

2021—Rocket Man..... Elton John

Letter from the Editor...

Welcome to the 2021 edition of the:

“InnoVenton Times”.

This past year rolled on with Covid still hanging about, the university made every opportunity for staff to get vaccinated, making our return to a sense of “normal” more possible. Our hand rub sanitizer testing continued but the larger manufacturing projects came to an end enabling us to focus on our stakeholder commitments with more intensity.

This edition includes a summary of one of our biggest projects for the DSI which came to an end; The Coalgae project. A promising development from that work has been the establishment of a Biorefinery Program at InnoVenton. We also take a look at developments and highlights for some of the Technology Development Projects completed during the year.

InnoVenton developed and presented three Short Learning Programs to SME’s these were; “A practical introduction to IoT and user interface programming”, “An introductory guide to Cosmetic Formulation” and “Process Safety”. These will all be on offer to interested parties in 2022.

As a result of sound Health and Safety protocols implemented at InnoVenton, no serious incidents occurred at the institute, this can also be attributed to everyone’s active commitment to creating a safe and healthy work environment for all.

The universities Technical Services, ICT and Security Departments are to be commended for continuing to provide services under trying conditions.

Online communication platforms have allowed meetings, training, staff development and customer interactions to continue despite restrictions. We trust that going forward, more opportunities for “mask to mask” engagements will be possible.

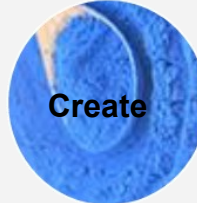
In acknowledging our stakeholders; thank you for supporting the Team at InnoVenton, you play a key role in ensuring the sustainability of the institute and enable us to contribute our expertise to several areas in the Bio economy and Technology space.

Much has been achieved through our joint initiatives.

To our staff, thank you for your grit and determination that has seen us sail through 2021 and on to a

new chapter in the life of InnoVenton. Hard work, dedication, sacrifice... you don’t often have one without the other. I trust you will enjoy seeing your work showcased in this Newsletter and will have a renewed sense of pride, unafraid and have courage to tackle lifelong learning experiences.

Delight and surprise our customers. Amaze our stakeholders. And always remember, “the confidence to show others what you do and how to do it, in a way that enables them to do a better job than you did, shows true leadership and leaves a legacy ”...Dr Melissa Gouws



COALGAE® ACCELERATED TRANSPORT FUELS

—Dr Gary Dugmore and Mr Peter Grant

At the end of this three-year DSI Project we are happy to report on the final state of affairs related to the project outcomes. The Coalgae® technology has been proven by means of algae cultivation and briquetting. Coalgae® briquettes meet the specifications, namely, wet and dry strength and ash fusion as stipulated by coal users. The briquettes qualify in terms of combustion efficiency and ash fusion for combustion in boilers. Coalgae® briquettes also qualify for gasification and syngas, where syngas is obtained from Coalgae, as is the case with base coal. Nevertheless, Coalgae® has not proven to be financially viable...not yet anyway, a few things would need to be set up. For example, changes need to be made to legislation regarding the biomass content in solid fuel combustion. If the coal price continues to increase steadily in a sustained manner, then Coalgae could be a cheaper alternative. There would need to be a breakthrough in increasing algal yields to rates that exceed natural growth rates to ensure an adequate supply of biomass for the Coalgae® briquetting process.

Another way we intended to improve the Coalgae business case was through the development of Downstream products, as this was not the case these can be considered as viable stand-alone businesses.

One such business case was for an Algae based fertilizer.



The Business case was changed from bulk agricultural fertilisers to serve a smaller high value home gardener market which can compete financially with existing biofertilizers. The smaller algae farm and small plant is more affordable, models predict an Internal Rate of Return around 20%.

AlgaeVite, an algae based pelletised fish food is another such example. This business package stands the best chance of commercialisation at an existing small production fish farm or SMME. Investment costs will be low and the product can be tested by the farm for market acceptance. The predicted Internal Rate of Return is around 18%. There could also be a business case for export, perhaps even internationally.



In terms of Gasification and liquid fuels from Coalgae, where at one stage the project was far behind schedule, we managed to complete the deliverables. A fixed bed gasifier and syngas analyser, producing syngas, were commissioned. A high pressure hydrotreater reactor system and a catalytic reactor system, which produced syngas, were also commissioned. We managed to make successful Fischer-Tropsch (syngas) and Hydrotreater catalysts. Another notable achievement was that the patent, now granted WO/2015/075639 on

Processing carbonaceous materials, was defended.

During the execution of this project InnoVenton developed capabilities, skills and established Assets to support the project and add to the expertise at the institute, these are:



- ◆ An Algae and aquatic bacteria cultivation and harvesting system suitable fresh or sea water
- ◆ A Microbiology laboratory for selecting and culturing microorganisms
- ◆ 4IR: Cell phone-based pond monitoring and control system
- ◆ A Gasifier for coal, coal-biomass and pelletised biomass with syngas analyser
- ◆ A Catalytic reactor system for heterogenous catalytic processes
- ◆ A Hydrotreater catalytic reactor for liquid fuel upgrading and oxygenate free biodiesel
- ◆ Catalyst preparation and testing techniques
- ◆ Staff members were trained in scientific techniques, technologies and 'Soft techniques' for example; risk assessment, safe work procedures, experimental planning and budgeting and project management. These are skills required in industry and relate to the OHS Act.

Across the duration of the project, 24 in-service trainees and interns were trained, 3 PhD's were awarded and 6 Publications produced.

Congratulations to the Project Team for the mammoth effort that was undertaken to ensure that the deliverables and objectives for this project, initiated by Prof Ben Zeelie, were honoured.



