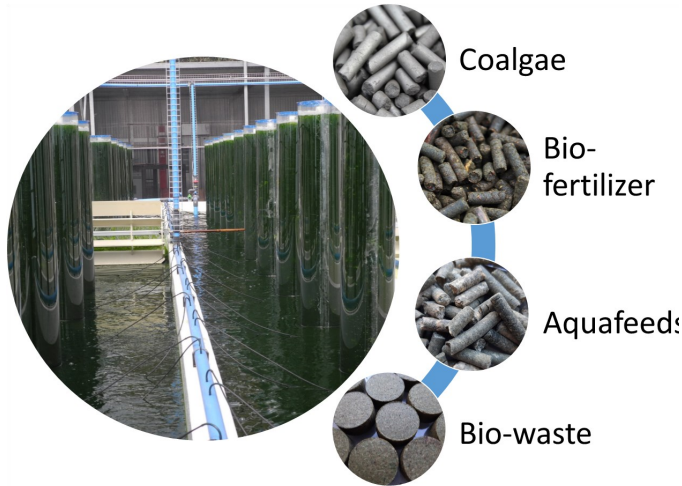


## 2019 — You Gotta be Safe (TWENTY-4-SEVEN)



### Letter from the Editor...

Welcome to the latest edition of the:

“InnoVenton Times”.

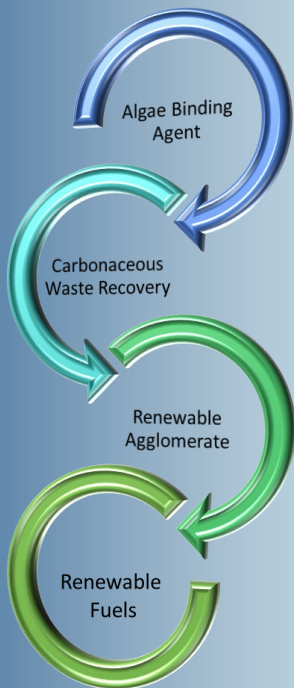
To all our readers, 2020 is sure to be another challenging year with an equal weight of opportunity.

Last year there was a focused effort to afford staff opportunities for personal and professional growth and development in the way of various technical and managerial training programs at the University. There was also a heavy emphasis on safety and safe operating procedures which continue to be integrated into our daily operations. We are in the process of developing a Process Safety and Risk course to offer our customers and stakeholders.

Developments and highlights of Technology Development Projects are emphasized in this issue. It is encouraging to see the progress made and the hard work that has been done, taking each project to the next level.

To our stakeholders, thank you for supporting and connecting with the Team at InnoVenton, your contributions, collaborations and industry relevant advice goes a long way in enabling us to identify ways that we can be of service.

To our staff, I want to encourage you to continue to find ways to delight and surprise our customers. InnoVenton will morph and evolve into a new “Avatar” which is an Engagement Entity. This, building on the foundation already established over the last 15 odd years. Remember, “making a difference in the lives of others, through the endeavors of our work at InnoVenton, shows and establishes purpose”. Always be willing to listen and hear the views of others. ...Melissa



## InnoVenton

Dream. Innovate. Create.

# COALGAE® AND TRANSPORT FUELS

By: Dr Gary Dugmore

Implementation of the technology for commercially viable production of liquid transport fuels containing a renewable fraction from Coalgae® is the overall objective of the project. It has been shown that the coal-algae agglomerate (Coalgae®) exhibits synergistic interactions between the coal and algae during thermal processing. Coalgae® has been qualified as suitable for use as a thermal fuel for power generation (Eskom) and boiler firing (John Thompson).



The current project grant funding from the DST (2018/20) targets the qualification of Coalgae® as a technically suitable and economic material for conversion to liquid transport fuels. Additionally, the project seeks to improve the Coalgae® business case through cost reduction of micro algae production and development of additional products with higher market value than thermal export grade coal.

