased demand for energy, while simultaneously trying to reduce the impact of on the environment. 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 or pay the loans back to put this infrastructures in place, notwithstanding that new power stations are often coal-based and will contribute to the global greenhouse gas problem.

A more local, but equally serious challenge, is that there is a very high unemployment rate in South Africa. This problem is also common to many other developing countries. This problem causes poverty and leads to social instability. We, at the same time, also have waste from households and industries that pollutes the environment, and which is expensive to dispose of safely. However, this apparently bleak scenario offers opportunities to us. A theme that runs through my research is how to utilize these carbon containing wastes and convert them to fuel and electricity in order to supply energy and jobs to communities while cleaning up the environment.

To this end my research utilises concepts such as process synthesis, thermodynamics, catalysis together with applied research to address the challenges associated with energy and water provision.

RESEARCH METRICS

Orcid Profile: 0000-0001-7873-8855
Scopus AI: 7006369481

Summary to date of research metrics:

Scopus
Total Citations: 3641 (May 2023)
H Index: 30 (May 2023)

Google Scholar Profile:
https://scholar.google.com/citations?user=0LTYNG0AAAAJ&hl=en
Total citations: 5101 (May 2023)
H Index: 36 (May 2023)
I 10 index: 128 (May 2023)

PAST RESEARCH

CHEMICAL REACTOR OPTIMISATION

There are many types of chemical reactor used in practice. An important question is: given the kinetics of a reacting system, what is the best reactor system to use to optimise a given objective? This question could not be solved by standard optimisation techniques because of the difficulty of handling mixing, which is essentially a discontinuous function. This was then an unsolved problem in chemical reactor theory until I, working with Prof David Glasser, then my PhD supervisor, developed a new method for optimising chemical reactors called the Attainable Region (AR) method that could handle these discontinuities. This method is based on graphical ideas and so can readily be taught via simple examples. The work has been widely cited and has now become part of the standard methods described in modern textbooks on chemical reactor theory and is taught in many undergraduate and postgraduate courses. We have also worked on devising methods for solving these problems using the AR method both graphically and numerically. I and my colleagues have written a textbook on the AR method which has been published by Wiley (Ming, D., Glasser, D., Hildebrandt, D., Glasser, B. and Metgzer, M. *Attainable Region Theory: An Introduction to Choosing an Optimal Reactor.* Wiley, New Jersey).

COMMINUTION

Comminution is an important operation in the mineral processing industry particularly as in order to extract minerals from rock it has to be broken up into fine particles. This is a highly energy-intensive process; according to the Coalition for Energy Efficient Comminution, comminution uses around 1,8% of total global electricity production (https://www.ceecthefuture.org/resource-center/factsheet).

I and my colleagues realised that particle breakage systems could be described as reaction type systems where the kinetics are essentially the breakdown rates of particles of various sizes. Thus, the power of the AR methods could be brought to bear on these processes. Much experimental work on various ores has been done and it has been shown that by controlling the comminution there can be significant improvements in the product specifications (amount of particles in the desired size range) and the energy required to do this. Work is continuing in this area with contact being made with industry to see how these ideas can be implemented in practice.

COLUMN PROFILE MAPS

Distillation is one of the most common methods of separation in the chemical industry but it too is very energy intensive. There was a need for new methods to design distillation systems to be more energy efficient. To help solve this problem I and my team developed a new method for distillation system design called the Column Profile Map (CPM) method. This has been described as “one of the three most important developments in distillation over the last decade”, and is able to help to synthesise and design more efficient distillation systems. As this method is also graphical in nature it can also easily be taught to both undergraduates and postgraduates and a text book by them us recently appeared (Daniel Beneke, Mark Peters, Diane Hildebrandt and David Glasser. (2013) Understanding Distillation Using Column Profile Maps. Wiley New Jersey). These ideas are not only useful for distillation but can also be applied to membrane separation systems and a book has also appeared (Mark Peters, David Glasser, Diane Hildebrandt and Shehzaad Kauchali. (2011) Membrane Process Design Using Residue Curve Maps. Wiley New Jersey)

FISCHER-TROPSCH (F-T) SYNTHESIS

The Fischer-Tropsch reaction is important industrially as it is used to make synthetic fuels from coal, oil and as now envisaged, organic wastes. I and my team have studied this very complex reaction over the last thirty years. While this reaction has been studied for over 80 years there is still much mystery about it and there are many unexplained phenomena. We have devised novel experiments to try to understand what are the difficulties associated with this system. We have ascertained that rather than viewing it as a reaction alone it needs to rather be viewed as a reactive-distillation type of system. The need to consider vapour-liquid effects with a complex product slate can lead to very complex model of the behaviour to describe that is found in practice.. The vapour-liquid effects can also lead to the complex heat transfer phenomena that we have found in experiments in tubes of different sizes and with different catalysts. This knowledge and experience have been put to use to design build and commission a successful pilot plant to turn syngas into synfuel for the Golden Nest company in Baoji China. Furthermore a successful demonstration plant to make synfuel from syngas from underground coal gasification (a world first) was designed for LincEnergy in Chinchilla Australia. We are currently working on building small-scale modular units to use organic feedstocks (eg agricultural waste, municipal solid waste and medical waste) to supply fuel and electricity to local areas.

PROCESS SYNTHESIS

The most recent work that I and my colleagues have been researching is Process Synthesis, a new way, using fundamental thermodynamics, to design process flow-sheets for chemical plants in order to, for instance, minimise carbon dioxide emissions and improve the efficient use of raw materials. Invited articles on this topic appeared in *Science* and the American Institution of Chemical Engineers Journal in 2009 and a book on the topic is currently in preparation. Classically, chemical engineers have chosen the flow-sheet for a plant based on the experience and the ingenuity of the designer and then the individual units designed using for instance a package such as Aspen Plus. The question then remains: how good was the original flow-sheet and could it have been chosen better? Here the basic idea is one would like to *synthesise* the flow-sheet based on fundamental principles to optimise some objective such a making synfuel from organic waste while minimising carbon dioxide emissions. There are essentially three principles that can be used to synthesise flow-sheets, these are an overall mass balance, a constraint called the energy balance and another which is essentially a work balance. The idea is that the feed materials have chemical potential and to make the most efficient plant we need to conserve this chemical potential in the products, whether they are chemicals or direct work outputs such as electricity. To be able to do this we have invented the g-h plot (Gibbs Free Energy vs Enthalpy). This is a two-dimensional plot no matter how complex the process and can be used to represent all possible processes including their efficiencies. Using the g-h plot we are able to synthesise processes to satisfy all the constraints we need to apply that have the highest efficiencies. Using this technique we have been able to come up with our small-scale modular plants which should be both efficient and cost effective.

BIO TECHNOLOGY

The F-T process produces large quantities of very pure carbon dioxide. With smaller modular F-T processes one can situate algal ponds on the outskirts of the process and grow algae. The algae can be used as an additional source of biomass for the process but could also be used for aquaculture, providing employment and a protein source, especially in areas with financial/food security challenges. We have a research programme to find the factors that can improve the growing rate of local algae (we have no wish to introduce exotic species). This has shown how we can increase growth rates by a factor of five.

There are some products of F-T that contaminate the water and we have been doing research that should lead to a better design of artificial wetlands to deal with these. These ideas can also be used to clean up water contaminated with metals (such as from acid mine water drainage) and even water that is biologically contaminated.

In addition we are looking at the fundamental thermodynamics behind digestion (aerobic and anaerobic) and other biological processes with the aim of determining the limits of performance of these systems. It would seem that consortia of organisms work together so as to maximize entropy generation, and thus the products that are favoured can be calculated from gh-plots.

SMALL SCALE WASTE-TO-ENERGY PLANTS FOR COMMUNITIES APPLICATION

Our fundamental work in Process Synthesis has enabled us to come up with a design that should be both more efficient (produce less carbon dioxide) and less expensive than the current mega-X to Liquids plants. A mock-up of such a plant in a container was built and demonstrated at COP 17 in Durban and evoked much interest.

We have also been installing small scale anaerobic digestors in communities to convert wet organic waste to biogas for cooking. We are investigating how robust the technology is in the field as well as the attitude and acceptance of the community to this form of energy.

The uptake of technology by communities is often very difficult and it is necessary to work with the communities in order to ensure that the technology meets their needs and expectations. To this end we have partnered with the Institute of Social and Health Sciences at UNISA in order to engage with communities and identify the needs and expectations of the community for a waste to energy system. This is a great opportunity for engineers, social scientists and the community to work together for the benefit of the community.

We have identified the community of the Tembelilhe in Johannesburg, an informal settlement, as an appropriate place to pilot the technology. The community in turn has identified suitable Early Childhood Development centres and requested that we build two units to feed gas to these schools. We are trying to manage the community's expectations and there have been many meetings with the community, facilitated by Prof Mohamed Seedat of the Unisa Institute for Social and Health Sciences and his research group.

The unit to be installed will use waste, normally produced by households, and turn it to electricity through a gasification process. The expected result is that the community will not only have access to energy but also to a cleaner environment which will reduce the health hazard and risk of injuries associated with unmanaged waste and burns resulting from fires caused by paraffin stoves.

In addition we are working with Prof Kitty Dumont, a Social Psychologist in the Department of Psychologist at UNISA, to understand the psychological barriers to the acceptance of new energy technologies. This work is ongoing and informs the way we approach communities when installing anaerobic digesters.

INDUSTRIAL WORK AND COMMERCIALISATION

In 2004 I began working with Golden Nest to build a Fischer-Tropsch pilot plant in Baoji, Shaanxi, China. I headed up the team that was responsible for the conceptual design, overseeing the feasibility study done with Lurgi, the basic engineering done by KBR and the detailed engineering, done by SCIDI, China. The team was responsible for all the laboratory testing of the catalysts as well as commissioning the pilot plant. The pilot plant has successfully been commissioned and an international review committee have given its approval of the technology.

In 2005 I headed up the team that entered into a contract with Linc Energy, Australia, to build a Fischer-Tropsch demonstration plant to test the concept of combining the Fischer-Tropsch process with underground gasification. This is the very first time this has been done in the world. The team was responsible for the conceptual design of the reactor system and also oversaw the feasibility study and basic engineering of this section. This pilot plant has been successfully commissioned.

I headed up the team that initiated the BeauTi-fueL concept, which is a containerised plant that converts biomass to fuel and electricity. The concept was demonstrated at COP 17 in Durban and there was great interest from the South African and international governments.

We have also had projects in the area funded by Sasol, Anglo Platinum as well as SANERI.

We have currently entered into a partnership for commercialisation of small waste to energy plants. We are also in a partnership with an international group to design small scale Gas-to Liquid plants.

5 YEAR RESEARCH PLAN

My research focuses on sustainability and developing new approaches to reducing greenhouse gas emissions. As my research has matured, I have become interested in implementing new technologies and the barriers to the adoption of these. I have divided my future research into several areas below; however, a common thread runs through this research plan: how do we address climate change?

DESIGN OF PROCESSES WITH REDUCED CO2 EMISSIONS

One could ask why do processes make CO_2 and how much do they need to make? A fully reversible process or reaction would, in the limit, define the lower bound for the amount of CO2 emitted. This boundary limits the performance of reactions (catalytic and biological) as well as processes. My colleagues and I are working on a textbook that describes how material and thermodynamic constraints can be used to determine the limits of the performance of a process or chemical reaction. The book is aimed mainly at chemists and chemical engineers, both students and practitioners. I believe that this book's material is important, and finishing this book it is high on my list of priorities.

This work raises interesting questions, such as how one can incorporate (sustainable) energy sources such as sunlight and/or electricity into reactions and processes. Understanding this will lead to new sustainable routes to produce chemicals. These ideas can be tested using, for example, plasma reactors, looking at biological systems and in other ways. The New Energy Laboratory at Zhejiang College of the Zhejiang University of Technology, of which I am the director, will focus mainly on developing more efficient chemical conversion technologies that incorporate other energy sources.

CATALYSIS:

FISCHER-TROPSCH AND THERMODYNAMIC EQUILIBRIUM

I have been researching the Fischer-Tropsch reaction for decades. I am now more than ever convinced that thermodynamic equilibria limit the performance of the reaction. I want to continue research and explore this. We previously looked at the

Fischer-Tropsch reaction's operation in a batch reactor (see paper 165 in my publication list). I have since then not had a student with either the interest or skills to continue this work. I want to continue this research, either with a postgraduate student or by doing the experiments myself. This will help to elucidate some of the limits on the Fischer -Tropsch reaction's performance, which would be quite a breakthrough in this field.

BIOTECHNOLOGY AND WATER TREATMENT

I have been studying the microbial treatment of wastewater. This raised interesting questions such as the biological limits of performance, particularly for anaerobic systems, and how closely these limits correspond to these systems' actual performance. This question is not only of theoretical interest but has significant implications for practical applications. All processes emit waste, and typically this waste is disposed of into the environment. The environment must "treat" this waste and convert or recycle it into benign substances. Thus, for example, a wastewater stream that discharges into a wetland will require a particular residence time, corresponding to the size of the wetland, to treat the waste. If we can quantify this process using simple measures, we can then determine the size of wetlands a company needs to maintain to treat their waste effectively.

BARRIERS TO THE ADOPTION OF NEW SUSTAINABLE PROCESSES

I have been working with a team of researchers to install anaerobic digesters to produce biogas at small-scale community level. Digestors ought to be a good way of supplying rural and urban communities with energy for cooking, heating, and lighting. In principle, the manure from one cow should provide enough energy for a household of 5 to cook and heat water for bathing, cleaning, etc. Some installations have been remarkably successful. For instance, we have one digestor that has been running trouble-free for more than five years and has supplied a farmer and his family with energy for his household needs meaning that he no longer has to buy LPG or paraffin. However, others have never worked "successfully" or, more correctly, were never adopted. So why are some of these installations so unsuccessful? In a paper (see paper 192 in my publications list), we explored the social barriers to adopting new technologies. In particular, we found that the feeling of disgust was triggered, leading to the "yuck factor" in people's perceptions of biogas, resulting in it not being adopted.