Microalgae Technologies Research Centre (MARC)

___Dr Gary Dugmore

Previously reported progress:

Stabilization by HDO on A-grade coal pyro oil is complete, high temperature stability 200°C is complete. We have distilled raw FT liquid into a petrol and kerosene/Jet fuel fractions. Gasifier and FT platforms for lab scale equipment are optimized, unit processes have been documented.

Updated progress:

GTI have completed the test gasification of 3MT Coalgae and conversion of syngas to produce liquid fuel. Samples are en- route to Inno-Venton for further processing and testing. An existing fixed bed reactor was modified to enable hydrocracking of stabilized pyrolysis oils at 190 bar H₂ pressure and 409 °C, Hydrotreated and distilled oil have been successfully hydrocracked using a laboratory developed catalyst (NiMo on amorphous silica-alumina support).



Figure 11: GTI Coalgae Hydrocracked Oil



Figure 12: A-Grade Coal Hydrocracked Oil

Way forward: Further steps towards commercialization of our algae growth system with a Bioremediation of effluent water with microalgae by producing biomass for use in a biofertilizer formulation project, funded by the DSI Industry & Environments Directorate in collaboration with Omnia. Compiling a Feasibility Study Grant Application with Appalachian Regional Commission (ARC) POWER. As well as discussions and NDA with entrepreneur, Paul Rubidge, regarding technology transfer of coal fines beneficiation and photobioreactors.

To check out more of the technical studies see the pg. 8 column by Dr Anna Collins on Pyrolysis.

BIO ECONOMY: Low cost Spirulina Cultivation

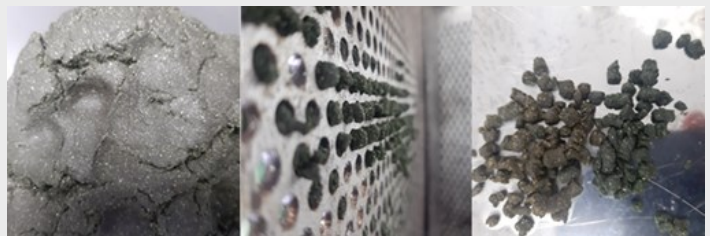
___Dr Carla Kampman

This project received funding from the Technology Innovation Agency Agricultural Bio-economy Partnership Program and proposes to demonstrate a low tech, cost effective, high yield Spirulina cultivation system based on a simple bucket system (photograph below) to produce fish (animal) feeds. The fish feed formulated, replaces all the fishmeal in the base formulation with Spirulina biomass to produce a



feed that is comparable to commercial feed in terms of pellet size and protein composition.

Tilapia are top feeders, which implies that they instinctively feed on floating food sources, rarely from the pond floor. Therefore, the formulated Spirulina-containing pellets need to float for them to be accepted by Tilapia as a food source. Processing fish feeds into pellets using conventional compression methods produce dense pellets, which sink and are therefore unfit for purpose. Aquafeed pelletizers, such as the DGP40 unit at InnoVenton, are designed to steam and puff pellets. Pellet size can be altered by simply using a different die size, offering flexibility in terms of the target fish size or age. The aim is to run the formulated fish feed through the aquafeed pelletizer by the end of January, and to test whether the floating pellets are palatable. The next phase of the LTS project is to conduct training on the full production line, from seeding through to producing the final fish feed pellets.



BIO ECONOMY: Phycocyanin production and extraction



The project aims to optimise the production of phycobiliproteins, particularly phycocyanin, from *Arthrospira*. The project investigated and optimised methods that affect phycocyanin production and extraction from the protein complexes through the comparison of various protein extraction methods and phycocyanin release.

The results achieved indicated that the process proposed may be novel with an inventive step related to separation of cellular components. An initial Market Study, Technology Transfer and Technoeconomic Assessments, indicates that further technological activities need to be undertaken. A focus on optimizing the proposed process, improving the economics, then scaling up the process to improve product quality and stabilization is required. The aim to development the preliminary technology package through pilot scale production (TRL 6) for eventual deployment by an entrepreneur.

BIO ECONOMY: Biofertilizer Formulation from Effluent Grown Algal Biomass



The aim of this project was to develop a liquid extract biofertilizer product from *Spirulina platensis* biomass in collaboration with Omnia. We were able to easily rupture the cells to liberate cell contents and then separate a water emulsion of cellular contents from diatomaceous earth from which an aqueous *Spirulina platensis* extract was obtained. This liquid extract was then preserved. The operating discipline and process control for the integrated pond trial is in place and set up to evaluate the production rate and biomass quality.

VACINATE, DON'T PROCRASTINATE

InnoVenton put prescribed measures in place to ensure that we were able to continue operating during every "Covid level" introduced by the country. Wearing masks, an emphasis on personal hygiene, daily screening, checking in/out and social

distancing processes are still being observed. Now that a vaccine is available, we encourage all our staff, customers and stakeholders to get vaccinated to protect their loved ones and themselves, enabling our economy to start recovering from the onslaught of the pandemic.



Milky Way Word search

For those of you who feel lost in space, try a galactic word search to soften your landing.... Or do some colouring therapy.