Under the further technical demonstration and optimisation of the Coalgae® system, InnoVenton has worked over the past 18 months to reduce CAPEX, OPEX and improve the yield of algae such that a favourable impact is achieved on the techno-economic model and business case for Coalgae® as a solid thermal fuel. The estimated CAPEX has been reduced by R501m (32%) and OPEX by R116/ton Coalgae® (15%). The project aims to achieve a further CAPEX reduction of R249m (15.8%) and algae yield improvement of 0.035-0.060 g/L per day (25-42%) which, if successful, will result in a positive NPV at 15% discount rate. The project proposes to achieve this through the combination of mitigating contamination issues and addressing the current design limitation that does not allow for the scale up of the PBR component of the system. It is possible to overcome the scale up of the PBR through heterotrophic or illuminated PBR's and at the same time mitigate contamination issues by using closed vessel bio reactors. In addition to this, the project will benchmark the

current algae growth system (hybrid open pond/ open PBR) with the algae growth system technology that is available in the global market and compatible with Coalgae® requirements.

The Coalgae® system at InnoVenton has the further objective in 2019 to produce and agglomerate 3MT of Coalgae® that will be required to produce litre scale liquid fuel products and qualification of Coalgae® as acceptable feedstock for coal to liquid (CTL) synfuel process at pilot scale.

The project aims to qualify Coalgae® as a suitable feedstock to the CTL process and estimate the impact of this conversion on the techno-economic case. Liquid transport fuels may be attained through gasification, FT conversion, hydrogenation and refining.

Over the past 4 months we have made the following progress:

- commissioned a suitable test gasification apparatus obtained from NWU
- modified a test fixed bed reactor rig for FT synthesis
- prepared FT catalyst
- installed on line analysis capability for gasification and FT test rigs
- commissioned the fixed bed FT reactor
- produced and analysed mL quantities of liquid FT products (raw FT liquids)
- procured hydrogenation catalyst and prepared a 1L stirred autoclave for hydrogenation service.

The above results show that over the past 18 months the CAPEX, OPEX have been improved through review of engineering design, alternative PBR configuration and optimisation of the fertilizer feed.

## New Appointments

Dr Jackie Collins



Dr Jackie Collins, who trained as a Chemical process engineer has been appointed as a Gasification Research Technician/Assistant at InnoVenton.

Jackie has taken responsibility in the area of hydro-deoxygenation (HDO) of pyrolysis oil produced from Coalgae®; working together with Mr Peter Grant on the Coalgae to liquid fuels project. She has a PhD from NWU qualifying as a Scientist from the North-West University and came to us to complete an internship. Her biggest challenge, however, will be to assist in the design and implementation of a high-pressure reactor for HDO of pyrolysis oil under more severe conditions. Jackie likes to listen to music, drink craft beer, and obsess over her dog.

Take Your Dog to Work Day



## Blue Green Algae

By: Dr Carla Kampman

Because of our experience in cultivating microalgae, a self-funded client approached us in 2018 with his novel tray system design for the indoor cultivation of Spirulina, a blue green algae with many potential applications. The scope of work included laboratory-based experiments where various light sources were tested, followed by the construction of a scaled prototype of the modified design to establish the efficiency and operability of the system. The project was completed and signed off by the client in 2019.



## 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](mailto:Gary.Dugmore@mandela.ac.za) /T: 041 504 3482

## More than R2.9 Million for student bursaries

During 2019 InnoVenton managed to raise and pay over R1.9 Million 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, Heraeus, Orion and Umicore sponsored students so that they could complete their in-service training in 2019 and gain some industry experience.

## InnoVenton

### Downstream Chemicals

### Technology Station

From its inception the Technology Station activities at InnoVenton have been fully integrated in to the larger institute so as to maximise the impact that e could have externally and leverage the impact of the station on the institute itself.

*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



## Short Learning Programs

If your company is interested in InnoVenton presenting a tailor made Short Learning program for your staff, please contact Mrs Louise Hamilton T 041 504 3953 to find out what we could offer you.