One of the suggested routes to overcome this feeling of disgust was to install digestors in the higher-end, cleaner environments, such as restaurants. Thus, we have established a series of digesters at an organic restaurant and farm. The gas is used for cooking in the restaurant and for providing energy in the staff accommodation. This situation essentially provides the basis for further research on how people’s attitudes to new energy systems, such as biogas, can be influenced by other factors, such as seeing biogas being used in a “clean” and “rich” environment.

Another digestor was installed at a local school in a rural community in the Drakensburg, which is also an interesting site for further study. The site was chosen based on need, manure availability, and having a local community leader willing to champion the project. However, apart from the local community's apparent scepticism, who took the view "that they will wait until they see this" before adopting the technology, we ran into many other, very unexpected barriers. Although most households had cattle, we could not use this manure in case we used it to “bewitched” the cattle – indeed, we had to buy manure from a local commercial farmer to prime the digestor! Furthermore, women (both post-menopausal or those menstruating) were not allowed near the cattle. It was believed this could harm the cattle by, for example, causing them to become infertile or miscarry calves.

Exploring these, sometimes frustrating, beliefs and barriers to adopting new technologies is very important for us as scientists to understand. We have to work in multidisciplinary teams with skills such as social psychology, social sciences, etc. If we do not understand these social and cultural barriers and how to overcome them, it does not really matter how well the science works as the technologies will not be adopted!

FUNDING

The table below summarises the funding received since 2007. In some cases, the companies and project details cannot be given due to the terms of the confidentiality agreements that were entered into. The exchange rate used is an average for the time period. Please note R = SA Rand; CNY = Chinese Yuan.

2007-2013	SARChI Funding	R10.5 million ($1.3 million)
2005 -2013	Industrial and Thrip Funding; This includes projects with Sasol, De Beers, Anglo Platinum, Anglo Coal, Score Metals, Pratley Putty, Eskom and Linc Energy.	R100 million ($13.5 million)
2004-2010	Golden Nest Project: The majority of this funding was used to	$14 million

	construct the CTL pilot plant. About $1 million of this funding came to the research group	
2013-2015	Waste to Energy (SPII)	$1 million
2012-2015	Modular GTL Plants	$500 000
2013-2017	UNISA funding for MaPS	$140 million ($10 million)
2019-2024	International Joint Research Laboratory of New Energy, Hebei University	CNY7 million ($1 million)
2019-2021	Keqiao Green Energy Material Joint Laboratory, Zhejiang College	CNY8.5 million ($1.2 million) and CNY9.5 million ($1.3 million) from associated companies
2018-2021	UNISA funding for IDEAS	$200 million ($10 million)
2021-2023	Joint Funding for Chinese/South African Collaboration: Conversion of CO_2 to Chemicals	R300 000 NRF Funding CNY500000 MOST Funding (Total $90 000)

STUDENT SUPERVISION

STUDENTS GRADUATED

DEGREES AWARDED: PHD

1. D. Fine (Ph.D.), Comparison of a Packed and Fluidized Bed Haemoperfusion Device. Awarded 1994.

2. J.G. Price (Ph.D.), The Investigation of Cobalt Catalysts in the Carbon Monoxide Hydration Reaction. Awarded 1995.

3. T. Van der Walt (Ph.D.), Gasification in the Lurgi Gasifier. Awarded 1996.
4. M. Jobson (Ph.D.), Separation and the Attainable Region. Awarded 1996.
5. Love (Ph.D.), Mathematics of the Attainable Region. Awarded 1996.
6. L. Jewell (Ph.D.), The Decomposition and Reduction of Nitric Oxide under Oxidising Conditions. Awarded 1996
7. S.A. Godorr (Ph.D.), The Attainable Region in Four and Higher Dimensional Spaces. Awarded 1999.
8. C. McGregor (Ph.D.), The Attainable Region for Processes with Separation, Mixing and Reaction. Awarded 1999.
9. W. Nicol (Ph.D.), The Attainable Region for Processes with Heating and Cooling, Mixing and Reaction. Awarded 1999.
10. T. Chronis (Ph.D.), The Kinetics of Fischer Tropsch Reaction with Ru-Co Catalysts. Awarded 2000.
11. B. Hausberger (Ph.D.), Modelling of Reactive Distillation Systems. Awarded 2003.
12. S. Kauchali (Ph.D.), Synthesis of Distillation Columns using the Attainable Region. Awarded 2003.
13. M. Tapp (Ph.D.), Analysis of Distillation Systems. Awarded 2004.
14. T. Vally (Ph.D.), Towards the Development of an Artificial Liver. Awarded 2005.
15. S. Holland (Ph.D.), A Study of Feed Addition Policies for Distillation. Awarded 2006.
16. T.G. Sediogeng (Ph.D.), Development of Numerical Algorithms for Determining the Attainable Region. Awarded 2006.
17. M. Joshua (Ph.D.), Development of a Novel Reactor for removing Heparin during Extracorporeal Procedures. Awarded 2007.
18. J. Steyn (Ph.D.), An Investigation into Increasing the Carbon Monoxide Tolerance of Proton Exchange Membrane Fuel Cell Systems using Gold Based Catalysts. Awarded 2007.
19. P. Mukoma (Ph.D.), Process and Reactor synthesis for Cobalt catalysts in the Fischer Tropsch reaction. Awarded 2007.

20. J. Mulopo (Ph.D.), Measurement of stripping profiles in a batch apparatus. Awarded 2007.

21. N. Khumalo (Ph.D.), Attainable Regions for Comminution. Awarded 2007.

22. T. Modise (Ph.D.), An experimental study of Column Profile Maps. Awarded 2007.

23. B. Patel (Ph.D.), Development of process synthesis methodologies: the methanol case study. Awarded 2007.

24. K. Jalama (Ph.D.), The effect of the addition of oxygenate compounds on the Fischer Tropsch Synthesis over a titania supported cobalt catalyst. Awarded 2007.

25. M. Bahome (Ph.D.), Carbon Nanotubes as a support for the Fisher Tropsch reaction. Awarded 2007.

26. M. Peters (Ph.D.), Design of separation system for use with both VLE based and membrane based separation processes. Awarded 2008.

27. D. Milne (Ph.D.), Attainable Regions for Industrial Reactions. Awarded 2008.

28. A.N. Mpela (Ph.D.), Gold catalysts for methanol synthesis. Awarded 2009.

29. T. Musanda (Ph.D.), Measurement of FT kinetics for reactor design. Awarded 2010.

30. L. Ngubevana (Ph.D.), Synthesis of Gasification Systems. Awarded 2011.

31. D. Beneke (Ph.D.), Distillation Column Synthesis. Awarded 2011.

32. O. Fasemore (Ph.D.), Development of a process for producing nematodes on an industrial scale. Awarded 2011

33. X. Lu (Ph.D.), FT: Towards Understanding. Awarded 2011.

34. R. Abbas (Ph.D.), Synthesis of complex column configurations. Awarded 2011.

35. Y. Yao (Ph.D.), Effect of CO_2 as a feed on the FT Reaction. Awarded 2011.

36. C. Sempuga (Ph.D.), Process synthesis: The effect of multiple reactions on process efficiency. Awarded 2011.

37. J. Fox (PhD.), Reactor Synthesis. Awarded 2012.

38. C. Masuku (Ph.D.), Development of optimal FT reactors to reduce CO_2 emissions. Awarded 2012.

39. M. Ntoampe (Ph.D.), Fermentation of Sweet Potatoes to make Chemicals. Awarded 2012.

40. C. Griffiths (Ph.D.), A biological based process for converting cellulose to chemicals. Awarded 2013.

41. F. Mulenga (Ph.D), Modelling the Effect of Various Parameters on the Efficiency of Ball Mills. Awarded 2013.

42. M. Tabrizi (Ph.D.), Process synthesis as a tool for minimization of waste water in the textile industry. Awarded 2013.

43. C. Sheridan (Ph.D), Modelling of Constructed Wetlands for Water Treatment. Awarded 2013.

44. X. Zhu (Ph.D.), Heat Transfer in Fischer Tropsch Reactors. Awarded 2013.

45. G. Danha (Ph.D), Optimizing Slurry Comminution Processes. Awarded 2013.

46. N. Felbab (Ph.D), Computational Methods in Distillation Synthesis. Awarded 2014.

47. D. Ming (PhD.), Reactor Synthesis. Awarded 2014.

48. N. Chimwani (Ph.D), Optimizing the Efficiency of Comminution Processes. Awarded 2014.

49. N. Asiedu, (PhD) Kinetic Modelling, Thermodynamic Studies and Simulation of Reactions with and without Boiling, using Temperature Time Information. Awarded 2015.

50. M Low (PhD.), Effect of Wavelength and CO_2 on Algae growth. Awarded 2016.

51. N. Hlabanga. (Ph.D.), Optimization of Comminution Processes. Awarded 2016.

52. A. Muleja (PhD.), Fischer Tropsch Synthesis (FTS): Is kinetics alone enough to explain the phenomenon? Awarded 2016.

53. P. Diale (Ph.D.), Effect of Encapsulation of the Efficiency of Algae Absorption of Heavy Metals. Awarded 2016.

54. J. Gorimbo (Ph.D), Reduction and Regeneration in the Fischer Tropsch Reaction. Awarded 2016.

55. R. Muvhiiwa (Ph.D), Theoretical and Experimental Analysis of Biomass Gasification Processes using the Attainable Region Theory. Awarded 2019.
56. N.J. Stacey (Ph.D), Alternatives to Distillation: Multi-membrane permeation and petrol pre-blending for bio-ethanol recovery. Awarded 2019.
57. P. Adriaanse (Ph.D) Greenhouse Energy Management. Awarded 2020
58. J Chang (Ph.D) Reduced graphene oxide supported cobalt catalysts for hydroformylation and Fischer-Tropsch synthesis. Awarded 2021
59. Y. Zang (Ph.D) Ethylene activity and Fischer-Tropsch synthesis: new perspectives in reaction mechanism. Awarded 2021
60. J. Shen (Ph.D) Fischer Tropsch synthesis fixed bed intensification. Awarded 2021
61. H.A. Shahid (Ph.D) Renewable hybrid polygeneration system from various unconventional feedstock. Awarded 2021
62. N.C. Shiba (Ph.D) The role of cobalt species in Fischer Tropsch synthesis: effects of support characteristics and reducing conditions. Awarded 2021.
63. O. K. Opeyemi (Ph.D) Rational design of metal-organic framework (MOF) – based supercapacitor electrodes for enhanced energy storage. Awarded 2021.
64. R. Letts (Ph.D) An exploratory model of water and solute excretion in animals. Awarded 2022.
65. L. Mguni (Ph.D) Metal supported on carbon-based materials for adsorptive desulphurization of fuels, Awarded 2022
66. K. Otun (Ph.D) Rational design of Metal-Organic Frameworks (MOF) based super capacitor electrodes for enhanced energy storage, Awarded 2022
67. M Tshwaku (Ph.D) Insight into Fischer Tropsch reactions: ethylene hydrogenation and ethylene co-feeding over precipitated iron catalyst, Awarded, 2022

DEGREES AWARDED: MSC

1. B.J. Glasser (M.Sc.), Optimal Reactor Structures for Exothermic Reversible Reactions. Awarded 1991.

2. P.M. Morgan (M.Sc.), An Experimental and Modelling Study of Coal Pyrolisis in a Lurgi Gasifier. Awarded 1992.

3. Y.K. Chen (M.Sc.), An Ethanol Conversion Study over Titania Supported Catalysts. Awarded 1993.

4. A.G. Mitchell (M.Sc.), Methanol Synthesis Investigation of Raney Type Cerium Promoted Catalysts. Awarded 1994.

5. G.J. Smit (M.Sc.), Modelling and Optimisation of an Oscillating VCM Reactor. Awarded 1995.

6. S. Dutt (M.Sc.), Energy Integration in Ethylene Manufacture. Awarded 1995.

7. F. Hopley (M.Sc.), Optimal Reactions Structures: On Teaching and a Novel Optimal Substructure. Awarded 1996.

8. C. Jeannot (M.Sc.), The Role of Supported Cobalt Catalysts in the Methane Partial Oxidation Reaction. Awarded 1996.

9. G.D. Ridge (M.Sc.), Modelling the Co-adsorption of Hydrogen Sulphide and Carbon Dioxide into an Aqueous Solution of Vanadium and Sodium Bicarbonate. Awarded 1996.

10. T. Chronis (M.Sc.), The Simple Measurement of Residue Curves and the Associated VLE Data for Ternary Liquid Mixtures. Awarded 1996.

11. R. Kaitano (M.Sc.), Modelling of Low Temperature of Coal Dumps. Jointly supervised with Prof. D. Glasser. Awarded 1999.

12. T. Malumisa (M.Sc.), Relationship between GC Analysis of a Mixture and its Separation by Distillation. Awarded 2000.

13. L.L. Mda (M.Sc.), Screening of Azeotropic Entrainers. Awarded 2001.

14. S. Baloyi (M.Sc.), Measurement of Mass Transfer Coefficients in Packed Distillation Columns using Temperatures. Awarded 2002.

15. S. Woolacott (M.Sc.), Process Synthesis on Methods of Water Treatment in a Pulp and Paper Plant. Facility. Awarded 2002.

16. M. Lebotse (M.Sc.), Comparison of Two Residue Curve Based VLE Measurement Methods. Awarded 2003.

17. M Kasumba (M.Sc.), Essential Oil Production Methods. Awarded 2003.

18. V. Ngwenya (M.Sc.), Process Synthesis Chemistry for the Fischer Tropsch System. Awarded 2004.

19. O. Fasemore (M.Sc.), Development of method for Paint Effluent Remediation. Awarded 2005.

20. S. Semosa (M.Sc.), Use of a Natural Zeolite in Water Treatement. Awarded 2005.

21. G. Darko (M.Sc.), Process Synthesis of a metallurgical process. Awarded 2005.

22. B. Williams (M.Sc.), Electrochemical Recovery of PGMs. Awarded 2005.

23. T. Konighofer (M.Sc.), Attainable Regions for electrochemical reactors. Awarded 2005.

24. M.N. Shaik (M.Sc.), Develop an on-line monitoring system for cobalt detection in non-aqueous industrial steam at Sasol Awarded 2006.

