In their element: The Zythologist is mixing beer with science for the perfect brew

From PhD to entrepreneurs, Monash start-up The Zythologist is using nano-brewing and chemical engineering to craft creative new brews.

And it's not just brewing beer on campus. It's educating the next generation of engineers and consulting with industry partners.

How? With space for ideas to ferment, world-class mentoring and financial backing.

Monash has ignited passionate students to become a booming start-up – with their sights set on reshaping Australian brewing.

Industry potential

Perfecting the brewing process

Perfecting beer isn't an art. It's a science.

In fact, over 300 chemical compounds shape a beer's flavour and quality.

Like any other drink, beer can be broken down, put under the microscope and examined. Routine tests monitor bitterness, alcohol and oxygen levels. And advanced analysis reveals key factors like hop compounds, off-flavours and microbiological management.

Chemical analysis equips breweries with the insights they need to refine and optimise their brewing process.

And that's just the beginning. Brewers can experiment with ingredients, try new processes and create wildly new flavours never thought possible.

Notes of passionfruit. Low bitterness levels. Or a smooth sweet vanilla aftertaste.

With nano-brewing, the commercial opportunities – and flavours – are endless.

The idea

Out of the lab and into industry

The story of The Zythologist begins with the Engineering student team, Monash BrewLab.

Founded by Monash Engineering PhD students Daniel Rojas Sanchez and Gina Pacheco Arredondo in 2018, the lab is Australia's first student-led nano-brewery.

"We created BrewLab to learn more about beer – the processes, the compounds and to develop all these crazy flavouring ideas we had. In fact, one of our first creations was a Michelada inspired tomato beer," recalls Gina.

In the lab, students apply their learnings in brewing science and process engineering to craft a range of beer and kombucha products.

Daniel and Gina led a multidisciplinary team of 50 Monash students who shared a passion for quality brewing. And soon forged industry partnerships with Keg King and Grain & Grape.

After completing their doctorate program, they didn't want to simply move on. They wanted to build something bigger.

"We wanted to pursue our dream. To take all we had learned and created in the lab, and bring it to industry," says Daniel.

In 2021, together with Shivam Tandon, they created The Zythologist – a science-based brewery and an analytical testing consultancy for craft breweries.

New business and entrepreneurs

From student team to sold-out products

From their beginnings at BrewLab, the team received ongoing support from the Faculty of Engineering.

Establishing grants supplied early funding to get started while dedicated mentoring provided the guidance and support to grow. And with labs, equipment and office space taken care of by Monash, the team was able to focus on building their business.

They received marketing assistance, promotion at faculty events and were strongly championed by the faculty executive team.

Yes, even deans appreciate a good brew.

"The dean, Elizabeth Croft, has endorsed us since we created BrewLab. She's backed us on everything we do. To have such strong support at that level has boosted our self-belief," says Daniel.

Transforming from student team to commercial operation, the trio were confident in the science and engineering aspects. But they were novices when it came to establishing a business.

In 2020 the team enrolled in The Generator, Monash's dedicated entrepreneurship program. The five-week Startup Sprint program provides early-stage start-ups with the skills, connections and commercial nous to rapidly scale their ventures.

The team received weekly masterclasses, one-on-one mentoring, pitch support and access to Monash's world-class network of alumni. The coaching and lessons learnt allowed the team to focus on their start-up, stress-free.

Through The Generator, the team won $5,000 in services from freelance marketplace fiverr.com. New brand identity. New e-commerce website. And a bright new future ahead.

And the most memorable moment of their venture so far?

"When we launched our first beer, we almost sold out within two months," recalls Shivam. "Seeing that market demand for our product – for something we were devoted to – was incredibly rewarding."

The vision

The hub of beer innovation and research

The Zythologist aims to be the centre of beer production, research, innovation and education in Australia.

And by aligning with the Monash Smart Manufacturing Hub, the team has the resources to make that dream a reality.

Embedded on campus, the team retains easy access to Monash's world-class facilities, including the new Chem-Bio Makerspace. And through their proximity to Australia's top-ranked chemical engineering department, the team can call upon the insights of leading researchers.

"The Monash community is so diverse and rich in expertise. And from a business perspective, you have such a large home crowd to support you and connect you with key industry contacts," says Shivam.

In addition to brewing beer, The Zythologist will offer testing and analytical services to industry partners across quality control, quality assurance and product development.

"We're consulting with established breweries. We're helping them to optimise their processes and create bold new flavours that they haven't been able to make before," said Gina.