MARS ROCKET
SPACE ASTEROID
ALIEN STAR
MOON PLUTO
NEBULA LUNAR

K	L	T	U	V	W	E	E	A	L	U	N	A	R	Z	U
K	A	P	E	S	V	B	M	A	Q	J	G	C	L	G	I
M	S	K	E	G	O	W	D	K	O	S	E	U	R	N	M
L	T	N	M	L	J	K	X	I	M	S	Y	P	H	S	D
S	E	R	S	D	A	H	N	W	A	H	I	C	L	B	O
V	R	H	S	I	G	V	X	D	R	D	E	V	R	E	X
R	O	H	R	B	R	B	Q	U	S	P	A	C	E	F	L
F	I	P	A	F	M	T	A	R	I	P	O	A	S	I	W
Q	D	L	O	R	O	C	K	E	T	A	I	G	K	V	F
K	K	O	S	L	O	N	S	T	L	H	Q	A	O	Y	K
N	B	Y	E	I	N	H	H	U	S	W	E	D	H	J	R
J	F	C	Z	M	V	O	B	B	O	L	R	P	T	S	R
E	U	H	A	S	D	E	Q	R	C	B	P	L	U	T	O
W	K	Z	R	X	N	E	I	L	A	L	S	G	E	A	K
O	C	F	E	S	G	W	I	K	J	H	U	D	S	R	M
J	Q	S	O	H	K	A	G	F	V	Z	A	M	E	X	R

More HAND SANITISER

The demand for hand sanitiser continued into 2021. Covid continued to surge and talks of a vaccine were starting to materialize. We did our part by making sure another 7000 bottles were distributed to university students and staff. The impact of the 2020/21 Sanitiser projects at InnoVenton were acknowledged at Parliament in May, this was welcome recognition for staff who had gone the extra mile to do their bit to help our country fight the pandemic.



InnoVenton continues to respond to client needs through provision of technology support services that include **consultation & feasibility studies, non-routine testing, prototyping & toll sample preparation, technology demonstration and short learning programs.**



Photo: Dr Melissa Gouws decanting sanitiser for Nelson Mandela University students.



IS YOUR HAND SANITISER DOING ITS JOB?

Alcohol content is key.

InnoVenton



2021 TS projects

Africa Loop- Repurposing Citrus Waste

The client is in the process of developing a grit hand soap from waste that comes out of a citrus processing plant situated in the Sundays River Valley. The waste consists of perlite and citrus oil, the combination of which having provided good results in terms of their capacity to cut through grease, a function of the abrasiveness of the perlite, but aided by the citrus oil content which also acts as an emollient. Our client needed help to develop a formulation which is more comparable to the soaps currently on the market

Algaeolix – Haematococcus Scale Up Cultivation

The clients vision is to build a business with the capabilities to grow microalgae biomass (not only *H. pluvialis*) in a cost-effective manner and to extract valuable components for the nutraceutical- and food industry markets. The exact product range and processes are to be established.

InnoVenton will do a literature review, collaborate with and assess the skills transfer required. We want to enable the client to develop a process, for the pilot scale cultivation of *Haematococcus pluvialis* and in the end manufacture astaxanthin.

Development of Building an IOT prototype Workshop

The course aims to explain the generic steps involved in building an IOT prototype, by practical application following the following steps:

1. Identify Goals and objectives
2. Research on IOT Hardware & Components
3. Design & Acquire the IOT Components
4. Define Data Streams
5. Fix Bugs

Development of Formulating Creams and Lotions Workshop

The Formulating Creams and Lotions workshop was offered as a practical course, with a strong emphasis on emulsions, which is one of the fundamental aspects of cosmetic formulation science and is one of the most common problems encountered by novice formulators.

Splash be gone - GIP



The analysis of the suitable ingredients that can be added in the formulation of Splash Be Gone that will reduce the surface tension of the water whilst also changing the viscosity of the water, to ensure that splash back produced is eliminated, requires a

surfactant combination that produces dense foam and foam that will last a prolonged time. Photo: Foam Splash Be Gone Formulation. It was found that the packaging is also an important factor for Splash Be Gone toilet product, the foam product formulated should have a

bottle with a foam applicator top that ensures the foam released is of the desired product parameters, the recommended container should be a foam aerosol spray container or the plastic foam applicator with small tops as they will produce small bubbles which in essence produced dense thick stable foam.

In-Service Training Project Development

The aim was to develop a structured, focused, practical training program, which can be offered to



Analytical Chemistry Diploma students seeking to complete their qualifications and/or graduates wanting to improve their laboratory skills to carry out post graduate laboratory work, and companies who wish to improve the skills of their employees. Special attention will be given to Good Laboratory Practice, and how that relates to a Quality Management System.

The hypothesis that, an intensive structured programme with focused individual training, will result in analytical chemists with credible knowledge, which they can share and report confidently, has proved successful. A contributing factor to this success, was the positive, willing to learn attitude of the students.

Photo: Mr Michael Du Preez and Miss Khanya Ncapayi, Interns 2021.



InnoVenton Collaborations

Would you and your Team like to collaborate with
InnoVenton ?

For more information contact Dr Gary Dugmore .

E: Gary.Dugmore@mandela.ac.za /T: 041 504 3482

InnoVenton Downstream Chemicals Technology Station

From its inception the Technology Station activities at InnoVenton have been fully integrated into the larger institute to maximise the impact that we have externally.

InnoVenton/DCTS strives to provide specific technology support and innovation in the areas of:

- Product replacement; extension or formulations
- Improving production/process flexibility;
- Reducing production lead times; Reducing environmental impacts; improving product quality; improving working conditions/safety;
- Providing expert technology, analytical, testing services; and
- Providing custom designed short learning programs for industry
- Kilo-lab, Distillation and Process Plant Facilities
- TIA Seed Funded Projects, Major Projects and Youth development Projects.

Enquiries: Mrs Louise Hamilton
Technology Station Manager
T 041 504 3953

R950K for student bursaries

During 2021 InnoVenton managed to raise and pay over R950 000 in bursaries to under-graduates. The support for our students came from a wide variety of sources; scholarships and grants from industry, accommodation and study-fee support from the Chieta, internships from TIA, and some internal InnoVenton funds. AECI, BASF, Clariter and Heraeus sponsored students so that they could complete their in-service training in 2021 and gain some industry experience. With Covid, an ever-present threat to the students being able to complete the year, the generosity and support of our stakeholder industries made all the difference. - Dr Shawn Gouws.