25. C. Wilson (M.Sc.), Measurement of effect of difference point composition on column profiles. Awarded 2006.

26. P.P. Mbhele (M.Sc.), Remediation of soil and water contaminated by heavy metals and hydrocarbons using silica encapsulation. Awarded 2007.

27. D. Gina (M.Sc.), Flocculation of wastewater from the production of low VOC paints. Awarded 2007.

28. M. Bowa (M.Sc.), The reduction of FT catalysts. Awarded 2009.

29. P. Diale (M.Tech.), Metal Absorption by Algae. Graduated Cum Laude 2011.

30. N. Fungura (M.Sc.), Optimization of a Comminution Circuit. Awarded 2011.

31. E. Kativu (M.Sc.), Optimal Growth of Algae. Awarded 2011.

32. H. Kok., (M.Sc.), Thermodynamic Analysis of Photosynthesis. Awarded 2011.

33. L. Okonye (M.Sc.), Process and Reactor Synthesis. Awarded 2011.
34. R. Valoyi (M.Sc.), Removal of Water from Fisher Tropsch Processes Synthesis. Awarded 2011.
35. K. Mbuyi (M.Sc.), The synthesis of methanol, DME and FT products over gold catalysts.. Awarded 2012.
36. D. Legodi (M.Sc.), Breakage and the Attainable Region. Awarded 2012
37. P. Sekwambane (M.Sc.), Synthesis of Gasification Systems. Awarded 2012.
38. L Sabbagh (M.Sc.), Growth of Bacteria on Activated Carbon. Awarded 2013.
39. N. Seedat (M.Sc), Measurement of Membrane Residue Curves. Awarded 2014.
40. E. Kasese (M.Sc.), Using Distributed Feed to Reduce Energy Consumption in Non-Sharp Splits. Awarded 2014.
41. Y. Zhang (M.Sc), Investigation of heat transfer in an Industrial Fischer Tropsch Fixed Bed reactor. Awarded 2014.
42. T. Bahunda (M.Sc), Process Synthesis. Awarded 2014.
43. B. Mlasi. (M.Sc), Measurement of Reaction Kinetics in a Thermos Flask. Awarded 2015.
44. E. Bono (M.Tech), Measurement of Reactive Residue Curves. Awarded 2016.
45. D. Bearman (M.Sc.), Measurement of Leaching Kinetics. Awarded 2016
46. C. Lumu (M.Sc), Fischer Tropsch. Awarded 2016
47. R. Muvhiiwa (M.Sc), Thermodynamic Limits of Performance of Anaerobic Bacterial Processes. Awarded 2016.
48. R. Khumalo (M.Sc), Optimisation of a comminution circuit. Awarded 2016.
49. R. Louw (MSc), Study of Separation in the Kidney. Awarded 2016.
50. C. Rashama (MSc), Investigating the fermentability of sugars derived from waste water from processing medium density fibreboard. Awarded 2019.

51. K. Ndlovu (MSc), A direct gasoline pre-blending of bioalcohol mixtures as a means of decreasing separation energy losses. Awarded 2020

52. G.M. Tshinguz (M.Tech) Estimation of the breakage function of a roller mill crushing quartzite. Awarded 2020.

53. P. Liebenberg (M.Tech) Process flowsheet modification for the maximum production of foundry and chemical chromite products. Awarded 2020.

54. S. Mubenesha (M.Tech) A design and development of iron ore Fischer Tropsch catalyst. Awarded 2020.

55. T.R. Kabi (M.Tech) Adsorptive Desulphurisation of diesel fuel on unprocessed Amarula (Sclerocarya Birrea) wastes or synthesized activated carbons from biomass wastes. Awarded 2020.

56. T. Nkomzwayo (M.Tech) Transition metal oxides supported on activated carbon for adsorptive desulfurization of diesel fuels. Awarded 2021.

57. M.E. Llane (M.Tech) The combined solar-photovoltaic electricity and solar-thermal heat application in power to chemicals process schemes: consideration of optimal solar photovoltaic surface area fractions. Awarded 2021.

58. J.H. Luvuno (M.Sc) The treatment of platinum refinery wastewater using an evaporative crystallizer. Awarded 2021.

59. S Zong (MTech), Controllable preparation and application of porous carbon based electrode materials, Awarded 2021

60. T. Mkozwayo (MTech), Transition metal oxides supported on activated carbon for adsorptive desulfurization of diesel fuels, Awarded 2021.

61. F. Katuchero (MTech)Temperature programmed reduction studies: the effect of reducing agents on iron ore for Fischer Tropsch synthesis, Awarded 2021.

62. S. Ncube (MTech) Biogas valorisation to liquid fuels: modelling and setting up process targets, Awarded 2022.

63. S. Dube (MTech) Synergistic co-conversion of biomass and biogas: performance targets and simulation analysis, Awarded 2022.

PUBLICATIONS

BOOKS

1. Peters, M., Glasser, D., Hildebrandt, D. and Kauchali, S. (2011) *Membrane Process Design Using Residue Curve Maps*. Wiley, New Jersey, USA ISBN 978-0-470-52431-2.
2. Beneke, D., Peters, M., Hildebrandt, D. and Glasser, D. (2013) *Understanding Distillation Using Column Profile Maps.* Wiley, New Jersey, USA ISBN 978-1-118-14540-1.

3. Ming, D., Glasser, D., Hildebrandt, D., Glasser, B. and Metgzer, M.(2016) *Attainable Region Theory: An Introduction to Choosing an Optimal Reactor.* Wiley, New Jersey, USA ISBN: 978-1-119-15788-5

4. Gorimbo, J., Liu, X., Yao, Y., & Hildebrandt, D. (Eds.). (2022). *Chemicals and Fuels from Biomass via Fischer Tropsch Synthesis: A Route to Sustainability*. Royal Society of Chemistry.

BOOK CHAPTERS

1. Hildebrandt D, and Fox JA (2022). Biomass to Liquid Fuel via Fischer–Tropsch (BTL-FT) Synthesis: Process Description and Economic Analysis, in Chemicals and Fuels from Biomass via Fischer Tropsch Synthesis: A Route to Sustainability. Volume 44, Page 412. Royal Society of Chemistry. ISBN 978-1-83916-393-7

2. Lu X and Hildebrandt D. (2022) Fischer–Tropsch Synthesis Reactors in Chemicals and Fuels from Biomass via Fischer Tropsch Synthesis: A Route to Sustainability. Volume 44, Pages 214 -260. Royal Society of Chemistry. ISBN 978-1-83916-393-7

3. Okoye-Chine CG, Gorimbo J, Moyo M Yao, Y, Liu X, Hildebrandt D and Fox JA (2022) Biomass to Liquid Fuel via Fischer–Tropsch (BTL-FT) Synthesis: Process Description and Economic Analysis in Chemicals and Fuels from

Biomass via Fischer Tropsch Synthesis: A Route to Sustainability. Volume 44, Pages 412-427. Royal Society of Chemistry. ISBN 978-1-83916-393-7

4. Chang J,Yao Y, Liu X, Gorimbo J. and Hildebrandt D. (2022) Application of Fischer–Tropsch Synthesis and Hydroformylation in Syngas Conversion to Oxygenates in Chemicals and Fuels from Biomass via Fischer Tropsch Synthesis: A Route to Sustainability. Volume 44, Pages 397-411. Royal Society of Chemistry. ISBN 978-1-83916-393-7

REFEREED JOURNALS

1. Glasser, D., Hildebrandt, D. and Crowe, C.M. (1987). A Geometric Approach to Steady Flow Reactors: The Attainable Region and Optimization in Concentration Space. *I&EC Res*, 26 (9), 1803–1810.

2. Peterson, D., Glasser, D., Williams, D. and Ramsden, R. (1988). Predicting the Performance of an Evaporative Condenser. *ASME J. Heat Transfer*, 110 (3), 748–753.

3. Hildebrandt, D., Glasser, D. and Crowe, C.M. (1990). The Geometry of the Attainable Region Generated by Reaction and Mixing; With and Without Constraints. *I&EC Res*., 29 (1), 49–58.

4. Hildebrandt, D. and Glasser, D.(1990). The Attainable Region and Optimal Reactor Structures. Presented at ISCRE 11, Toronto, July 1990. Published in *Chem. Eng. Sci*., 45 (8), 2161–2168.

5. Young, B.D., Hildebrandt, D. and Glasser, D. (1992). Analysis of an Exothermic Reversible Reaction in a Catalytic Reactor with Periodic Flow Reversal. *Chem. Eng. Sci.*, 47 (8), 1825–1837.

6. Glasser, B., Hildebrandt, D. and Glasser, D. (1992). Optimal Mixing for Exothermic Reversible Reactions. Presented at AIChE Annual Meeting, Chicago, 1990. *I&EC Res*, 31 (6), 1541–1549.

7. Glasser, D., Hildebrandt, D. and Godorr, S. (1994). The Attainable Region for Segregated, Maximum Mixed and Other Reactor Models. *I&EC Res*., 33 (5), 1136–1144.

8. Godorr, S., Hildebrandt, D. and Glasser, D. (1994). The Attainable Region for Systems with Mixing and Multiple Rate Processes: Finding Optimal Reactor Structures. *Chem. Eng. J*., 54 (3), 175–186.

9. Hildebrandt, D. and Glasser, D. (1994). Predicting Phase and Chemical Equilibrium using the Convex Hull of the Gibbs Free Energy. *Chem. Eng. J*., 54 (3), 187–197.

10. Hildebrandt, D. and Biegler, L.T. (1995). Synthesis of Chemical Reactor Networks. Presented at FOCAPD, Snowmass, Colorado, 1994. Published in *AIChE Symp. Ser*., 305, 52–67.

11. Jobson, M., Hildebrandt, D. and Glasser, D. (1995). Attainable Products of Vapour-Liquid Separation of Homogeneous Ternary Mixtures. *Chem. Eng. J*., 59 (1), 51–71.

12. Fine, D.R., Glasser, D., Hildebrandt, D., Esser, J.D., Chetty, N., and Lurie, R.E. (1995). An Anatomical and Physiological Model of the Hepatic Vascular System, *Journal of Applied Physiology*, 79 (3), 1008–1026.

13. Glover, G., van der Walt, T.J., Glasser, D., Prinsloo, N.M. and Hildebrandt, D. (1995). DRIFT Spectroscopy and Optimal Reflectance of Heat-Treated Coal from a Quenched Gasifier, *Fuel*, 74 (8), 1216–1219.

14. Hopley, F.D., Glasser, D. and Hildebrandt, D. (1996). Optimal Reactor Structures for Exothermic Reversible Reactions with Complex Kinetics. Presented at ICSRE 14, Brugge (1996), *Chem. Eng. Sci*., 52 (10), 2399–2407.

15. Jobson, M., Hildebrandt, D. and Glasser, D. (1996). Variables Indicating the Cost of Vapour-Liquid Equilibrium Separation Processes. *Chem. Eng. Sci*., 51 (21), 4749–4757.

16. Jewell, L., Sokolovskii, V.D., Coville, N.J., Glasser, D. and Hildebrandt, D. (1996). A Catalytic Trap for Low-Temperature Complete NO Reduction in Oxygen-Rich Media. *Chem. Commun*, 17, 2081–2082.

17. Sun, Q., Young, B, Williams, D.F., Glasser, D. and Hildebrandt, D. (1996). A Periodic Flow Reversal Reactor: An Infinitely Fast Switching Model and a Practical Proposal for its Implementation. Presented at USPC-2, St Louis, September (1995), *Canadian J. Of Chem. Eng*., 74 (5), 760–765.

18. Feinberg, M. and Hildebrandt, D. (1997). Optimal Reactor Design from a Geometric Viewpoint: 1. Universal Properties of the Attainable Region. *Chem. Eng. Sci*., 52 (10), 1637–1665.

19. Nicol, W., Hildebrandt, D. and Glasser, D. (1997). Process Synthesis for Reaction Systems with Cooling via Finding the Attainable Region. *Comp. and Chem. Eng*., 21, S35-S40. Presented at PSE '97/Escape'7, Trondheim.

20. Glasser, D. and Hildebrandt, D. (1997). Reactor and Process Synthesis. *Comp. and Chem. Eng*., 21, S775–S783. Plenary Paper Presented at PSE '97/Escape'7, Trondheim.

21. Sokolovskii, V.D., Jeannot, J.C., Coville, N.J., Glasser, D., Hildebrandt, D. and Makoa, M. (1997). High Yield Formation by Partial Oxidation of Methane over Co-alumina Catalysts. Natural Gas Conversion IV. Studies in Surface *Science and Catalysis*, 107, 461–465.

22. Price, J.G., Glasser, D., Hildebrandt, D. and Coville, N.J. (1997). Fischer-Tropsch Synthesis: DRIFTS and SIMS Surface Investigation of Co and CO/Ru on Titania Supports. *Natural Gas Conversion IV. Studies in Surface Science and Catalysis*, 107, 243–-248.

23. McGregor, C. Glasser, D. and Hildebrandt, D. (1997). Process Synthesis for a Reactive Distillation System Using Attainable Region Results. Distillation and Absorption '97, Edited by R. Darton, *Trans. IChemE*., 142 (1), 187–196.

24. Chronis, T. Glasser, D. and Hildebrandt, D. (1997). A Simple, Reasonably Accurate Method for Measuring Residue Curves and the Associated VLE. Distillation and Absorption '97, Edited by R. Darton, *Trans. IChemE*., 142 (2), 663–674.

25. Kaitano, R., Glasser, D. and Hildebrandt, D. (1997). A Laboratory Study of a Reactive Surface Layer for the Prevention of Spontaneous Combustion. *Reviews in Engineering Geology*. Geological Society of America. Presented at the 8th National Meeting of SAIChE, Cape Town, 85.

26. Nicol, W., Hildebrandt, D. and Glasser, D. (1998). Crossing Reaction Equilibrium in an Adiabatic Reactor System. *Developments in Chemical Engineering and Mineral Processing,* 6, 41–54.

27. McGregor, C., Hildebrandt, D. and Glasser, D. (1998). Process Synthesis of a Reactor-Separator -Recycle System via an Attainable Region Approach. *Developments in Chemical Engineering and Mineral Processing*, 6. 21–40.