## Marketing ... Making an impact.

**SASUF Workshop** - Dr Candace Davison presented at the *Sustainable Aquaculture development for coastal communities and food security* hosted by SASUF (South Africa- Sweden University Forum). was

**SACI EC Career and Innovation Day** - Dr Melissa Gouws presented at the SACI Eastern Cape Career and Innovation Event hosted by Rhodes University, this was seen as an excellent platform to showcase what our institute offers to students and entrepreneurs. The title of the presentation was "Taking your idea out of the lab and into industry".

**Fort Hare** -The 2019 class of Chemistry Honours students from the University of Fort Hare were taken on a tour of the Mandela University Chemistry Department, this included exposure to projects and services at InnoVenton.

**National Stakeholders** - InnoVenton attended the *National Stakeholder Consultative Meeting on Research and Innovation in Renewable Energy (held at CSIR, Pretoria)*, this formed part of the DST Renewable Energy Consultations in South Africa in preparation for an EU/AU joint program submission (LEAP-RE). InnoVenton attended the pre-LEAP-RE follow up workshop between EU and AU stakeholders in Stellenbosch.

**SAAFoST** - The institute hosted and participated in a workshop on *Waste Reduction in the Food Industry* initiated by the SAAFoST (South African Association for Food Science and Technology). Dr Nicole Vorster presented some of her work on the olive pomace project.



Above from the left: Dr Gary Dugmore, Ms Juliette le Roux from SAAFoST, Dr Nicole Vorster and Ms Adine Visser.



## New Appointments

### Miss Nolundi Maninjwa



Miss Nolundi Maninjwa was appointed as a Chemical Engineering Intern at InnoVenton in 2019 as part of her post-graduate training. Nolundi has taken responsibility for the running and monitoring of the Fischer-Tropsch reaction rig and the distillation of the liquid products. She obtained a Bachelor of Engineering degree in Chemical Engineering in 2018 at the University of Pretoria and came to us to complete her internship. Part of the challenge she will be faced with

will be the operation of Process utilities at InnoVenton like the on-line GC and Distillations to name a few. Nolundi has a quiet disposition and loves to keep her male colleagues on their toes. Some of her hobbies include going on road trips or spending the day binge watching true crime documentaries.

## National Science Week



As part of the Annual *National Science Week* events, a group of 25 learners were introduced to the concepts and practicalities of microalgae cultivation at our demonstration facility. They were also given a presentation introducing the Chemical Process Technology Diploma and the BSc Formulation Science programs hosted in the Faculty.

## New Equipment Acquisitions

During 2019 the local chemical industry contributed and re-sourced equipment to the value of R 2 million for training and projects, namely:

**Crystallization unit:** AECI sponsored the purchase of a new Crystallization Unit valued at R460 500 from Edu-Science. Dr Shawn Gouws and the 3<sup>rd</sup> year CPT students are going to have some fun this year during their practical's experimenting with crystallization techniques.



**SCADA PLC Control System:** AECI and BASF have made it possible for InnoVenton to secure an R1.2M upgrade on their SCADA (Supervisory Control Acquisition Data system) and PLC (Process Logic Control system) used to run the Kilo-Lab facilities, simulator mini-plant units and distillation unit. The 3<sup>rd</sup> year Chemical Process Technology students will benefit from and be exposed to these units as part of their training. The upgrade is done through AVENG, a leader in PLC controls in partnership with Emerson. It would not have been possible to install this state-of-the-art integrated system without the generous support of our industry stakeholders.



Above from the left: Mr Lebogang Nthabane and Mr Joost Smal from Avenue with Dr Shawn Gouws in the Kilo-Lab with one of the PLC's.

## InnoVenton

### Automotive Components Testing

Our laboratory is able to carry out tests against various specifications and requirements for a range of moulded automotive components or raw polymer materials used to manufacture interior car parts.