InnoVenton

Product Formulation

Have you ever wanted to Formulate your own product?. But weren't sure where to start.?

InnoVenton can help you understand how to mix and blend various components in a way so that they don't react but instead interact to provide a final product with very specific desired properties or functions.

You would have access to Chemical Research and Development expertise and Technology Support as you design your formulation.

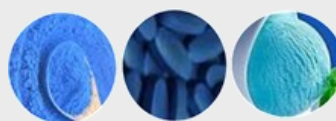
Some products developed in our laboratories include: personal care products, household cleaning products, pharmaceutical products, industrial chemical products and water treatment products to name a few.

We would help you design and optimise your formulation.

Enquiries: Mrs Louise Hamilton Technology Station Manager T 041 504 3953

InnoVenton

Our role is to provide technology support services, skills development training and a technology development capability for basic research and client projects. This includes improving the alignment of basic research and formal teaching with needs.



Essential Sterolin PROJECT.

This project focused on the Development of a process to produce of β -sitosterol- β -D-glucopyranoside at scale.

Process development and optimisation was needed to inform an efficient, robust, economical and practical technology, which can be transferred to the manufacturing entity. The process has been proven by Imagicchem on a kilogram scale using standard laboratory type equipment. Imagicchem are no longer able to produce the product for ESP. ESS have an existing market and business for this product and required a facility to manufacture the product to enable continuation of



supply. The volume of product required is small and could therefore be produced at DCTS in annual campaigns if the technology transfer is successful.



A batch trial of β -sitosterol- β -D-glucopyranoside was conducted, using our kilo lab facility to determine the performance of the process at DCTS. From the trial(s) an accurate projection of product quality, process efficiency and conversion cost was possible.

River Bio Science- Ant Bait



Our client requested assistance with Scale-Up and manufacturing of an Ant bait formulation, they had started commercial production, after the installation of a dispensing (packaging) system. With the interventions from InnoVenton production targets of 2000kg now have the potential of being increased to about 25 000kg.

Photo: Miss Siphosethu Dylvane (Intern) preparing

a sample of product.

PYROLYSIS – Microalgae Technologies Research Centre (MARC) _____ Dr Anna Collins



Upgrading of hydrocarbon products through hydrogenation processes to more valuable/ desired products have been done in petroleum refineries (Garba & Galadima, 2018). Products derived from coal sources may require more than one stage of processing to achieve complete hydrogenation; due to the concentration of oxygenate- and aromatic compounds (Furimsky, 2000). Hydrotreating of a hydrocarbon feedstock is a multi-functional process in which the content of nitrogen, sulphur, oxygen, metals, and aromatic groups are reduced (Kamyab, 2016). Catalysts used during the conversion processes are dependent on selectivity, ease of activation, and processing conditions. Acidic catalyst supports, such as amorphous silica-alumina, contribute to the selectivity and efficacy of the catalyst by promoting cracking reactions (Robinson & Dolbear, 2006).

At InnoVenton, crude oil was prepared through low-temperature pyrolysis of coal and GTI Coalgae® sample pellets; and collection of subsequent condensable volatiles. The oil was vacuum distilled, to an atmospheric equivalent, with the final temperature of 300°C to separate the medium- to light oil fractions from the heavy tar components.

Hydro-deoxygenation of the medium- to light distillates was performed in an autoclave at 90 bar hydrogen pressure and 300°C. A sulphided nickel-molybdenum catalyst on alumina support was prepared and used in the HDO process.

We designed and commissioned a high-pressure and temperature hydrotreating catalytic reactor system. This reactor system can operate at up to 150bar hydrogen pressure and 400°C and is the only hydrotreater available for contract research in South Africa. We produced our own nickel-molybdenum catalyst supported on amorphous silica-alumina, which was also prepared here, that was highly active during hydrotreating of the oil samples. Figure 1(a) presents the catalyst before the calcination process and Figure 1(b) the catalyst after calcining.

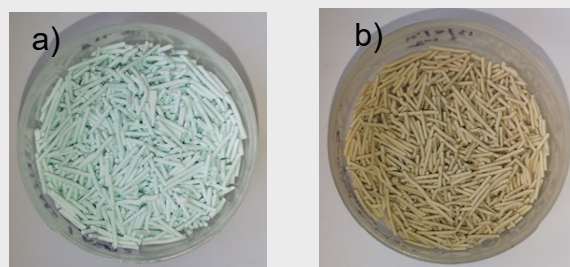
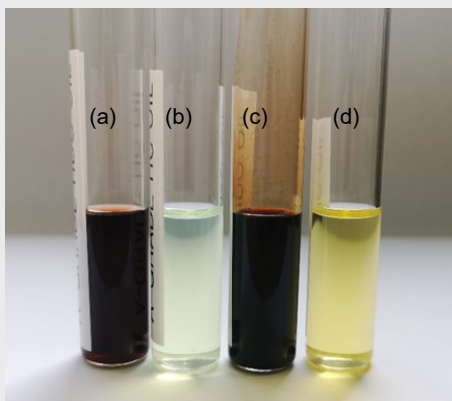


Figure 1: Nickel-Molybdenum catalyst used for hydrotreatment (a) uncalcined and (b) calcined

Figure 2 shows the stabilized oil samples obtained from the coal and GTI Coalgae® samples; where Figure 2(a) and (c) represent the HDO stabilized oils and Figure 2(b) and (d) the hydrotreated oils.