"We want to be in a position that when people need a beer expert, they contact The Zythologist," adds Daniel.

In the rapidly growing craft beer industry, there's a shortage of skilled brewers. The Zythologist wants to meet this education opportunity and run industry courses to upskill the workforce.

"While craft brewing is more popular than ever, it's mostly people stepping up from experience, not education. It's our vision to deliver a steady pipeline of graduate chemical engineers with brewing expertise into industry," says Shivam.

A continued collaboration

From PhD and student team to start-up to national innovation hub, The Zythologist's partnership with Monash has and will continue to be fundamental to its success.

Through the Smart Manufacturing Hub, The Zythologist offers a pathway for industry partners to access the research expertise, education and infrastructure that Monash provides.

The Zythologist will support undergraduate and postgraduate education through its continued involvement with Monash BrewLab.

"We started from an idea that originated at Monash. As we go forward, we only see that relationship becoming more fruitful for both sides.

"We're eager to foster the talent pipeline even further, helping students forge their own commercial paths. Providing opportunities for students to learn while creating something tangible they can be proud of," says Daniel.

Visit the Graduate Research website to find out how a PhD can expand your career options.

Follow the links to explore the latest brews and learn more about The Zythologists and Monash BrewLab.

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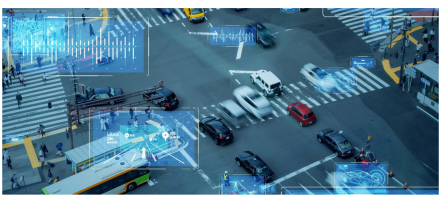


Start with science, but don't stop there: Why two scientists switched to engineering to build a better tomorrow

Engineering isn't in competition with science. In fact, it's the natural extension of it. As an engineer, you apply theory to solve real-world problems. You deploy your analytical mindset out on project sites – and in the boardroom.

With the current shortage of skilled engineers, qualified engineering professionals are more in demand than ever. (And attracting luxrative salaries too.)

We sat down with two Monash lecturers who embraced engineering – and haven't looked back.

Changing careers from science to engineering

"I'll never stop being a scientist," says Dr. Roger Dargaville.

"But I now approach my research with an engineering mindset. To take the theory a step further to design practical solutions."

Roger first completed a Bachelor of Science (Honours). But as his research into renewable energy became more applied, he morphed from scientist to engineer.

He's now a senior lecturer and researcher at Monash's Department of Civil Engineering, specialising in climate change and transitioning energy systems.

Similarly, Dr. Wynita Griggs, Roger's colleague at the Department, started with a Bachelor of Science and Arts, with an Honours year in mathematics. But during her postdoctoral years, she developed a desire to contribute to society in a more concrete way.

"While solving theoretical problems contributes to our collective knowledge base, this is not necessarily a tangible contribution," says Wynita.

"I wanted to be able to look out of the window, point to something real, and say: Yes, I helped build that. Which is what I'm doing – and enjoying – today."

"I'll never stop being a scientist, but I now approach my research with an engineering mindset. To take the theory a step further to design practical solutions."

Transferable skills, grounded in STEM

During her postdoctoral fellowship in Ireland, Wynita expanded her engineering toolkit. She learnt how to code, collaborated with industry partners and seized opportunities to apply theoretical ideas in real-world scenarios.

But she wasn't starting from a blank slate – far from it. Her strong mathematical foundation steered her approach.

Wynita had published papers on mathematical control theory (used in vehicle speed advisory systems). And for her first venture into engineering, she designed and built a vehicle-in-the-loop traffic emulation platform. She used the platform to validate a number of vehicle-speed advisory system algorithms that she and her colleagues had developed.

"Having only previously worked on theoretical mathematical problems, I was eager to try something new. And I enjoyed it immensely."

She then joined the European Union's Horizon 2020 ENABLE-S3 project to build and validate autonomous systems across the automotive, maritime and aerospace domains. In particular, she collaborated with IBM Research – Ireland to develop and test a context-aware, in-car reasoning system, and secured patents on the technology.

"Contributing to a real industry project was extremely rewarding and spurred my professional development."

Likewise, Roger credits his science background for cementing the value of critical thinking, data management, programming and clear communication.

"In particular, my 'question everything' approach proved immensely helpful in engineering. That curiosity has steered me to look beyond surface-level problems – to unearth underlying challenges and opportunities in energy systems," says Roger.