28. Curtis, V., Nicolaides, C.P., Coville, N.J., Hildebrandt, D. and Glasser, D. (1999). The Effect of Sulfur on Supported Cobalt Fischer-Tropsch Catalysts. *Catalysis Today*, 49 (1–3), 33–40.

29. McGregor,C. Glasser, D. and Hildebrandt, D. (1999). The Attainable Region and Pontryagin's Maximum Principle. *Ind. Eng, Chem. Res*,. 38 (3), 652–659.

30. Godorr, S., Hildebrandt, D., Glasser, D. and McGregor, C. (1999). Choosing Optimal Control Policies using the Attainable Region Approach. *Ind. Eng, Chem. Res,*. 38 (3), 639–651.

31. Glasser, D., Hildebrandt, D. and Hausberger, B. (2000). "Costing" Distillation Systems From Residue Curve Based Designs. Presented at PSE 2000. *Comp. and Chem. Eng*., 24 (2–7), 1275–1280.

32. Kauchali, S., McGregor, C. and Hildebrandt, D. (2000). Binary Distillation Revisited using the Attainable Region. Presented at PSE 2000. *Comp. and Chem. Eng*., 24, 231–237.

33. Nicol, W., Hernier, M., Hildebrandt, D. and Glasser, D. (2001). The Attainable Region and Process Synthesis: Reaction Systems with External Cooling and Heating. The effect of Relative Cost or Reactor Volume to Heat Exchange Area on the Optimal Process Layout. *Chem. Eng. Sci*., 56 (1), 173–191.

34. Nicol, W., Hildebrandt, D. and Glasser, D. (2002). The Cost of Crossing Reaction Equilibrium in a System that is Overall Adiabatic. *Comp. and Chem. Eng*., 26 (6), 803–*809*.

35. Kauchali, S., Rooney, W.C., Biegler, L.T., Glasser, D. and Hildebrandt, D. (2002). *Linear* Programming Formulations for Attainable Region Analysis, *Chem. Eng. Sci*., 57 (11), 2015–2028.

36. Tapp M., Kauchali S., Hausberger B., McGregor C., Hildebrandt D. and Glasser D. (2003). An experimental simulation of distillation column concentration profiles using a batch apparatus, *Chem. Eng. Sci*., 58, 479–486.

37. Kauchali, S., Hausberger, B. Hildebrandt, D. Glasser, D. and Biegler, L.T. (2004). Automating Reactor Network Synthesis; Finding a Candidate Attainable Region for Water-Gas Shift (WGS) Reaction. *Comp. & Chem. Eng*., 28 (1–2), 149–160

38. Tapp, M., Holland, S.T., Hildebrandt, D. and Glasser, D. (2004). Column Profile Maps 1: Derivation and Interpretation; *Ind. Eng. Chem. Res*., 43 (2), 364–374.

39. Holland, S.T., Tapp, M., Hildebrandt, D. and Glasser, D. (2004) Column Profile Maps 2: Singular Points and Phase Diagram Behavior in Ideal and Non-Ideal Systems. *Ind. Eng. Chem. Res*., 43 (14), 3590–3603.

40. Milne, D., Glasser, D., Hildebrandt, D. and Hausberger, B. (2004). The Application of the Attainable Region Concept to the Oxidative Dehydrogenation of 1-Butene in Inert Porous Membrane Reactors. *Ind. Eng. Chem. Res*., .43 (8),1827–1831.

41. Jewell, L., Fasemore, O.A., Glasser, D., Hildebrandt, D., Lafras, H., Van Wyk, N. and Boyd, C. (2004). Towards zero waste production in the paint industry. Presented at the Biannual Conference of Water Institute of South Africa, Cape Town, May 2004. *Water SA*, 30 (5), 95–99.

42. Holland, S.T., Tapp, M., Hildebrandt, D., Glasser, D. and Hausberger, B. (2004). Novel Separation System Design Using “Moving Triangles”. *Comp. & Chem. Eng.*, 29 (1), 181–189.

43. Ngwenya, T., Hildebrandt, D., Glasser, Coville, N. and Mukoma, P. (2005). Fischer-Tropsch Results and their Analysis for Reactor Synthesis. *Ind. Eng. Chem Res*, 44(16), 5987–5994.

44. Mulopo, J.L., Kauchali, S., Hausberger, B., Hildebrandt, D. and Glasser, D. (2005). Experimental Simulation of Distillation Column Concentration Profiles

using a Batch Apparatus: Columns Stripping Section. *Chem. Eng. Sci*.., 60 (24), 6815–6823.

45. Patel, B., Hildebrandt, D. and Glasser, D. (2005). Thermodynamics Analysis of Processes I: Implications of Work Integration. *Ind. Eng. Chem. Res*., 44 (10), 3529–3537.

46. Bahome, M.C., Jewell, L., Hildebrandt, D., Glasser, D. and Coville, N.J, (2005). Fischer-Tropsch synthesis over iron catalysts support on carbon nanotubes. *Applied Catalysis A: General*, 287 (1), 60–67.

47. Modise, T, Tapp, M. Glasser, D and Hildebrandt, D. (2005). Can the operating leaves of the distillation column really be expanded? *Ind. Eng. Chem. Res.* 44 (19), 7511–7519.

48. Milne, D., Glasser, D., Hildebrandt, D. and Hausberger, B. (2006). Reactor selection: Plug Flow or Continuously Stirred Tank? *Chem. Eng. Prog.*, 102 (4), 34–37.

49. Milne, D., Glasser, D., Hildebrandt, D. and Hausberger, B. (2006) Graphically assess a reactor's characteristics, *Chem. Eng. Prog.*, 102 (3), 46-51.

50. Milne, D., Glasser, D., Hildebrandt, D. and Hausberger, B. (2006). The oxidative dehydrogenation of n-butane in a fixed-bed reactor an in an inert porous membrane reactor- maximizing the production of butenes and butadiene*. Ind. Eng. Chem. Res*., 45 (8), 2661–2671.

51. Mukoma, P., Glasser D., and Hildebrandt D. (2006). A process synthesis approach to investigate the effect of the probability of chain growth and conversion on the efficiency of Fischer Tropsch synthesis, *Ind. Eng. Chem. Res*., 45 (17), 5928–5935.

52. Varghese, M., Hildebrandt, D., Glasser, D., Rubin, D., and Crowther, N. (2006). Efficiency of Polymer Beads in the Removal of Heparin: Towards the development of a Novel Reactor. *Artificial Cells, Blood Substitutes and Biotechnology*, 34 (4), 419–433

53. Khumalo, N., Hausberger, B., Kauchali, S., Hildebrandt, D. and Glasser, D. (2006). The Application of the Attainable Region Analysis in Comminution, *Chem. Eng. Sci*., 61 (18), 5969–5980.

54. Peters, M., Kauchali, S., Hildebrandt, D., and Glasser, D. (2006). Derivation and Properties of Membrane Residue Curve Maps. *Ind. Eng. Chem. Res.* 45 (26), 9080–9087.

55. Jalama, K., Coville, N.J., Hildebrandt, D., Glasser, D. and Jewell, L. (2007). Fischer-Tropsch Synthesis over Co/TiO2: Effect of Ethanol Addition, *Fuel*, 86 (1–2), 73–80.

56. Mpela, A., Hildebrandt, D., Glasser, D., Scurrell, M.S and Hutchings, G.J. (2007). Low-pressure methanol and dimethyl-ether synthesis from syngas over gold-based catalysts, *Gold Bulletin*, 40 (3), 219–224.

57. Mukoma, P., Hildebrandt D., Glasser, D. and Coville, N. (2007). Synthesizing a Process from Experimental results: A Fischer-Tropsch Case Study. *Ind. Eng. Chem. Res*., 46 (1), 156–167. Presented at CATSA, Durban, November 2003.

58. Khumalo, N., Glasser, D., and Hildebrandt, D and Hausberger, B. (2007). An Experimental Validation of a Specific Energy Based Approach for Comminution. Chem. Eng Sci., 62 (10), 2765–2776.

59. Bahome, M.C., Jewell, L.L., Padayachy, K, Hildebrandt, D., Glasser, D., Datye, A.K., Coville, N.J. (2007). Fe-Ru Small Particle Bimetallic Catalysts Supported On Carbon Nanotubes For Use In Fischer-Tropsch Synthesis. *Appl. Catal. A-Gen*, 328 (2), 243–251.

60. Jalama, K., Coville, N.J., Hildebrandt, D., Glasser, D., Jewell, L.L. (2007). Effect of Cobalt Carboxylate Precursor Chain Length On Fischer-Tropsch Cobalt/Alumina Catalysts. *Applied Catalysis A-General*, 326 (2), 164–172.

61. Jalama, K.; Coville, N.J.; Hildebrandt, D.; Glasser, D.; Jewell, L.L.; Anderson, J.A.; Taylor, S.; Enache, D. and Hutchings, G.J. (2007). Effect of the Addition of Au on Co/Tio2 Catalyst For The Fischer-Tropsch Reaction. *Topics in Catalysis* 44 (1–2), 129–136.

62. Modise, T., Hildebrandt, D., and Glasser, D. (2007). Experimental measurement of the saddle node region in a distillation column profile map by using a batch apparatus. Presented at Distillation and Absorption, London, 2006. IChemE Symposium Series No. 152, 431–439. *Chem. Eng. Res. Des.* 85 (A1), 24–30.

63. Steyn, J., Pattrick, G., Scurrell, M. Hildebrandt, D., Raphulu, M.C. and van der Lingen E. (2007). On-line deactivation of Au/TiO2 for CO oxidation in H2-rich gas streams. *Catalysis Today*, 122, 254–259.

64. Patel, B., Hildebrandt, D., Glasser, D. and Hausberger, B. (2007). The Synthesis and Integration of Chemical Processes from a Mass, Energy and Entropy Perspective. *Ind. Eng. Chem. Res*. 46 (25), 8756–8766.

65. Metzger, M., Glasser, B., Glasser, D., Hausberger, B., and Hildebrandt, D. (2007). Teaching Reaction Engineering Using the Attainable Region, *Chem. Eng. Ed*. 258–264.

66. Mulopo, J.L., Hildebrandt, D. and Glasser, D. (2008). Reactive Residue Curve Map Topology: Continuous Distillation Column with Non Reversible Kinetics, *Comp.& Chem. Eng*., 32 (3), 622–629.

67. Peters, M.; Kauchali, S., Hildebrandt, D. And Glasser, D. (2008). Application of Membrane Residue Curve Maps to Batch and Continuous Processes. *Ind. Eng. Chem. Res*. 7 (47), 2361–2376.

68. Khumalo, N., Glasser, D., Hildebrandt, D. and Hausberger, B. (2008). Improving Comminution Efficiency using Classification: An Attainable Region Approach. *Powder Technology*, 187 (3), 252–259.

69. Varghese, M.S., Hildebrandt, D., Glasser, D. Rubin, D.M. Crowther, N.J. (2008). The Effect of Poly-L-Lysine/Alginate Bead Membrane Characteristics on the Absorption of Heparin. *Artificial Cells, Blood Substitutes and Biotechnology*, 37 (1), 13–22.

70. Steyn, J., Pattrick, G., Scurrell, M.S. , Hildebrandt, D. and van der Lingen, E. (2008). An unconventional Au/TiO2 PROX system for complete removal of CO from non-reformate hydrogen. *Gold Bulletin*, 41 (8), 318–325.

71. Milne, A.D., Seodigeng, T, Glasser, D. Hildebrandt, D. and Hausberger, B. (2009). Candidate Attainable Regions for the Oxidative Dehydrogenation of n-Butane using the Recursive Constant Control (RCC) Policy Algorithm. *Ind. Eng Chem. Res*. 48, (11), 5211–5222.

72. Metzger, M.J., Glasser, D., Hausberger, B., Hildebrandt, D. and Glasser, B.J. (2009). Use of the Attainable Region Analysis to Optimize Particle Breakage in a Ball Mill, *Chem. Eng. Sci*, 64 (17), 3766–3777.

73. Hildebrandt, D., Glasser, D., Hausberger, B., Patel, B. and Glasser, B.J. (2009). Producing Transportation Fuels with Less Work. *Science*, 323, 1680–1681.

74. Glasser, D. Hildebrandt, D., Hausberger, B., Patel, B. and Glasser, B.J (2009). Systems Approach to Reducing Energy Usage and Carbon Dioxide Usage. *AIChE J*. 55 (9), 2202–2207.

75. Hildebrandt, D., Glasser, D and Patel, B. (2009). Reduction of CO2 emissions from CTL processes: Use of a novel FT based chemistry; Advances in Fischer-Tropsch Synthesis, Catalysts and Catalysis, Editors: Davis and Occelli, CRC Press; Chapter 17, 317–329.

76. Glasser, D., Hildebrandt, D., Hausberger, B., Patel, B. and Glasser, B.J. (2009). Attainable Chemical Processes: A Systems Approach. *Chem. Eng. Prog.* 105 (9), 24–24.

77. Seodigeng, T. Hausberger, B., Hildebrandt, D. and Glasser, D. (2009). Recursive Constant Control Policy Algorithm for Attainable Regions Analysis. *Comput. Chem. Eng.* 33 (1), 309–320.

78. Holland, ST; Abbas, R.; Hildebrandt, D. and Glasser, D. (2010) Complex Column Design by Application of Column Profile Map Techniques: Sharp-Split Petlyuk Column Design. *Ind. Eng. Chem. Res*. 49, 327–349.

79. Milne, D., Seodigeng, T., Glasser, D., Hildebrandt, D. And Hausberger, B. (2010). The Oxidative Dehydrogenation of n-Butane in a Differential Side-Stream. *Catalysis Today*., 156, 237-245.

80. Hildebrandt, D., Beneke, D., Abbas, R., Holland, S.T., Very, M. and Glasser, D. (2010). Column Profile Maps as a Tool for Synthesizing Complex Column Configurations. Presented at 7th International Conference on the Foundations of Computer-Aided Process Design, Jun 07-12, 2009, Breckenridge, CO; *Comput. Chem. Eng*. 34, 1487–1496.