Figure 2: Stabilized oil samples; (a) Coal HDO oil, (b) Coal hydrotreated oil, (c) GTI HDO oil, and (d) GTI hydrotreated oil



Elemental analysis was done on the oil samples to determine the extent of nitrogen, sulphur, and oxygen removal from the hydrodeoxygenated oil by subjecting it to the hydrotreating process. The results showed that nitrogen, sulphur, and oxygen content was reduced by 31%, 84%, and 83% for the oil obtained from the coal sample; and 43%, 96%, and 54.9% for the oil obtained from the GTI Coalgae® sample.

Comprehensive two-dimensional gas chromatography, coupled with a mass spectrometer, was done on the oil samples to determine the extent of conversion and upgrading hydrotreatment had on the HDO oils. A visual comparison of the blob diagrams shows that hydrotreatment of the HDO stabilized coal oil decreased the phenolic-, aromatic-, cyclic-, nitrogenate- and oxygenate compounds while increasing the paraffin and olefin compounds can be seen.

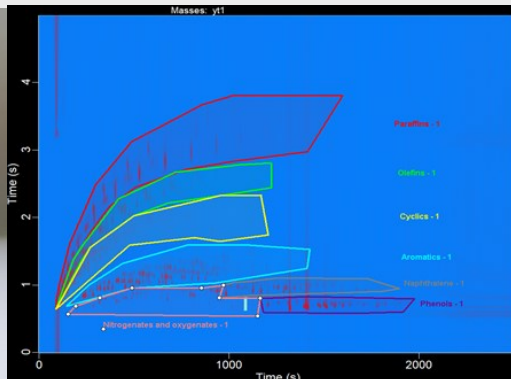
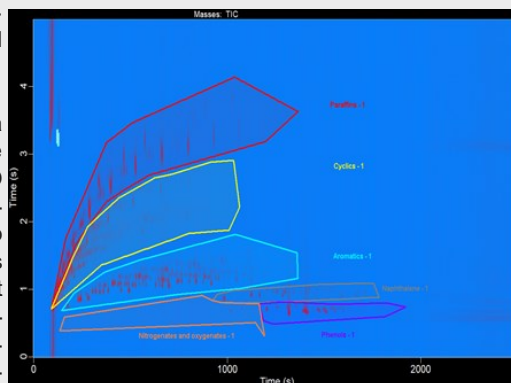


Figure 4: Blob diagrams for the HDO and hydrotreated GTI Coalgae® oil samples

The decreases may be due to several reasons such as isomerization of compounds, bond saturation, heteroatom removal, or ring-opening. The increases in less complex molecules, such as paraffin and olefins, suggests conversion and upgrading of the more complex compounds during processing.



References
 Furimsky, E. 2000. Catalytic hydrodeoxygenation. *Applied Catalysis A: General*, 199 (2):147-190.

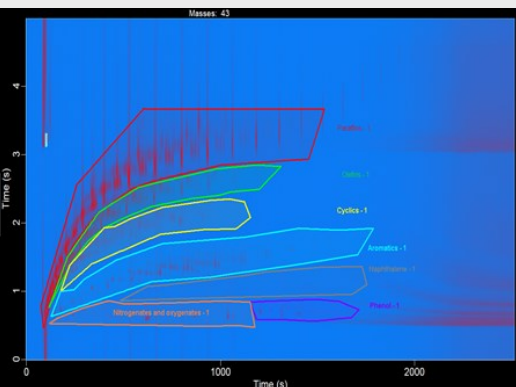
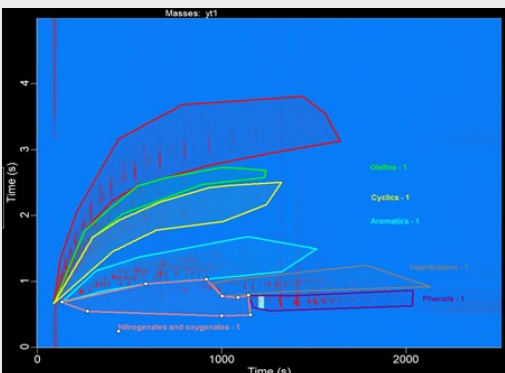


Figure 3: Blob diagrams for the HDO and hydrotreated coal oil samples

Hydrotreatment of the HDO stabilized GTI Coalgae® oil showed decreases in the phenol-

ic, naphthalene-, olefin-, nitrogenate-, and oxygenate compounds with increases in paraffin and cyclic compounds.



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InnoVenton Presents

An introductory Guide to Cosmetic Formulation

Are you interested in setting up your own natural skin care business, but don't know where to start? Join us for a day to find out. **You don't even need a scientific background.**

The course will cover

- Evaluating your formulation idea
- Introduction to formulation terminology and the language of formulation
- Packaging and Regulatory requirements

Who should attend? Inventors and entrepreneurs who would like to acquire basic tools to better understand and evaluate their idea



Formulation Science Showcase 2021

The BSc Formulation Science Students, "Class of 2021" exhibited an inspirational range of products at their annual product showcase held in December at InnoVenton. From blue eyeshadow to fizzy flush toilet balls each student was challenged to come up with a formulation that had a unique selling point, present the idea supported by marketing material and make a sample of the product for evaluation. The theme of this year's projects centered on the use of phycocyanin, a blue pigment...so you can just imagine what the formulated ice-cream looked like.

They developed business plans to support their products and had to "pitch" their ideas to a panel of critics who served as "potential investors". Dr Nicole Vorster is the programme's coordinator, for more information feel free to contact her at

Nicole.Vorster@mandela.ac.za



Product Photos from top to bottom showing some of the products developed by the Formulation Science students in 2021.

Introducing ShaSha Skin-care by Vuyisa Ntsundwana.

Charcoal /herbal toothpaste based on a traditional root was formulated by Deborah Balogun.



A Body lotion with yeast extract was presented by Lerato Nyelele.



Photo: Formulation Science Class of 2021 with their lecturer, Dr Nicole Vorster (front row, middle).