- ◆ Thermal Cycles
- ◆ Extensometer (Tensile) Testing
- ◆ Odour, Fogging
- ◆ Formaldehyde
- ◆ Flammability and
- ◆ Substances of Concern etc.

The laboratory management is committed to ensure that all laboratory staff are competent and conversant with a management system in order to achieve continuous improvement in meeting customer expectations through on time service delivery and accuracy in work done. ***So if you need to have some chemical analysis done and are not sure who to ask, give us a call for all your analytical testing requirements.*** Enquiries: Louise Hamilton, Technical Manager, T 041 504 3953

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.



## A Funky Festival of Formulations

The BSc Formulation Science Students, “Class of 2019” put forward an inspirational range of products at their annual product showcase held in November at InnoVenton. From solid shampoo bars to instant stain removers’ 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 centred on the use of marula and moringa seeds and oil, which were used in seven of the 11 products.

They developed a business plan to support their products and had to “pitch” their ideas to a panel of critics who served as “potential investors”. Each of the products had something unique about them that set them apart from other products currently available in the market. Dr Nicole Vorster is the programs coordinator, for more information feel free to contact her at [Nicole.Vorster@mandela.ac.za](mailto:Nicole.Vorster@mandela.ac.za)



From left, Avukonke Jona developed a fish feed for African Catfish formulated using marula seed cake (a waste product from marula oil extraction) as a protein source. Luzaan Potgieter’s formulation was an instant stain remover pen to remove food-based stains from clothing. Sivuyisiwe Gora developed an exfoliating soap bar formulated with moringa oil and moringa seed powder (a waste product from moringa oil extraction). A natural shampoo bar formulated with natural oils including moringa oil was the brainchild of Avril Jaftha. This eliminates the need for environmentally unfriendly plastic containers.



From left, Phila Henge developed a moringa oil hair food formulation. An exfoliating clay facial mask with marula stone powder was formulated by Abulile Dilima. Bryce Koeberg did something a little different and formulated a silvering solution for coating plastics to produce a highly reflective surface. Believina Makhubela developed a body massage cream with moringa oil.

## Innovation Emerging Excellence Award



Dr Nicole Vorster was recognised by the Nelson Mandela University as its emerging innovator for 2019. Currently a Formulation Science lecturer in the Chemistry Department, Dr Vorster's innovation project is to optimise an antioxidant extract from olive pomace, the by-product of olive oil processing.

Prototypes of cosmetic products containing these extracts were showcased at the Innovation Bridge in 2017, the resulting intellectual property (IP) was accepted in 2018, and the technology readiness level of 5 (TRL5) reached. The extracts contain many antioxidants which stimulate moisturisation, anti-ageing, UV-protection and have antimicrobial properties.

Funding was also approved in 2019 to conduct market feasibility studies for the commercialisation of the extracts.

## 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

## Tsetse-fly attractant

One of the major sub-Saharan diseases that has over the years reached epidemic proportions is the sleeping sickness. It is most prevalent in the tropical regions among the rural populations. According to WHO statistics: In 1998, almost 40 000 cases were reported, but estimates were that 300 000 cases were undiagnosed and therefore untreated. And, during the last epidemic the prevalence reached 50% in several villages in Angola, the Democratic Republic of the Congo, and South Sudan. Sleeping sickness was the first or second greatest cause of mortality in those communities, even ahead of HIV/AIDS.

In 2009, after continued control efforts, the number of cases reported dropped below 10 000 (9 878) for the first time in 50 years. This decline in number of cases has continued with 997 new cases reported in 2018, the lowest level since the start of systematic global data-collection 80 years ago. The estimated population at risk is 65 million people.

The disease is mostly transmitted through the bite of an infected tsetse fly. Infected people go through the initial stage characterized by fever, headaches, enlarged lymph nodes, joint pains and itching. These will then be followed by a second stage shown by changes of behaviour, confusion, sensory disturbances, poor coordination and disturbance of the sleep cycle. Without treatment, sleeping sickness is considered fatal.