81. Patel, B., Hildebrandt, D. and Glasser, D. (2010). An Overall Thermodynamic View of Processes: Comparison of Fuel Producing Processes, *Chem. Eng. Res*., 844-860.

82. Sarkar, A., Jacobs, G., Mukoma, P., Glasser, G., Hildebrandt, D., Coville, N and Davis, B. Fischer-Tropsch Synthesis: Comparison of the Effect of Co-Fed Water on the Catalytic Performance of CO Catalysts Supported on Wide-Pore and Narrow-Pore Alumina; Advances in Fischer-Tropsch Synthesis, Catalysts and Catalysis, (2009) Editors: Davis and Occelli, CRC Press, Chapter 14, 243–268.

83. Ngigi, G.K., Hildebrandt, D. and Glasser, D. (2010). Adapting Process Unit Relations in Experimental Data Weighting Procedures: A Phase Equilibrium Case Study, *Ind. Eng. Chem*. Res. 49, 1975–1981.

84. Sempuga, B. C., *Hildebrandt*, D., Patel, B., Glasser, D. and Hausberger, B. (2010). Classification of Chemical Processes: A Graphical Approach to Process Synthesis to Improve Reactive Process Work Efficiency, *Ind. Eng. Chem. Res*., 49, 8227–8237.

85. Xiaowei Zhu, Hildebrandt, D. Glasser, D. and Xiaojun Lu. (2010). A Study of Radial Heat Transfer in a Tubular Fischer Tropsch Synthesis Reactor. ISCRE 21, Philadelphia, USA June 2010. In*d. Eng Chem. Res*. 49, 10682-10688.

86. Ming, D., Hildebrandt, D. and Glasser, D. (2010). A Revised Method of Attainable Region Construction Utilizing Rotated Bounding Hyperplanes. Presented at ISCRE 2010, Philadelphia, USA, June 2010 *Ind. Eng. Chem. Res*., 49, 10549-10557.

87. Yao, Y., Hildebrandt, D. Glasser, D. and X. Liu. (2010) Fischer –Tropsch Synthesis Using H2/CO/CO2 Syngas Mixtures over a Cobalt Catalyst. *Ind. Eng. Chem. Res*., 49, 11062-11066.

88. Lu, X., Hildebrandt, D., Liu, X. and Glasser, D. (2010) Making Sense of the Fischer-Tropsch Synthesis Reaction: Start-up. *Ind. Eng. Chem. Res.,* 49, 9753-9758.

89. Ngubevana, L., Glasser, D. and Hildebrandt, D. (2011) Introducing novel graphical techniques to assess gasification. *Energy Conv. & Management*, 52, 547-563.

90. Tabrizi, M.T.F., Glasser, D., and Hildebrandt, D. (2011) Wastewater Treatment of Reactive Dyestuffs by Ozonation in a Semi-Batch Reactor. *Chem. Eng. J*., 166, 662-668.

91. Kalala J., Coville, N.J., Xiong, H., Hildebrandt, D., Glasser, D., Taylor, S., Carley, A., Anderson, J.A. and Hutchings, G.J. (2011) A comparison of Au/Co/Al2O3 and Au/Co/SiO2 catalysts in the Fischer-Tropsch reaction. *Applied Catalysis A: General*., 395, 1-9.

92. Sempuga, B.C., Hildebrandt, D., Patel, B. and Glasser, D. (2011) Work to Chemical Processes: The Relationship between Heat, Temperature, Pressure and Process Complexity. *Ind. Eng. Chem. Res.,* 50, 8603-8619.

93. Katubilwa, F. M., Moys M.H., Glasser, D., and Hildebrandt, D. (2011) An Attainable Region Analysis of the Effect of Ball Size on Milling, *Powder Technology*, 210, 36-46

94. Felbab, N., Hildebrandt, D. and Glasser, D. (2011) A New Method of Locating all Pinch Point Loci and Distillation Boundaries. *Comp & Chem. Eng*., 35, 1072-1087.

95. Beneke, D. A., Hildebrandt, D. and Glasser, D. (2011) On Column Profile Maps: An Analysis of Sharp Splits*. Ind. Eng. Chem. Res*., 50, 6331-6342.

96. Lu, X., Zhu, X., Hildebrandt, D., Liu, X. and Glasser, D. (2011) A New Way to Look at Fischer Tropsch Synthesis Using Flushing Experiments. *Ind. Eng. Chem. Res*., 50, 4359-4365.

97. Masuku, C.M., Hildebrandt, D. and Glasser, D. (2011) The Role of Vapour-Liquid Equilibrium in Fisher-Tropsch Product Distribution., *Chem. Eng. Sci*. 66, 6254-6263.

98. Yao, Y., Liu, X., Hildebrandt, D. and Glasser, D. (2011) Fischer –Tropsch Synthesis Using H2/CO/CO2 Syngas Mixtures over a Iron Catalyst. *Ind. Eng. Chem. Res*. 50, 11002-11012.

99. Sheridan C. M., Glasser D. and Hildebrandt D., Petersen, J and Rohwer, J. (2011) An Annual and Seasonal Characterisation of Winery Effluent in South Africa. *S.A. J of Enology and Viticulture*, 32, 1-8.

100. Kativu, E., Hildebrandt, D., Matambo, T. and Glasser, D. (2012) Effects of CO2 on South African fresh water microalgae growth. *Environmental Progress and Sustainable Energy*. 31, 24-28.

101. Masuku, C.M., Shafer, W.D., Ma, W., Gnanamani, M.K., Jacobs, G., Hildebrandt, D., Glasser, D. and Davis, B.H. (2012) Variation of Residence Time with Chain Length for Products in a Slurry-Phase Fischer-Tropsch Reactor. *J. Cat*. 287, 93-101.

102. Masuku, C.M., Hildebrandt, D. and Glasser, D. (2012) Olefin Pseudo-Equilibrium in the Fischer-Tropsch Reaction. *Chem. Eng. J*., 181, 667-676.

103. Masuku, C.M., Ma, W., Hildebrandt, D., Glasser, D. and Davis, B.H. (2012) A Vapor-Liquid Equilibrium Thermodynamic Model for a Fischer-Tropsch Reactor. *Fluid Phase Equilibria*, 314, 38-45.

104. Liu, X., Hildebrandt, D. and Glasser, D. (2012) Environmental Impacts of Electric Vehicles in South Africa. *S.A. J of Sci*., 108, 91-96.

105. Sempuga, B.C., Patel, B., Hildebrandt, D. and Glasser, D. (2012) Efficient Combustion: A Process Synthesis Approach to Improve the Efficiency of Coal-Fired Power Stations. *Ind. Eng. Chem. Res*.,51, 9061-9077.

106. Mbuyi, K.G., Scurrel, M.S., Hildebrandt, D. and Glasser, D. (2012) Conversion of Synthesis Gas to Dimethylether Over Gold-based Catalysts. *Topics in Catalysis*. 55,771-781.

107. Yao, Y., Liu, X., Hildebrandt, D. and Glasser, D. (2012) Fischer-Tropsch synthesis using H-2/CO/CO2 syngas mixtures: A comparison of paraffin to olefin ratios for iron and cobalt based catalysts. *Applied Catalysis A- General*, 433, 58-68.

108. Metzger, M.J., Desai, S.P., Glasser, D. and Hildebrandt, D. (2012) Using the attainable region analysis to determine the effect of process parameters on breakage in a ball mill. *AICHE J.*, 58, 2665-2673.

109. Glasser, D. Hildebrandt, D., Liu, x., Lu, X. and Masuku, C.M. (2012) Recent advances in understanding the Fischer–Tropsch Synthesis (FTS) reaction. *Current Opinion in Chemical Engineering*, 1, 296-302, Elsevier.

110. Lu, X., Hildebrandt, D., Liu, X. and Glasser, D. (2012) A Thermodynamic Approach to Olefin Product Distribution in Fischer-Tropsch Synthesis. *Ind. Eng. Chem. Res.*, 51, 16544-16551.

111. Ming, D., Hildebrandt, D. and Glasser, D. (2012) A graphical method of improving the production rate from batch reactors *Ind. Eng. Chem. Res.*, 5, 13562-13573

112. Yao, Y.; Liu, X.; Hildebrandt, D.; and Glasser, D.(2012) The effect of CO2 on a cobalt-based catalyst for low temperature Fischer-Tropsch synthesis. *Chem. Eng. J., 19,* 318-327

113. Okonye, L.U., Hildebrandt, D. and Glasser, D. (2012) Attainable Regions for a reactor: Application of ΔH ΔG plot. *Chem. Eng Res. and Des*., 90, 1590-1609.

114. Asiedu, N., Hildebrandt, D., Glasser, D. (2013*)* Estimating Thermodynamic and Equilibrium Quantities of Exothermic Reversible Processes. *Ind. Eng. Chem. Res.,* 52 (23), 7630-7639.

115. Beneke, D., Hildebrandt, D. and Glasser, D. (2013) Feed Distribution in Distillation: Assessing Benefits and Limits with Column Profile Maps and Rigorous Process Simulation. *AIChE J.,* 59 (5), 1668-1683*.*

116. Chimwani, N., Glasser, D., Hildebrandt, D., Metzger, M. and Mulenga, F. (2013) Determination of the milling parameters of a platinum group minerals ore to optimize product size distribution for flotation purposes. *Minerals Engineering,* 43*,* 67-78.

117. Felbab, N., Patel, B., El-Halwagi, M., Hildebrandt, D. and Glasser, D. (2013) Vapor recompression for efficient distillation. 1. A new synthesis perspective on standard configurations. *AIChE J.,* 59 (8), 2977-2992.

118. Metzger, M., Glasser, B., Patel, B., Fox, J., Sempuga, B., Hildebrandt, D. and Glasser, D. (2013) Liquid Fuels from Alternative Carbon Sources Minimizing Carbon Dioxide Emissions. *AIChE Journal*, 59 (6), 2063-2078.

119. Ming, D., Glasser, D. and Hildebrandt, D. (2013) Application of attainable region theory to batch reactors. *Chem. Eng. Sci.,* 99*,* 203-214.

120. Seedat, N., Parag, P., Govender, D., Peters, M., Hildebrandt, D. and Glasser, D. (2013) Experimental Measurement of Membrane Residue Curve Maps. *Ind. Eng. Chem. Res.,* 52 (32), 11142-11150*.*

121. Tabrizi, M., Glasser, D. and Hildebrandt, D., (2013) Ozonation of Textile Reactive Red 198 Dye in a CSTR. *Journal of Advanced Oxidation Technologies,* 16 (1), 159-167.

122. Stacey, N. T., Peters, M., Hildebrandt, D. and Glasser, D. (2013). Synthesis of two-membrane permeation processes using residue curve maps and node classification. *Ind. Eng. Chem. Res.,* 52 (41), 14637-14636.

123. Ntwampe, I. O., Hildebrandt, D. and Glasser, D. (2013). The effect of mixing on the treatment of paint wastewater with Fe 3 and Al 3 salts. *Journal of Environmental Chemistry and Ecotoxicology,* 5 (1), 7-16*.*

124. Fox, J. A., Hildebrandt, D., Glasser, D., and Patel, B. (2013). A graphical approach to process synthesis and its application to steam reforming. *AIChE J.,* 59 (10), 3714-3729.

125. Ntwampe, I. O., Jewell, L. L., Hildebrandt, D., and Glasser, D. (2013). The effect of water hardness on paint wastewater treatment by coagulation-flocculation. *Journal of Environmental Chemistry and Ecotoxicology,* 5 (3), 47-56*.*

126. Asiedu, N*.* , Hildebrandt, D., and Glasser, D. (2013) Modeling and Simulation of Temperature Profiles in a reactive Distillation System for Esterification of Acetic Annhydride with Methanol. *Chemical and Process Engineering Research*, 10, 51-94.

127. Asiedu N, Hildebrandt D, Glasser D (2013) Kinetic Modeling of the Hydrolysis of Acetic Anhydride at Higher Temperatures using Adiabatic Batch Reactor (Thermos-Flask). *J Chem Eng Process Technol.,* 4, 176.

128. Sheridan, C.M., Glasser, D. and Hildebrandt, D. (2014) Estimating Rate Constants of Contaminant Removal in Constructed Wetlands Treating Winery Effluent: A Comparison of Three Different Methods. *Process Safety and Environmental Protection.,* 92 (6), 903-916.

129. Masuku, C., Hildebrandt, D., Glasser, D. and Davis, B. (2014) Steady-state attainment period for Fischer-Tropsch products. *Top. Cat.,* 57, 582-587.

130. Asiedu, N. , Hildebrandt, D., and Glasser, D. (2014) Batch Distillation Targets for Minimum Energy Consumption. *Ind. Eng. Chem. Res.,* 53 (7), 2751-2757.

131. Chimwani, N., Mulenga, F.K., Hildebrandt, D., Glasser, D. And Bwalya, M.M. (2014) Scale-up of Batch Grinding Data for Simulation of Industrial Milling of Platinum Group Minerals Ore. *Minerals Engineering,* 63, 100-109.

132. Zhu, X., Lu, X., Liu, X., Hildebrandt, D. and Glasser, D. (2014) Heat Transfer Study with and without Fischer-Tropsch Reaction in a Fixed Bed Reactor with TiO_2, SiO_2 and SiC supported Cobalt Catalyst. *Chem. Eng. J*., 247, 75-84.

133. Sheridan, C., Hildebrandt, D. and Glasser, D. (2014) Turning wine (waste) into Water: Toward Technological Advances in the Use of Constructed Wetlands for Winery Effluent Treatment. *AIChE J.,* 60 (2), 420-431

134. Fox, J.A., Hildebrandt, D., Glasser, D., Patel, B. And Hausberger, B. (2014) Process Flow Sheet Synthesis: Reaching Targets for Idealized Coal Gasification. *AIChE Journal*, 60 (9), 3258-3266.

135. Letts, R.F.R., Rubin, D.M., Louw, R.H., Hildebrandt, D. (2014) Glomerular Protein Separation as a Mechanism for Powering Renal Concentrating Processes. (2014) arXiv:1405.5743[q-bio.TO]

136. Asiedu, N, Hildebrandt, D. and Glasser, D. (2014) Experimental Simulation of a Two-Dimensional Attainable Region and Its Application in the Optimization of Production Rate and Process Time of an Adiabatic Batch Reactor. *Ind. Eng. Chem. Res.,* 53 (34), 13308-13319.