Fizzy Flush was formulated by Yusra Carloo.

Eyeshadow with phycocyanin was presented by Nandipha Tyhali



Blue Ice cream with phycocyanin as a colourant was made by Anneke van Rooy.



Collaboration with Endress + Hauser

Dr Shawn Gouws

The Diploma for Chemical Process Technology was initiated by the Nelson Mandela University in 2013. The first intake of students has grown from 21 to over 75 for the 3-year study period. The program accommodates grade 12 students and past employees from industry who have chosen to further their academic career path and enhance their career in the job market.

The course content is designed to assist the learning and teaching pedagogy to develop an all rounded student prepared for their chosen career path. The modules taught cover fundamentals such as inorganic, organic and general chemistry, introductory physics and mathematics all form a foundation. Successive modules in process chemistry build a platform of knowledge for the student preparing them for the work environment. The other main modules form part of the core content, these incorporate technology material, principles of chemical engineering and process control.

Over the last five years several props were added to enhance the teaching of the technology section of the course. This enables the students to have a more practical approach during their development as chemical process operators.



Photo: Dr Shawn Gouws and Mr Leon Nel who designed, built and set up this demonstration unit for the students.

One such endeavour has been in collaboration with Endress + Hauser who donated several pieces of equipment towards the building and commissioning of a process rig, that will be used to set up a basic process unit for the manufacture of cheese. This process rig will serve as a practical demonstration of several aspects, such as safety features, process controls, and troubleshooting. The equipment donated includes the following: A station for measuring pH and conductivity. An Advanced Graphic Data Manager device connected to the PC con-

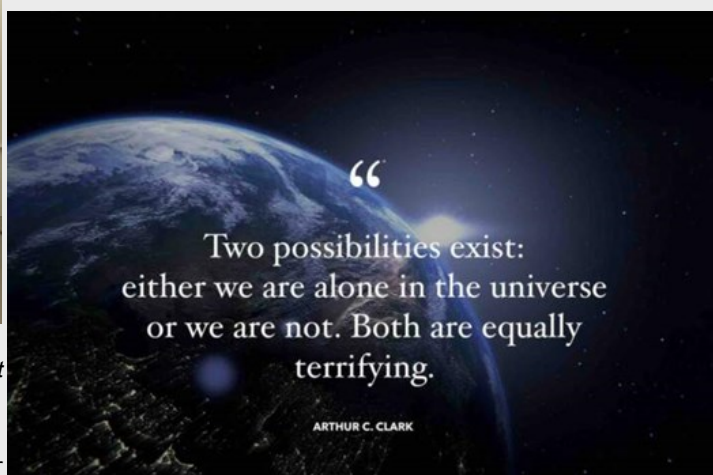
trolled process rig will be used for set-points, do trending and find faults through troubleshooting whilst be connected to various inline thermocouples.

The process layout of the cheese unit makes use of utilities and principles related to heat exchange, temperature control and handling volumes of liquids. This food-based processing system is an ideal, safe way to demonstrate these concepts to students. Besides, in the end, they get to enjoy the efforts of their labour and have a product to show and share.



Collaborations like the one this program enjoys with Endress + Hauser, demonstrates industries' commitment to work integrated training and work readiness programs. This benefits the students, as they pre-

pare for the working world, and industry, who looks to employ a more skilled work force keeping pace with technologies as they evolve in the process environment.



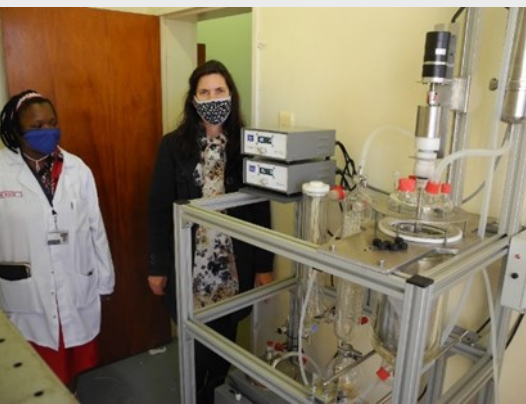
InnoVenton Services

InnoVenton continues to respond to client needs through provision of technology support services that include consultation & feasibility studies, routine analytical testing, non-routine testing, prototyping & toll sample preparation, technology demonstration and short learning programs

New Equipment Acquisitions

The **DGP40 Fishfeed Pellet machine** was purchased through Ecotao Enterprises and has a feed rate of 30-50 kg/h. It was purchased for the Low-Tech Spirulina (LTS) project, which aims to develop the process of cultivating Spirulina in a low-tech bucket system, with the downstream incorporation of the harvested and processed biomass into a Tilapia feed formulation. The aquafeed pelletizer is earmarked to become one of the Technology Demonstrators InnoVenton aims to establish as part of the DSI funded/TIA administrated Biorefinery project.

A **Soxhlet extraction unit** was purchased from Glass Chem. The custom-built equipment installed is a pilot-scale Soxhlet extractor for extraction of bioactive compounds from olive pomace and other biomass/agricultural waste material/plants. The equipment was bought



with TIA Tech Dev funds for an aquaculture project in which olive extracts will be added to fish feed formulation as antioxidant to stabilise the oils in the feed. The olive extracts will also be used in cosmetic products, and other applications still to be identified. Photo:

Dr Nicole Vorster and master's student, Ms Ndumi Koza will be working with this unit.

DARE TO BELIEVE...



FOR MY PART I KNOW NOTHING WITH ANY CERTAINTY, BUT THE SIGHT OF THE STARS MAKES ME DREAM. — VINCENT VAN GOGH

2022 Biorefinery Program

This proposal to the DSI I&E embeds a 3-year programme at InnoVenton alongside the existing technology station and was approved in October 2021. The program will provide a stable platform of resources to develop, package, transfer and support microalgae technologies and products to manufacturing and commercial activity through SMME's, entrepreneurs, and larger commercial entities.