To manage the disease, one of the ways is to trap the tsetse-fly using

insect traps laced with poisonous tsetse-fly attractant. It is for this reason that Matken Phenolics, a company based in East London in the Eastern Cape has proposed a project to develop a method to manufacture one such attractant from the natural ingredient, clove oil (eugenol), as a replacement for raw materials derived from petrochemicals. The proposed attractant is 3-n-propyl phenol (also called 3-Propylphenol).

The project is funded by TIA and the laboratory process development is carried out by DCTS (InnoVenton). Once the laboratory synthesis has been optimized, the synthesis will be scaled up in the pilot plant to produce larger quantities for testing and marketing the product. This is hoped to be completed by 30/06/2020.

The laboratory process entails cleavage of the hydroxyl group from eugenol to give 1-methoxy-3-propylbenzene and its de-methylation of the methoxy group to yield 3-propylphenol.

Photo LHS: Hydroxyl group cleavage in the Laboratory.

By: Mofu Setloboko



# Biopesticide Production

By: Louise Hamilton

Chemical pesticides are the most commonly used method of pest control in agriculture. However, due to the development of pesticide resistance, the harmful effects to beneficial flora and fauna, international pressure by trading partners such as the EU and the potential of chemical pesticides ending up in human consumption areas, there is a need for alternative controls. The use of organic-solid-waste in the control of plant and soil pathogens in agricultural systems has been reported to be an alternative control method in agricultural systems. The microbial communities present in organic waste have antagonistic characteristics that directly attack or limit the growth and progressiveness of plant-based pathogens and plant parasites. It is important to ferment the organic waste under suitable conditions that would enable the proliferation of suitable microbes that have the desired properties. In this aspect, Bt and its products is the main microbial agent for control.

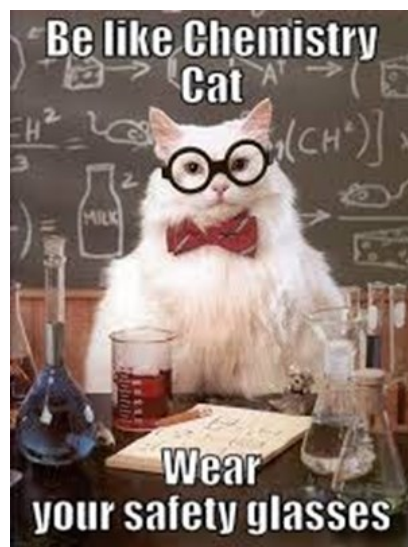
The use of Bt in control of pests, has been reported to be highly specific and safe for the environment. The technology in comparison to the chemical pesticide counterparts would require lower technology and mechanical input, making the system suitable for low cost production. The system is also not harmful to non-target vertebrates and has a big market locally and internationally, with a global market in excess of over 2.5 billion USD. There continues to be potential for expansion and penetration of Bt products into the market both locally and globally.

The overall aim of the project was to establish a solid-state fermentation (SSF) system for the production of biopesticides through fermentation of kitchen organic waste.



The proposed technology was successfully demonstrated and validated with bioassays in the laboratory.

The process has been successfully optimized for culturing conditions and SSF prototype and demonstration conducted.