137. Chimwani, N., Mulenga, F.K., Hildebrandt, D., Glasser, D. And Bwalya, M.M. (2015) Use of the attainable region method to simulate a full-scale ball mill with a realistic transport model*, Minerals Engineering,* 73, 116-123.

138. Masuku, C.M., Lu, X., Hildebrandt, D. and Glasser, D. (2015) Reactive Distillation in Conventional Fischer-Tropsch Reactors. *Fuel Processing Technology*, 130, 54-61.

139. Danha, G., Hildebrandt, D., Glasser, D. and Bhondayi, C. (2015) Application of basic process modeling in investigating the breakage behavior of UG2 ore in wet milling, *Powder Technology*, 279, 42-48.

140. Chimwani, N., Mulenga, F.K., and D Hildebrandt. (2015) Ball size distribution for the maximum production of a narrowly-sized mill product. *Powder Technology*, 284, 12-18.

141. Mlasi, B., Glasser, D. and Hildebrandt, D. (2015) Kinetics of the Decomposition of hydrogen Peroxide in Acidic Copper Sulfate Solutions. *Ind. Eng. Chem. Res*, 54 (21), 5589-5597

142. Danha, D., Hildebrandt, D., Glasser, D. and Bhondayi, C. (2015) A Laboratory Scale Application of the Attainable Region Technique on a Platinum Ore, *Powder Technology*, 274, 14-19.

143. Letts, R.F.R., Rubin, D.M., Louw, R.H., Hildebrandt, D. (2015) Glomerular Protein Separation as a Mechanism for Powering Renal Concentrating Processes. *Medical Hypotheses,* 85 (2), 120-123.

144. Hildebrandt, D., Glasser, D., Patel, B., Sempuga, B. C., & Fox, J. A. (2015). Making Processes Work. *Computers & Chemical Engineering,* 81 (4), 22-31.

145. Asiedu, N, Hildebrandt, D. and Glasser, D. (2015) Experimental Simulation of Three-Dimensional Attainable Region for Synthesis of Exothermic Reversible Reaction: Ethyl Acetate Synthesis Case Study. Optimization of Production Rate and Process Time of an Adiabatic Batch Reactor. *Ind. Eng. Chem. Res.,* 54 (10), 2619-2626.

146. Asiedu, N., Hildebrandt, D., & Glasser, D. (2015). Geometry and reactor synthesis: maximizing conversion of the ethyl acetate process. *International Journal of Industrial Chemistry*, 6 (2), 77-83.

147. Low, M., Glasser, D., Ming, D., Hildebrandt, D. and Matambo, T. (2015) Batch Partial Emptying and Filling To Improve the Production Rate of Algae. *Industrial & Engineering Chemistry Research,* 54 (50), 12492-12502.

148. Muvhiiwa, R.F., Hildebrandt, D., Glasser, D., Matambo, T. and Sheridan, C. (2015) A thermodynamic approach toward defining the limits of biogas production. *AIChE Journal,* 61 (12), 4270-4276.

149. Lu, X., Hildebrandt, D. and Glasser, D. (2015) Distribution between C 2 and C 3 in low temperature Fischer–Tropsch synthesis over a TiO 2-supported cobalt catalyst*. Applied Catalysis A: General,* 506, 67-76.

150. Muleja, A.A., Yao, Y., Glasser, D. and Hildebrandt, D. (2016) Effect of feeding nitrogen to a fixed bed Fischer–Tropsch reactor while keeping the partial pressures of reactants the same. *Chemical Engineering Journal,* 293, 151-160

151. Muleja, A.A., Yao, Y., Glasser, D. and Hildebrandt, D. (2016) A study of Fischer-Tropsch synthesis: Product distribution of the light hydrocarbons. *Applied Catalysis A: General*. 517, 217-226.

152. Gorimbo, J., Lu, X., Liu, X., Hildebrandt, D. and Glasser, D. (2016) A long term study of the gas phase of low pressure Fischer-Tropsch products when reducing an iron catalyst with three different reducing gases. *Applied Catalysis A: General,* 534, 1-11.

153. Stacey, N.T., Peters, M., Hildebrandt, D., and Glasser, D., (2017) Shortcut Node Classification for Membrane Residue Curve Maps. *Journal of Membrane Science and Research*, (3), 84-89.

154.

155. Louw, R.H., Rubin, D.M., Glasser, D., Letts, R.F.R. and Hildebrandt, D. (2017) Thermodynamic considerations in renal separation processes. *Theoretical Biology and Medical Modelling*, 14 (1), 2

156. Muleja, A.A., Yao, Y., Glasser, D. and Hildebrandt, D. (2017) Variation of the Short-Chain Paraffin and Olefin Formation Rates with Time fora Cobalt Fischer–Tropsch Catalyst. *Ind.Eng.. Chem. Res.,* 56 (2), 469-478

157. Hildebrandt, D., Lu, X. and Maphoto, T. (2017) South Africans pioneer heat transfer technology for conversion of waste to energy. *South African Journal of Science*, 113, 1-2.

158. Danha, G., Bhondayi, C., Hlabangana, H., and Hildebrandt, D. (2017) Determining the PGM bearing mineral phase in the UG2 ore, *Powder Technology*, 315, 236–242.

159. Gorimbo, J., Muleja, A., Lu, X., Yao, Y., Liu, X., Hildebrandt, D., and Glasser, D. (2017) Lu Plot and Yao Plot: Models To Analyze Product Distribution of Long-Term Gas-Phase Fischer−Tropsch Synthesis Experimental Data on an Iron Catalyst, *Energy Fuels*, (5), 5682-5690.

160. Gorimbo, J., Lu, X., Liu, X., Hildebrandt, D., and Glasser, D. (2017) A long term study of the gas phase of low pressure Fischer-Tropsch products when reducing an iron catalyst with three different reducing gases, *Applied Catalysis A: General,* 534, 1–11.

161. Gorimbo, J., Lu, X., Liu, X., Yao, Y., Hildebrandt, D., and Glasser, D. (2017) Low pressure Fischer Tropsch synthesis: In-situ Oxidative Regeneration of Iron Catalysts. *Ind. Eng. Chem. Res.,* 56 (15), 4267-4274.

162. Muvhiiwa,R., Hildebrandt, D., Chimwani, N., Ngubevana, L. and Matambo, T (2017) The impact and challenges of sustainable biogas implementation: moving towards a bio-based economy. *Energy, Sustainability and Society,* 7 (1), 20

163. Fox, J.A., Hildebrandt, D., Glasser, D. and Patel, B.2017(2017) Process flow sheet synthesis: Systems-level design applied to synthetic crude production. *AIChE Journal,* 63 (12), 5413-5424.

164. Louw, R.H*., Rubin, D.M., Glasser*, D., Letts, R.F.R. and Hildebrandt, D. (2017) Thermodynamic considerations in renal separation processes. *Theoretical Biology and Medical Modelling* 14 (1), 20

165. Hlabangana, N., Danha, G., Bwalya, M.M., Hildebrandt, G. and Glasser, D. (2017) Application of the attainable region method to determine optimal conditions for milling and leaching. *Powder Technology* 317, 400-407.

166. Lu, X., Zhu, X., Masuku, C.M., Hildebrandt,D. and Glasser, D. (2017) A study of the Fischer–Tropsch Synthesis in a batch reactor: rate, phase of water, and catalyst oxidation. *Energy & Fuels,* 31 (7), 7405-7412.

167. Stacey, N., Hildebrandt, N., (2017) Quantitative Modeling of a Greenhouse as a Bioreactor to Process Power Station Emissions, *Environmental Progress & Sustainable Energy*, 37, 1-7.

168. Muvhiiwa, R., Lu, R., Hildebrandt, D., Glasser, D., and Matambo, T. (2018) Applying thermodynamics to digestion/gasification processes: the Attainable Region approach, *Journal of Thermal Analysis and Calorimetry,* 131 (1), 25-36.

169. Stacey, N.J., Fox, J. and Hildebrandt, D. (2018) Reduction in greenhouse water usage through inlet CO2 enrichment, *AIChE Journal,* 64 (7), 2324-2328.

170. Muvhiiwa, R.F., Sempuga, B., Hildebrandt D., Van Der Walt, J. (2018)Study of the effects of temperature on syngas composition from pyrolysis of wood pellets using a nitrogen plasma torch reactor. *Journal of Analytical and Applied Pyrolysis,* 130, 159-168.

171. Kapfunde, N., Masuku,C.M., Hildebrandt, D., (2018) Optimization of the Thermal Efficiency of a Fixed-Bed Gasifier using Computational Fluid Dynamics. *Computer Aided Chemical Engineering,* 44, 1747-1752.

172. Adeleke, A.A., Liu, X., Lu, X.,Moyo, M. and Hildebrandt. D. (2018) Cobalt Hybrid Catalysts in Fischer-Tropsch Synthesis. *Rev. Chem. Eng.,* 36 (4),1-21.

173. Glasser, L., Fox, J.A., Hildebrandt, D., and Glasser, D. (2018) Thermodynamic Optimisation of Steady-Flow Industrial Chemical Processes. *International Journal of Industrial Chemistry*, 9, 353–361.

174. Gorimbo, J., Muleja, A.,Liu, X. and Hildebrandt, D. (2018), Fischer-Tropsch synthesis: product distribution, operating conditions, iron catalyst deactivation and catalyst speciation. *International Journal of Industrial Chemistry*, 9, 317-333.

175. Chimwani, N., Hildebrandt, D. (2019) Modeling of an open mill with scalped feed for the maximum production of a desired particle size range. *Particulate Science and Technology,* 37 (3), 314-324.

176. Mguni, L.L., Yao Y., Liu,X.. Yuan, Z., Hildebrandt, D. (2019) Ultra-deep desulphurization of both model and commercial diesel fuels by adsorption method, *Journal of Environmental Chemical Engineering*, 7 (2), 102957.

177. Mguni, L.L,, Yao, Y, Nkomzwayo, T., Liu ,X., Hildebrandt, D. and Glasser,D. (2019) Desulphurization of diesel fuels using intermediate Lewis acids loaded on activated charcoal and alumina, *Chemical Engineering Communication*, 206 (5), 572–580.

178. Chike George Okoye-Chine, Mahluli Moyo, Xinying Liu, Diane Hildebrandt, (2019) A Critical Review of the Impact of Water on Cobalt-Based Catalysts in Fischer-Tropsch Synthesis, *Fuel Processing Technology*, 192, 105-129.

179. Chike George Okoye-Chine; Oliver Mbuya; Tau Ntelane; Mahluli Moyo; Diane Hildebrandt. (2020) The effect of silanol groups on the metal-support interactions in silica-supported cobalt Fischer-Tropsch catalysts. A Temperature programmed surface reaction, *Journal of Catalysis*, 381, 121-129.

180. Otun, K.O., Liu, X. and Hildebrandt, D. (2020) Metal-organic framework (MOF)-derived catalysts for Fischer-Tropsch synthesis: Recent progress and future perspectives. *Journal of Energy Chemistry*, 51, 230-245.

181. Rubin, D., Stacey, N., Matambo, T. and Hildebrandt, D. (2020) Oxygen transfer Characteristics of a Hollow Fiber Dialyser: Towards Possible Repurposing of Dialysers as Blood Oxygenators in the Context of Constrained Availability of Respiratory Support. *medRxiv,*
doi: https://doi.org/10.1101/2020.04.06.20055236.

182. Gorimbo, J. and Hildebrandt, D. (2020) Thermochemical Conversion of Carbon Dioxide to Carbon Monoxide by Reverse Water-Gas Shift Reaction over the Ceria based Catalyst. *Conversion of Carbon Dioxide into Hydrocarbons*, Vol. 1 Catalysis, 43-61.

183. Rubin, D.M., Stacey, N.T., Matambo, T., Do Vale, C., Sussman. , M.J., Snyman, T., Mer, M. and Hildebrandt, D. (2020) Toward Respiratory Support of Critically Ill COVID-19 patients Using Repurposed Kidney Hollow Fiber Membrane Dialysers to Oxygenate the Blood, *Journal of Healthcare Engineering*, Article ID 8862645 **|** https://doi.org/10.1155/2020/8862645

184. Fernandez-Torres, M.J, Hildebrandt, D., Sempuga, B.C. and Caballero, J.A. (2020) Integrating environmental concerns into the teaching of mathematical optimization. *Education for Chemical Engineers*, 32,40-49.

185. Yao, Y., Liu, X., Gorimbo, J., Xiong, H., Fox, J., Glasser, D. and Hildebrandt, D. (2020) Fischer-Tropsch synthesis: A long term comparative study of the

product selectivity and paraffin to olefin ratios over an iron-based catalyst activated by syngas or H2. *Applied Catalysis A: General*, 602, 117700.

186. Zhang, Y., Tshwaku, M., Yao, Y., Chang, J., Lu, X., Liu, X. and Hildebrandt , D.(2020) Reaction of ethylene over a typical Fischer-Tropsch synthesis Co/TiO2 catalyst. *Engineering Reports,* 2 (9),e12232.

187. Ansari, S.H., Ahmed, A., Razzaq, A., Hildebrandt, D., Liu, X., Park, Y.K. (2020) Incorporation of solar-thermal energy into a gasification process to co-produce bio-fertilizer and power. *Environmental Pollution*, 266, 115103.

188. Zhang, Y., Yao, Y., Chang, J., Lu, X., Liu, X. and Hildebrandt, D. (2020) Fischer-Tropsch synthesis with ethene co-feeding: Experimental evidence of the CO-insertion mechanism at low temperature. *AIChE Journal*, 66 (11), e17029.

189. Gorimbo, J., Muvhiiwa, R., Llane, E. and Hildebrandt, D. (2020) Cobalt Catalyst Reduction Thermodynamics in Fischer-Tropsch: An Attainable Region Approach. *Reactions*, 1 (2), 115-129.