The key elements of the program align with the countries Bioeconomy strategy and with InnoVenton in terms of its position in our Higher Education Institution (HEI) Faculty of Science and as a Host Technology Station. So, through the program we are now in a position to:

- ◆ Develop Microalgae as a renewable feedstock
- ◆ Develop and create productization steps of knowledge for the value chain
- ◆ Leverage concepts & research from HEI
- ◆ Transfer technologies and products to manufacturing and commercialization through SMME's, entrepreneurs, and larger commercial entities
- ◆ Develop integrated biorefineries from microalgal feedstock

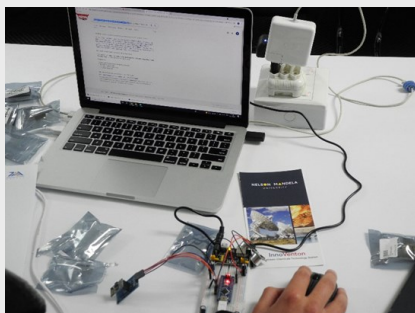
In the first year, our objectives will be to compile and set up technology transfer documentation, technology demonstrators, develop skills, engage with stakeholders creating awareness, and offer technology transfer support. In the two years that follow we will endeavour to offer:

- ◆ Value propositions: cultivation technologies and product line formulations,
- ◆ Packaged Microalgae Biorefinery concepts,
- ◆ Formulation pilot facilities,
- ◆ Fractionation pilot facilities and process technology development and Biochemical/chemical derivatization product & process technology. A pipeline of market pull and knowledge push concept notes/proposals that can be resourced through Council funded academics/students/NRF at TRL1-4 and Research & Development projects resourced through HEI participation and,
- ◆ Skills Development & Training can be actioned by developing and delivering appropriate Short Learning programmes to transfer skills and disseminate technology.

The Biorefinery program is an exciting new stage in the growth of microalgae technology in South Africa at InnoVenton.

InnoVenton Workshop

A practical introduction to IoT and user interface programming



Join us for two days practical introduction to the concept of The Internet of Things, and microcontrollers programming with cell phone applications

What the course will cover

- Understand and explain the concepts of IoT, microcontrollers and communication methods
- Programme an Arduino board
- Be able to communicate with their chosen application via a cell phone

Who should attend?

Individuals interested in learning about IoT for professional or personal use
No prior knowledge or experience of programming or electronics required

Course Requirements

Laptop with an internet connection and a Cellular phone

BOOK NOW AS SPACE IS LIMITED

For more information and bookings please contact:

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Facilities, Safety, Health & Environment

InnoVenton renewed its commitment to Health and Safety issues at the institute. Routine inspections together with keen cooperation from staff enabled us to enjoy a tidy, safe working environment. The university SHE office should be thanked for their active participation in ensuring that we meet fire safety requirements for our operations. Responsible waste management has been a theme during the year. Each chemist has taken care to “do-no-harm” to the environment when we have to dispose of potentially harmful substances or waste in general. Reduce, Reuse and Recycle continue to be principles on which our waste management is based on. Special thanks to Chem-Solved for their ready co-operation in safely removing spent materials from site.



Reorganising workspace, removing redundant assets, striving for a fit-for-purpose workspace and reconfiguration of our Chemical Stores have been some of the activities we have undertaken to create space for process demonstrations at InnoVenton.

Black Hole SUDOKU

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7				9				4
	3	1			4	6	7	
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	7			6	1	9	2	
	8	5		2		7		

Each row, column and square (9 spaces each) needs to be filled out with the numbers 1-9, without repeating any numbers within the row, column or square. After all that heavy reading you may need something to flex your brain a bit.

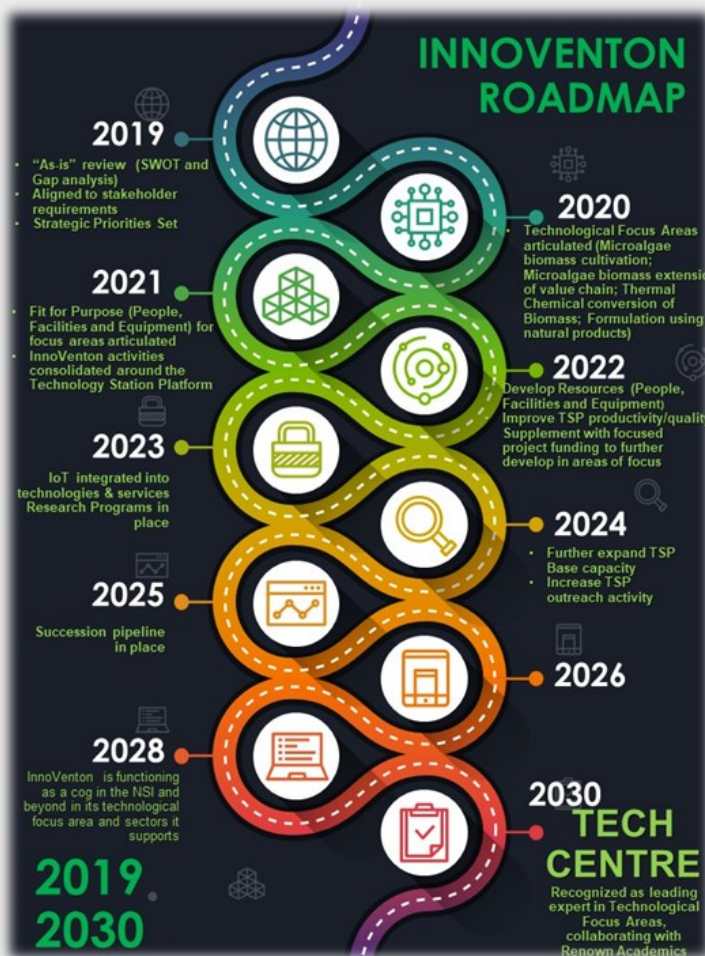
InnoVentons

STRATEGIC DIRECTION

Our role is to provide technology support services; skills development training and a technology development capability for basic research and client projects. This includes improving the alignment of basic research and formal teaching with needs. Our strategic Priorities are:

- To Capitalize on the experience of our staff
- Leverage our reputation and resources
- Promote our core activities
- Increase collaboration within the Faculty
- Align research with stakeholders requirements
- Build core technology capability at InnoVenton
- Ensure excellence and efficiency
- Increase customer focus
- Optimise the balance of activities (services vs technology development vs research)

What the future could hold...



InnoVenton

Dream. Innovate. Create.
Specialist Analytical Services

Gas Chromatography

- GCMS, (Fingerprinting comparison of volatile/semi-volatile organic compounds)
- SIMDIS, (Simulated Distillation of Fuels)
- GC x GC, (Separation of complex hydrocarbon mixtures)

Coal and Biomass Analysis

- ◆ Thermal Gravimetric Prox-Analysis (moisture, volatiles, ash, fixed carbon)
- Calorific Value

Spectroscopy

- ◆ UV/Vis, Qualitative and Quantitative analysis
- FTIR, Raw material fingerprinting

Fuel Analysis

- ◆ Flash point, Density, Viscosity, Bomb Calorimeter
- IR, FAMES, Cetane number
- Copper Strip, Iodine Value
- CFPP, Cloud Point, Oxidation Stability
- Vapour Pressure, Distillation Points
- Energy Value, Carbon Residue, Sulfated Ash
- Methanol Content



Looking forward - 2022

2022 promises to be another project packed year. The following are a few of the main activities planned :

Biorefinery Program: The program, funded by the DSI will provide a resource platform to develop and support microalgae technologies. Setup transfer packages and product ideas for manufacturing and commercial activities.

So, we're sure you were wondering...What an Algae biorefinery is?

Well, the algae biorefinery concept represents the transformation of algae biomass through a sustainable processing way to produce bio-fuels and value-added chemical products (Trivedi et al., 2015)

Biorefineries can help in utilizing the optimum energy potential of organic wastes and may also resolve the problems of waste management and Green House Gas emissions. Wastes can be converted, through appropriate enzymatic/chemical treatment, into either gaseous or liquid fuels.



No, not this.....

but rather... something like, well.... This....



TIA Seed Fund Projects:

Flameless Paraffin: The project proposes an alternative cooking stove to the open flame paraffin fuelled cooking devices known to cause domestic fires and health problems. It would be developed as a catalytic heater that operates with no flame. The feasibility of supported oxidation catalysts suitable for affordable flameless heating and cooking devices would be investigated.

Tsetse Fly Attract: Tsetse flies are disease carrying pests causing many deaths annually. They can be lured into poisonous traps with chemical attractants. This project proposes the development of a method to manufacture prophenol from clove oil. After laboratory synthesis is optimised we would propose a scaled up synthesis at our pilot plant for trials.

Phycocyanin Development: Refinement and optimisation of the laboratory-scale process we have developed on plant scale. We continue to develop a technology package for transfer to an entrepreneur or SME.

Client Projects:

Cosmetic Formulation Improvement: Clients have requested assistance to improve formulations for body lotions and face creams using various specialized key ingredients.

SLP Process Safety

This course will provide a broad understanding of the tools and problem-solving techniques used in process safety.

The course covers different hazards found in the chemical industry, safe work permits, consequences of toxic vapours, fires and explosions the SHE considerations regarding these consequences, process design and operations, asset integrity, legal aspects, management of change and safety cultures. The format of the presentations will be on MS Teams.

Who would benefit:

- Anyone involved with a role that does not have direct line responsibility for process safety
- Anyone who would like to develop a broad understanding of process safety

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NELSON MANDELA
UNIVERSITY



Looking forward - 2022

Moon Rock Scones

Hands on time 10 minutes, plus **cooling & cooking time** about 15 minutes. **Makes** 12.

400g self-raising flour, plus extra to dust,

175ml double cream

175ml sparkling lemonade (Sprite)

Optional: Whipped cream, to serve. Jam, to serve.

Method

1. Preheat oven to 220°C. Line a baking tray with baking paper. In a large bowl, mix all ingredients to make a dough. Tip into a lightly floured surface and knead briefly to bring together. Or use a muffin pan if you have one instead.
2. Pat dough to an even 2cm thickness, then stamp out 6cm plain or fluted rounds, reshaping and stamping out trimmings. Arrange scones on prepared tray spacing apart (only if you didn't use a muffin pan). You should have 12 scones.
3. Bake for 12 to 15 minutes, until golden and risen. Cool on a wire rack. Serve with cream and jam, if you like.

*For the health conscious: Each scone (without cream and jam):
About 820kJ, 4g protein, 8g fat (5g saturated), 26g carbohydrate (1g total sugars), 1 g fibre.*



InnoVenton

Technology and Specialized Development

InnoVenton/DCTS strives to provide specific technology support and innovation in the areas of:

• **Research**

- Applied Chemistry in Product and Process Development

• **Teaching and Learning**

- Formal qualifications and non-formal short courses.

• **Engagement and Services**

- Technology Support and Demonstrations
- Prototyping and Manufacturing
- Analytical and testing services
- Quality services
- Consultation and feasibility studies

For More about **InnoVenton**

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Our Facebook page:

www.facebook.com/InnoVenton



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