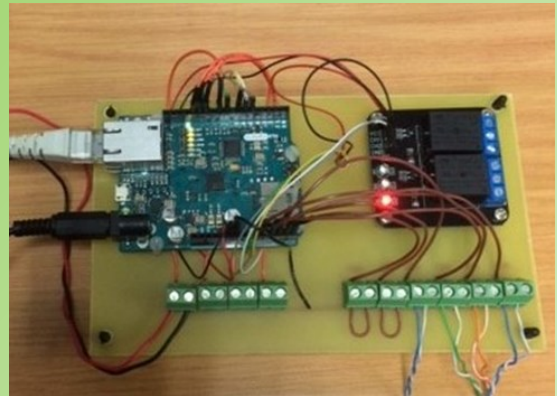




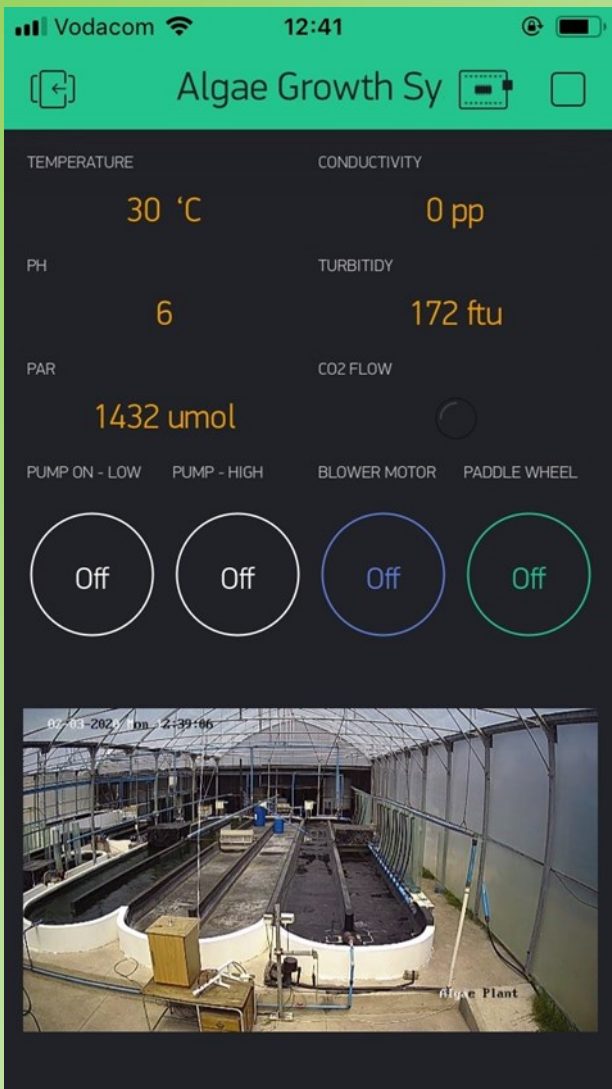
# Algae Growth System - 4IR and ALL

By: Derek Hislop

InnoVenton needed to make a cheap and affordable control system for our Algae Plant. We wanted to monitor pH, Temperature, Turbidity, Conductivity and Light Intensity (PAR). We also needed the pH to be kept at 7. An Arduino micro controller was used because it is a cheap affordable, open source controller. We added cellular phone control so that the motors and pumps can all be controlled from the cellular phone. Here is a picture of the Cellular Application with a video feed so enabling it to be controlled remotely.



Above: A picture of the Arduino controller with interface connections.



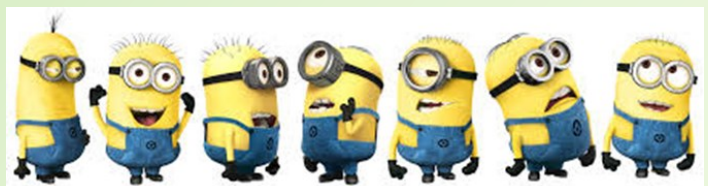
Above: Electrode sensors in the raceways.

The data generated must be uploaded to "the cloud". In this case, we are using Axxess Linux Hosting. This data can then be downloaded onto any computer for evaluation and trending.

This project has enabled us to use 4IR Technology to interface sensors and upload data to the cloud and control pumps and motors in real time. We intend to transfer this knowledge to beginners that have no knowledge of microcontrollers or basic programming. InnoVenton has an opportunity to introduce them to this technology and show them just how easy this is. A training course is being developed to empower SME's to implement this sort of system in their process environments.

If you have an idea for a practical application that needs monitoring and control, please contact us for more information. Perhaps you want to enrol for the SLP " **An introduction to IOT (Internet of Things) and practical user face programming**". We are offering this short learning program to SME's and individuals.