190. Yao, Y.,Sempuga, B.C., Liu, X. and Hildebrandt, D.(2020) Production of fuel and chemicals from a CO2/H2 mixture. *Reactions*, 1 (2), 130-146.

191. Okoye-Chine, C.G., Moyo, M. and Hildebrandt, D. (2020) The Influence of hydrophobicity on Fischer-Tropsch synthesis catalysts. *Reviews in Chemical Engineering,* 000010151520200037. https://doi.org/10.1515/revce-2020-0037

192. Ndlovu, K., Stacey, N., Fernandes-Torres, M. and Hildebrandt, D. (2021) A Direct Gasoline Pre-Blending of Bioalcohol Mixtures as a means of Decreasing Energy Losses. Biofuels, 12 (6), 615-623, DOI: 10.1080/17597269.2018.1546487

193. Dumont, K.B., Hildebrandt, D. and Sempuga, B.C. (2021) The “yuck factor” of biogas technology: Naturalness concerns, social acceptance and community dynamics in South Africa. *Energy Research and Social Scienc*e, 71, 101846.

194. Okonye, L.U., Yao, Y., Hildebrandt, D., and Meijboom, R. (2021) Contributing to energy sustainability: a review of mesoporous material supported catalysts for Fischer-Tropsch synthesis. *Sustainable Energy and Fuels*, 5, 79-107.

195. Li, Y., Liu, Y., Mu, H., Liu, R., Hao, Y., Wang, X., Hildebrandt, D., Liu, X and Li, F. (2021) The simultaneous adsorption, activation and in situ reduction of carbon dioxide over Au-loading BiOCl with rich oxygen vacancies. *Nanoscale*, 13 (4), 2585-2592.

196. Shiba, N.C., Yao, Y., Liu, X.,and Hildebrandt., D. (2022) Recent developments in catalyst pretreatment technologies for cobalt based Fischer-Tropsch synthesis. Reviews in Chemical Engineering, 38 (5), 503-538

197. Shen, J., Ho, W.H., Liu, X. and Hildebrandt, D. (2021) Tubular reactor internals for suppressing hot spot formation to the Ficher-Tropsch reaction. *Chemical Engineering and Processing-Process Intensification*, 161, 108309

198. Zhang, Y., Yao, Y., Chang, J., Gorimbo, J., Liu, X. and Hildebrandt, D. (2021) The interaction of CO, H2 and ethylene over a typical Cobalt-based Fischer - Tropsch Synthesis catalyst. *Applied Catalysis A: General,* 614, 118024.

199. Chang, J., Zhang, Y., Lu, X., Yao, Y., Liu, X. and Hildebrandt, D. (2021) Insight into the role of Co2C supported on reduced graphene oxide in Fisher-Tropsch synthesis and ethene hydroformylation. *Applied Catalysis A: General*, 614, 118050.

200. Shiba, N.C., Yao, Y., Forbes, R.P., Okonye-Chine, C.G., Liu, X., and Hildebrandt, D.,(2021) Role of CoO-Co nanoparticles supported on SiO2 in Fischer-Tropsch synthesis: Evidence for enhanced CO dissociation and olefin hydrogenation. *Fuel Processing Technology*, 216, 106781.

201. Otun, K.O., Yao, Y., Liu, X. and Hildebrandt, D., (2021) Synthesis, structure and performance of carbide phases in Fisher-Tropsch synthesis: a review. *Fuel*, 296,120689.

202. Okonye-Chine, C.G., Moyo, M. and Hildebrandt, D. (2021) The effect of hydrophobicity on SiO2-supported Co catalysts in Fisher-Tropsch synthesis. *Fuel*, 296, 120667.

203. Sun, T., Wang, H., Liu, J., Chu, X., Xing, X., Liu, S., Tang, E., Liu, X. and Hildebrandt D. (2021) Recoverable acrylamide-vinylamine copolymer immobilized TEMPO mediated oxidation of cellulose with good catalytic performance and low cellulose degradation. *Cellulose*, 1-4.

204. Shen, J., Li, Y.C., Ho, W.H., Liu, X. and Hildebrandt, D., (2021) Experimental and simulation study of the temperature distribution in a bench-scale fixed bed Fischer-Tropsch reactor. *AIChE Journal*, 67 (5), e17145

205. Mguni L.L., Yao, Y., Ren, J., Liu, X. and Hildebrandt, D. (2021) Modulated synthesized Ni-Based MOF with improved adsorptive desulfurization activity. *Journal of Cleaner Production*. 323, 129196

206. Zhang., Y., Yao. Y., Shen, J., Chang,J., Gorimbo, J., Liu, X., and Hildebrandt, D. (2021) Effect of ethylene co-feeding in Fischer-Trospch Synthesis: A study of reaction equilibrium and competition. *Fuel*. 301, 121146202.

207. Shiba, N.C., Liu, X., Hildebrandt, D. and Yao, Y. (2021) Effect of Pre-Treatment Conditions on the Activity and Selectivity of Cobalt-Based Catalysts for CO Hydrogenation. *Reactions.* 2 (3), 258-274.

208. Mguni L.L., Yao, Y., Ren, J., Liu, X. and Hildebrandt, D. (2021) Modulated Synthesis of a Novel Nickel-Based-Organic Framework Composite Material for

the Adsorptive Desulfurization of Liquid Fuels. *Industrial & Engineering Chemistry Research.* 60 (30), 10997-11008.

209. Muvhiiwa, R., Sempuga, B. and Hildebrandt, D. (2021) Using the GH Spece to show heat and work efficiencies associated with nitrogen plasma gasification of wood. *Chemical Engineering Science*, 1167931.

210. Okoye-Chine, C.G., Moyo, M. and Hildebrandt, D. (2021)Fischer-Tropsch Synthesis: The effect of hydrophobicity on siilca-supported iron catalysts. *Journal of Industrial and Engineering Chemistry*, 97, 426-433

211. Chang, J., Zhang, Y., Yao, Y., Liu, X., Hildebrandt D. (2022) Reduced graphene oxide supported cobalt catalysts for ethylene hydroformylation: Modified cobalt-support interaction by rhodium. Fuel, 324, 124479

212. Shiba, N.C., Liu, X., Mao, H., Qian, X., Hildebrandt, D., Yao, Y. (2022) Effect of Ru-promotion on the catalytic performance of a cobalt-based Fischer-Tropsch catalyst activated in syngas or H_2. Fuel, 320, 123939

213. Otun, K.O., Zong, S., Hildebrandt, D., Liu, X. (2022) Self-assembled Zn-functionalized Ni-MOF as an efficient electrode for electrochemical energy storage. Journal of Physics and Chemistry of Solids, 167, 110779

214. Kabi, T., Hildebrandt, D., Liu, X., Yao, Y. (2022) Adsorption of dibenzothiophene in model diesel fuel by amarula waste biomass as a low-cost adsorbent. Journal of Environmental Management, 309, 114598

215. Otun, K.O., Xaba, M.S., Zong, S., Liu, X., Hildebrandt, D., El-Bahy, S.M., El-Bahy, Z.M. (2022) Double linker MOF-derived NiO and NiO/Ni supercapacitor electrodes for enhanced energy storage. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 634, 128019

216. Shen, J., Ho, W.H., Zhang, Y., Liu, X., Yao, Y., Hildebrandt, D., Abd El-Gawad, H. H., Ali, H.M. (2022) Design of a Fischer-Tropsch multi-tube reactor fitted in a container: A novel design approach for small scale applications. Journal of Cleaner Production, 362, 132477

217. Nkomzwayo, T., Mguni, L., Hildebrandt, D., Yao, Y. (2022) Adsorptive desulfurization using period 4 transition metals oxide: A study of Lewis acid strength derived from the adsorbent ionic-covalent parameter. Chemical Engineering Journal, 444, 136484

218. Ramutsindela, F.K., Okoye-Chine, C.G., Mbuya, C.O.L., Mubenesha, S., Gorimbo, J., Okonye, L.U., Liu, X., Hildebrandt, D. (2022) The effect of reducing gases on raw iron ore catalyst for Fischer-Tropsch synthesis. Journal of the Taiwan Institute of Chemical Engineers, 131, 104163

219. Otun, K.O., Xaba, M.S., Zong, S., Liu, X., Hildebrandt, D., El-Bahy, S.M., Alotaibi, M.T., El-Bahy, Z.M. (2022) ZIF-8-derived ZnO/C decorated hydroxyl-functionalized multi-walled carbon nanotubes as a new composite electrode for

supercapacitor application. Colloid and Interface Science Communications, 47, 100589

220. Shiba, N.C., Liu, X., Hildebrandt, D., Mao, H., Yao, Y. (2022) Enhanced catalytic activity on Co/SiO_2 via hydrogenation–carburization–hydrogenation reduction procedure for synthetic fuel production. Energy Reports, 8, 201-206

221. Ijoma, G.N., Mutungwazi, A., Mannie, T., Nurmahomed, W., Matambo, T.S., Hildebrandt, D. (2022) Addressing the water-energy nexus: A focus on the barriers and potentials of harnessing wastewater treatment processes for biogas production in Sub Saharan Africa. Heliyon, 8, e09385

222. Okoye-Chine, C.G., Forbes, R., Joshua Gorimbo, J., Moyo, M., Liu, X., Hildebrandt, D. (2022) The effect of pretreatment on SiO_2 for Co-based Fischer-Tropsch synthesis catalysts: a study of the reduction pathway. Chemical Engineering Communications, DOI: 10.1080/00986445.2022.2056452

223. Mguni, L.L., Ndhlovu, A., Liu, X., Hildebrandt, D., Yao, Y. (2022) Insight into Adsorptive Desulfurization by Zeolites: A Machine Learning Exploration. Energy Fuels, 36, 4427-4438

224. Wang, N., Liu, H., Zhou, X., Luo, Q., Yang, X., Yang, H., Shu, H., Xu, H., Zhang, Q., Hildebrandt, D., Liu, X., Qiao, S., Liu, B., Feng, Q. (2022) Improving Harsh Environmental Stability of Few-Layer Black Phosphorus by Local Charge Transfer. Advanced Functional Materials, 2203967

225. Lia, J., Liu, R., Meng Ning, M., Li, Y., Liu, Y., Liu, X., Khangale, P., Hildebrandt, D., Wang, X., Li, F. (2022) Insight into the relationship between redox ability and separation efficiency via the case of α-Bi_2O_3/$Bi_5NO_3O_7$. Inorganic Chemistry Frontiers, 9, 3578

226. Zhang, B., Chen, L., Zhang, Z., Li, Q., Khangale, P., Hildebrandt, D., Liu, X., Feng, Q., Qiao, S. (2022) Modulating the Band Structure of Metal Coordinated Salen COFs and an In Situ Constructed Change Transfer Heterostructure for Electrocatalysis Hydrogen Evolution. Advanced Science, 9, 2105912

227. Li, X., Han, X., Li, G., Du, J., Cao, Y., Gong, H., Wang, H., Zhang, Y., Liu, S., Zhang, B., Liu, X., Khangale, P., Hildebrandt, D., Sun, J., Chen, A. (2022) Nonsacrificial Nitrile Additive for Armoring High-Voltage LiNi0.83Co0.07Mn0.1O2 Cathode with Reliable Electrode– Electrolyte Interface toward Durable Battery. Small, 18, 2202989

228. Okonye, L.U., Yao, Y., Ren, J., Liu, X. and Hildebrandt, D. (2023) A perspective on the activation energy dependence of the Fischer-Tropsch synthesis reaction mechanism. Chemical Engineering Science 265, 118259

229. Okoye-Chine, G.C., Forbes, R., Gorimba, J., Moyo, M., Liu, X., Hildebrandt, D. (2023) The effect of pretreatment on SiO2 for Co-based Fischer-Tropsch

synthesis catalysis: a study of the reduction pathway. Chemical Engineering Communications, 210, (7), 1097-.

230. Fernandez-Torres M.J., Hildebrandt, D., Glasser, D., and Sempuga, B.C.(2023) Thermodynamic constraints on the reduction of nitrates in drinking water. Industrial and Engineering Chemistry Research 62 (12), 5305.

231. Zhang, B., Liu, H., Zhai, P., Zhang, R., Wang, W., Khangale, P., Hildebrandt, D., Liu, X. Qiao, S. (2023) Well-defined oligomer “Blood Cells” and conducting polymer “Neurons” constructing “muscle”-biometric electrocatalysis for water electrolysis. Advanced Functional Materials 33, (8), 22114402023.

232. Diale. P.P., Hildebrandt,D., Glasser, D., Matambo, T.S., Makgato, S.S. (2023) An analysis of the processes, kinetics and equilibrium of iron's biosorption on immobilized green microalgae. SA Journal of Chemical Engineering, 45,210-220.doi.org/10.1016/j.sajce.2023.05.007.

233. Zong, S., Chen, A., Wisniewski, M., Macheli, L., Jewell, L., Hildebrandt, D., and Liu, X. (2023) Effect of temperature and pressure on electrochemical CO2 reduction: A mini review. Carbon Capture Science & Technology, 8. 100133. doi.org/10.1016/j.ccst.2023.100133.

234. Liu, Y., He, C., Jiang, X., Zhang, R., Liu, X., Hildebrandt, D., and Lu, Z. (2023) Fischer-Tropsch synthesis to α-Olefins with low CO2 selectivity on a Co2C catalyst. Chemical Engineering Journal, 479, 147927. doi.org/10.1016/j.cej.2023.147927.

CONFERENCE PROCEEDINGS

1. Glasser, D., Hildebrandt, D., Godorr, S. and Jobson, M. (1993). A Geometric Approach to Variational Optimisation: Finding the Attainable Region. 12th World Congress IFAC, Sydney, Australia, V, 37–44.

2. Price, J.G., Coville, N.J. Glasser, D and Hildebrandt, D. (1993). An investigation into Co/Ru Bimetallic Catalysts for the Fisher Tropsch Reaction. International Conference on Catalysis and Catalytic Processing, Cape Town, 137–144.

3. Fine, D.R., Lurie, R.E., Glasser, D., Hildebrandt, D., Esser, J.D. and Chetty, N. (1993). Identification of an Aorta Background for Organ Scintigraphic Deconvolution Studies. 15th Annual International Conference IEEE Engineering in Medicine and Biology Society, October, San Diego. 517–518.