This system allows for 24hr monitoring and control of the algae growth cultivation system in the Green house at InnoVenton.



## 2019 Graduates

Congratulations to Dr Hope Baloyi and Dr Vitus Ejiseme Oblalo who both obtained their PhD's in Chemistry at the Nelson Mandela University with projects linked to aspects of the Microalgae to Energy Project at InnoVenton.



### OFFICE SAFETY TIPS A GUIDE FOR MINIONS



**DO NOT**  
Swallow, snort  
or wash hands  
and body with  
bright liquids or  
chemical products

# 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

- ◆ ED-XRF, Fast Semi-quantitative elemental analysis.
- ◆ UV/Vis, Qualitative and Quantitative analysis
- ◆ FTIR, Raw material fingerprinting

#### Fuel Analysis

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

## Looking forward - 2020

2020 promises to be another project packed year. The following are a few of the main activities planned :

**Microalgae Technologies:** The establishment of a Microalgae Technologies Research Centre at InnoVenton stems from success and deliverables met during the first 3 Years of this project. Support from the Department of Science and Innovation has enabled InnoVenton to expand the previous Microalgae to Energy Project into much larger Microalgae Technologies Research. Deliverables and focus areas for the next 2 years will hone in on the development of energy and liquid fuels from microalgae. One of the main aspects will be in the areas of fuels, chemicals and specialities.

**Hand Sanitiser for Nelson Mandela University:** With the onset of COVID-19 in March 2020, InnoVenton has formulated and manufactured an alcohol based Hand Sanitiser for use on campus.

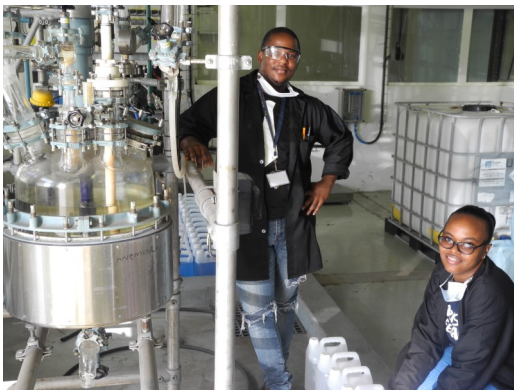


Photo: Sifundo Duma and Nolundi Maninjwa making Hand Sanitiser in the Kilo Lab.

### 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.

**Spirulina Bucket system:** This seed fund application proposes optimising and refining the current process making the cultivation system simpler and easier to operate. The project also considers packaging the production of phycocyanin further as a transferable technology. A local NGO is considering incorporating a system like this into their existing aquaculture activities.

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

### Our 2020 Strategic Priorities are:

- Increase effective collaboration
- Align resourcing
- Build core technological capability
- Ensuring excellence and efficiency
- Customer Focus
- Ensure optimum balance of leverage (Services/ Technology Development/ Basic Research)

## 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.



## Looking forward - 2020

### CHOCOLATE MOOSE

Something for the chocoholics among us! You'll need:

- 1) 350g dark chocolate chopped
- 2) 270g water
- 3) An ice bath (cold water and ice)



Firstly, put equal parts of water and ice into a medium bowl for the ice bath. Boil the 270g water in a sauce pan, or microwave, and pour it into a second bowl.

Then add the chopped chocolate and stir for a few minutes until melted. Place this bowl with the chocolate over the ice bath and whisk vigorously. Continue to whisk until the mixture has the consistency of stiff whipped cream. Refrigerate to set.



## 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
  - Technology Demonstration
  - Analytical and testing services
  - Quality services

Our Laboratory is willing to assess and assist you with your testing and analysis requirements.

Contact Details: Editor: Dr Melissa Gouws

Email: [Melissa.Gouws@mandela.ac.za](mailto:Melissa.Gouws@mandela.ac.za) T: 041 504 3233

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