4. Nicol, W., Glasser, D. and Hildebrandt, D. (1998). Optimising Adiabatic Reactor Systems with Internal Heat Exchange, Presented at FOCAPD, Snowbird, Utah, July.

5. McGregor, C., Hildebrandt, D. and Glasser, D. (1998). The Use of Attainable Regions to Synthesise and Optimise Novel Multiphase Reactors. Presented at *ISCRE 15*, Newport Beach, September.

6. Hausberger, B., Hildebrandt, D. Glasser, D. and McGregor C. (2000). Feed Addition Policies for Ternary Distillation Columns. Presented at *FOCAPD '99*. *AIChE Symposium Series* No. 323, 96, 402–405.

7. Glasser, D., Hildebrandt, D. and McGregor C. (2000). There is more to Process Synthesis than Synthesising a Process. Presented at *FOCAPD '99*. *AIChE Symposium Series* No. 323, 96, 311–319.

8. Hildebrandt, D. and McGregor C. (2000). A New Concept in Process Synthesis: Maximising The Average Rate. Presented at *Fifth International Conference on Foundations of Computer-Aided Process Design*. *AIChE Symposium Series* No. 323, 96, 320–323.

9. Glasser, D., Hildebrandt, D. and Mitova, E. (2001).Teaching Chemical Reactor Synthesis to undergraduates via the Attainable Region Method. Presented at *6th World Congress of Chemical Engineering*, Melbourne.

10. Lebotse, M., Nielsen, C., Kauchali, S., Hausberger, B., Glasser, D. and Hildebrandt, D. (2001). Measuring VLE in a Batch Still: A Comparison of Three Methods of Operation. Presented at *6th World Congress of Chemical Engineering,* Melbourne.

11. Glasser, D., Hildebrandt, D. and Hausberger, B. (2001). Modelling Rates for Design Purposes. Presented at *6th World Congress of Chemical Engineerin*g, Melbourne.

12. Holland, S.T., Tapp, M., Hildebrandt, D. and Glasser, D. (2002). Modeling Coupled Distillation Column Sections Using Profile Maps. *35th European Symposium on Computer Aided Engineering*. Editors: Grievink, J. and van Scgijndel, J. Elsevier. 211–216.

13. Kauchali, S., Hausberger, B., Mitova, E., Hildebrandt, D and Glasser, D. (2002). Automating reactor network synthesis: Finding a candidate attainable region for water-gas shift (WGS) reaction. *35th European Symposium on Computer Aided Engineering*. Editors: Grievink, J. and van Scgijndel, J. Elsevier. 217–222.

14. Mitova, E., Glasser, D., Hildebrandt, D. and Hausberger, B. (2003). Finding Candidates for Multidimensional Attainable Regions. *Process Systems Engineering*, Editors: Chen and Westerberg. 565–569.

15. Seodigeng, T., Hausberger, B., Hildebrandt, D., Glasser, D. and Kauchali, S. (2003). DSR Algorithm for Construction of Attainable Region Structures, *Process Systems Engineering*, Editors: Chen and Westerberg. 594–600.

16. Holland, S.T., Tapp, M., Hildebrandt, D., Glasser, D. and Hausberger, B. (2003). Novel Separation System Design using Moving Triangles. *Process Systems Engineering*, Editors: Chen and Westerberg. 832–839.

17. Vally, T., Hildebrandt, D., Rubin, D., Crowther, N. and Glasser, D. (2003). Application of Process Synthesis Methodology to Biomedical Engineering for the Development of Artificial Organs. *Process Systems Engineering*, Editors: Chen and Westerberg. 1216–1221.

18. Ngigi, G., Glasser, D., Hildebrandt, D. MaPS (Managed Process Synthesis) (2003). A methodology, integrated with the experimental programme, to develop a flow sheet. A first step. *Process Systems Engineering*, Editors: Chen and Westerberg. 1328–1334.

19. Tapp, M., Holland, S.T., Hausberger, B., Hildebrandt, D. and Glasser, D. (2003). Expanding the Operating Leaves in Distillation Column Sections by Distributed Feed Addition and Sidestream Withdrawal. *Process Systems Engineering*. Editors: Chen and Westerberg. 1050–1057.

20. Kauchali, S., Hausberger, B., Seodigeng, T., Hildebrandt, D. and Glasser, D. (2004). A Comparison of Automated Techniques in Determining Candidate Attainable regions. A Case Study: The Water-Gas-Shift Reaction. *European Symposium of Computer-Aided Process Engineering,* Lisbon, Portugal, May.

21. Tapp, M., Holland, S.T., Hildebrandt, D. and Glasser, D. (2004). Make Distillation Boundaries Work for You! *European Symposium of Computer-Aided Process Engineering* , Lisbon, Portugal, May.

22. Patel, B., Hildebrandt, D., Glasser, D. and Hausberger, B. (2005). Overcoming the overall positive Free Energy of a process: Using the second law analysis to understand how this is achieved. *7th World Congress of Chemical Engineering*, Glasgow, Scotland, July.

23. Khumalo, N., Hausberger, B., Hildebrandt, D. and Glasser, D. (2005). The Application of the Attainable Region Analysis to Comminution, *7th World Congress of Chemical Engineering*, Glasgow, Scotland, July.

24. Mukoma, P., Hildebrandt, D., and Glasser, D. (2005). The integration of Process Synthesis into an experimental program for Fischer-Tropsch Synthesis

(FTS) Chemistry, *7th World Congress of Chemical Engineering*, Glasgow, Scotland, July.

25. Modise, T., Hildebrandt, D., Glasser, D., Kauchali, S. and Tapp, M. (2005). Experimental Simulation of a Distillation Column Profile Maps using a Batch Apparatus. *7th World Congress of Chemical Engineering*, Glasgow, Scotland, July.

26. Seodigeng, T., Hausberger, B., Hildebrandt, D., and Glasser, D. (2005). Attainable Regions Analysis for Processes with Mixing and Heat Transfer. *7th World Congress of Chemical Engineering*, Glasgow, Scotland, July.

27. Mulopo, J.L., Glasser, D., and Hildebrandt, D. (2005) Topological-based Analysis of Simple Distillation Accompanied by a Single Reaction. *7th World Congress of Chemical Engineering*, Glasgow, Scotland, July.

28. Vrey, M., Focke, W.W., Hildebrandt, D. and Glasser, D. (2005). Consistent Cubic Mixing Rules for Cubic EOS. *7th World Congress of Chemical Engineering*, Glasgow, Scotland, July.

29. Tapp, M. Holland, S.T., Hildebrandt, D. and Glasser, D. (2005). Is distributing the feed composition X_f over several trays a good idea? *7th World Congress of Chemical Engineering*, Glasgow, Scotland, July.

30. Moodley, A., Kauchali, S.K., Hildebrandt, D. and Glasser, D. (2005). Debottle-necking reactor networks by attainable region analysis. Proceedings of the *First International Conference on Modeling, Simulation and Applied Optimisation*, Sharjah, UAE., February 1–3.

31. Zhao, Yanjun, Mpela, A, Enache, D.I, Taylor, S.H., Hildebrandt, D., Glasser, D., Hutchings, G.J., Atkins, M.P. and Scurrell, M. (2005). Study of carbon monoxide hydrogenation over Au supported on zinc oxide catalysts. *American Chemical Society, Division of Petroleum Chemistry*, **50** *(2)*, 206–207.

32. Peters, M., Kauchali, S., Hildebrandt, D. and Glasser, D. (2006). Separation of Methanol /Butene/MTBE using hybrids distillation–membrane processes, Presented at *Distillation and Absorption*, London, *IChemE Symposium Series* No. 152, 152–161

33. Mpela, A., Hildebrandt, D., Glasser, D., Hutchings, G.J. and Scurrell, M.S. (2006). A Process synthesis approach to the low-pressure methanol and dimethyl ether synthesis over gold-based catalysts, *2006 World Gold Conference*, Limerick, Ireland, 3–6 Sept.

34. Wilson, C., Hildebrandt, D. and Glasser, D. (2006). Experimental column profile maps with varying delta points in a continuous column for the acetone methanol ethanol system. Presented at *Distillation and Absorption*, London, *IChemE Symposium Series* No. 152, 111–121.

35. Ngigi, G., Hildebrandt, D. and Glasser, D. (2006). Evaluation of phase equilibria for dilute mixtures for design purposes. Presented at *Distillation and Absorption*, London, *IChemE Symposium Series* No. 152, 928–936.

36. Modise, T., Hildebrandt, D., and Glasser, D. (2006). The experimental simulation of the saddle point region in a distillation column profile map by using a batch apparatus. Presented at *Distillation and Absorption*, London, *IChemE Symposium Series* No. 152, 431–439.

37. Mulopo, J.L., Glasser, D. and Hildebrandt, D. (2006). How to decide when and how much to use reactive distillation. Presented at *Distillation and Absorption*, London, *IChemE Symposium Series* No. 152, 964–972.

38. Peters, M., Kauchali, S., Hildebrandt, D. and Glasser, D. (2006). Application of Membrane Residue Curve Maps to Continuous Hybrid Distillation-Membrane Processes. Presented at *SAIChE 2006*, Durban, 20–22 September. *SACEC 2006*, Poster PD013, ISBN No. 1 86840 617 2.

39. Patel, B., Hildebrandt, D., Glasser, D. and Hausberger, B. (2006). The synthesis of chemical processes from a mass, energy and entropy perspective. Presented at *SAIChE 2006*, Durban, 20–22 September. *SACEC 2006*, Poster PD012, ISBN No. 1 86840 617 2.

40. Kalal, B., Gray, V.M., Hildebrandt, D. and Glasser, D. (2006). Anaerobic Fluidized Bed Bioreactor for the Conversion of Carbohydrates in Wastewater into Hydrogen. Presented at *SAIChE 2006*, Durban, 20–22 September. *SACEC 2006*, OraleS06, ISBN No. 1 86840 617 2.

41. Tabrizi, M.T.F., Glasser, D., Hildebrandt, D. And Alton, A. (2006). Decolourization of Textile Dyestuffs with ozone in wastewater treatment. Presented at *SAIChE 2006*, Durban, 20–22 September. *SACEC 2006*, PosterEES04, ISBN No. 1 86840 617 2.

42. Fasemore, O.A., Nyamboli, M., Hildebrandt, D., Glasser, D. and Grey, V.M. (2006). Evaluation of the Nutrient Utilization Dynamics of *Photorhabdus luminescens* under Batch Culture. Presented at *SAIChE 2006*, Durban, 20–22 September. *SACEC 2006*, PosterPID01, ISBN No. 1 86840 617 2.

43. Khumalo, N., Glasser, D., and Hildebrandt, D. (2006). Overview of the application of the attainable region analysis to comminution. Presented at *SAIChE 2006*, Durban, 20–22 September. *SACEC 2006*, OralPD013, ISBN No. 1 86840 617 2.

44. Mukoma, P., Hildebrandt, D., Glasser, D., Coville, N., Jacobs, G. and Davis, B.H. (2006). Fischer- Tropsch Synthesis: A study of the effect of water on a cobalt catalyst. Presented at *SAIChE 2006*, Durban, 20–22 September. *SACEC 2006*, OralPDO17, ISBN No. 1 86840 617 2.

45. Ngigi, G.K., Patel, B., Glassser, D. and Hildebrandt, D. (2006). Implications of the second law of thermodynamics on a reactive distillation process. Presented at *SAIChE 2006*, Durban, 20–22 September. *SACEC 2006*, Poster PD010, ISBN No. 1 86840 617 2.

46. Peters, M. Kauchali, S., Hildebrandt, D., Glasser, D. (2007). Graphical Comparison of Coupled Membrane Columns with Differing Selectivity. *ICSST 2007*, Beijing, China, 14–16 October.

47. Ntunka, M. . Kauchali, S., Hildebrandt, D., Glasser, D. (2007). Investigation of Distillation Processes using the Attainable Region Approach. *ICSST 2007*, Beijing, China, 14–16 October.

48. Asiedu, N., Hildebrandt, D., Glasser, D., Hauberger, B. (2007). Batch Distillation Targets for minimum Energy Consumption. *ICSST 2007*, Beijing, China, 14–16 October.

49. Abbas, R., Kauchali, S., Hildebrandt, D., Glasser, D. (2007). Column Profile Maps for a Dividing Wall Column Using a Non-Ideal System. *ICSST 2007*, Beijing, China, 14–16 October.

50. Abbas, R., Kauchali, S., Hildebrandt, D., Glasser, D. (2007). Experimental Validation of Column Profiles Maps using a Petlyuk Column Under Total Reflux Conditions for the Acetone/Methanol/ Ethanol System. *ICSST 2007*, Beijing, China, 14–16 October.

51. Patel, B., Hildebrandt, D., Glasser, D. and Hausberger, B. (2007). Coal-to Liquid: An environmental friend or foe? Proceedings of the *24th International Pittsburgh Coal Conference*, Johannesburg, South Africa.

52. Peters, M., Seedat, N., Hildebrandt, D. and Glasser, D. (2014) From concept to design: the use of membrane residue curve maps to characterize and design membrane processes, *Distillation and Absorption.* 2014.

53. Hildebrandt, D. and Fox, J. (2014) Addressing a Design Defect: Process Targets and Flowsheets, *FOCAPD 2014.*

54. Sempuga, B.C., Hildebrandt, D., Glasser, D. and Seedat, M. (2014) Designing a Waste to Energy Plant for Informal Settlements. *FOCAPD 2014.*

55. Liu, X., Patel, B., and Hildebrandt, D. (2015) Water free XTL processes: Is it possible and at what cost? 12th International symposium on Process Synthesis Engineering and 25th European Symposium on Computer Aided Process Engineering, Copenhagen, Denmark, 2015

56. Moreroa, M., Hildebrandt, D. and Matambo, T. (2018) Aerobic Bioremediation of Ficher-Tropsch Effluent – Short Chain Alcohols and Volatile Fatty Acids. Proceedings of the World Congress on Engineering and Computer Science 2018 Vol II WCECS 2018, October 23-25, 2018, San Francisco, USA

PATENTS

TUBULAR REACTORS

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