Engineering a better tomorrow

Now, as Monash lecturers, Wynita and Roger are just getting started.

Roger is researching how to design and optimise large-scale (continental) electrical energy systems. A major component is understanding how weather variability impacts demand (for example, hot days result in greater air conditioning demand), and the electricity output from wind and solar technologies.

By deploying his atmospheric physics and mathematical skills in an optimisation programming framework, he's building a roadmap towards a low carbon energy future – one that's technically and economically viable.

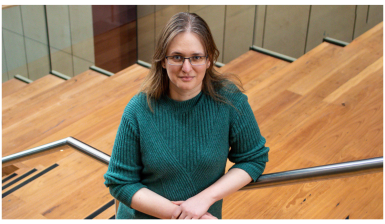
"My sights are set on accelerating Australia's transition to a low carbon energy system. I'm working with the Australian Energy Market Operator on its energy system plan and with energy retailers to decarbonise their generation fleet. And I'm publishing papers on system modelling, storage technologies and electric vehicles.

"On top of that I take great pride in seeing my undergraduate and postgraduate students make their own impact too. It all adds up. And it's exciting to be building momentum."

For Wynita, she's continuing to explore the applications of control theory in smart city innovations like autonomous vehicles. And she's eager to explore the potential for connected e-bikes.

"With motors boosting human pedal power, traditional car concerns like speed regulation can now be considered for cyclists.

"Moreover, creating green waves – where vehicles move in tandem through city intersections – may help improve cyclist safety. We're developing transport solutions that will change people's lives."



"I wanted to be able to look out of the window, point to something real, and say: Yes, I helped build that. Which is what I'm doing – and enjoying – today."

Make the switch and gain an edge

Are you a science, maths or IT graduate who wants to stand out in the competitive graduate employment market – and develop sustainable solutions for today's global challenges?

With Monash's Master of Professional Engineering, you'll gain the industry experience and technical expertise you need to become an accredited engineer in just three years (or fewer). In fact, over 94% of our postgraduates secure full-time employment within four months of graduation.

And when you make the switch to engineering, your science heritage will remain an invaluable asset throughout your career.

"I now see myself as part scientist, part engineer. I still enjoy solving theoretical problems for the pure purpose of wanting to understand the natural and physical world," says Wynita.

"But then the engineer inside me lights up. I can harness that abstract thinking to design tangible, meaningful contributions to society."

94%

of our postgraduates secure full-time employment within four months of graduation

NematiQ

Nano tech with huge potential: How a Monash lab breakthrough became the future of filtration

It's easy to take clean water as a given. As abundant as the air we breathe. But the water that flows from our taps travels quite a journey – often beginning as wastewater.

Wastewater can contain harmful hitchhikers like bacteria, textile dyes and pesticides. So before we can safely reuse it, we need to remove these pollutants – which takes time and (lots of) energy.

Enter eco-friendly graphene nanofiltration membranes. This state-of-the-art technology needs less energy, it's more durable and it's better at filtering out pollutants.

Professor Mainak Majumder shares how the technology, which he developed in a Monash lab, is set to transform the filtration industry.

INDUSTRY CHALLENGE

Removing the issues with filtration

For years, wastewater has been passed through polymer membranes to remove pollutants. Filtering out the likes of dissolved organics and bacteria in drinking water, and dyes and oils after industrial use.

But cleaning water like this takes significant energy to pass the water through the membrane. And polymer membranes have a short lifespan when they're used in harsh conditions, such as the high PH levels or temperatures found in industrial wastewater.

Even more concerning, sometimes these membranes can't completely remove dissolved organic matter. So the water then needs to be disinfected with chlorine – which tastes unpleasant and can react to form harmful carcinogenic compounds.

The entire process is inefficient, expensive and, too often, unsafe.

Surely there's a better way?

The big idea to revolutionise filtration, is a small one. A very small one. Nanofiltration membranes made from incredibly thin layers of graphene.

THE IDEA

Thinking small and scaling up

"This journey started in 2005, when I began my PhD studies on membrane technology. But despite years of effort, the manufacturing process we developed wasn't scalable," recalls Monash University Professor Mainak Majumder.

Jump forward to 2016 when, in a Monash research lab, Mainak had his eureka moment. Together with Abozar Akbari, his PhD student at the time, they developed their first proof of concept using a new high-speed, layer-by-layer process.

"After a decade of research, we were finally able to make graphene membranes with industrial scalability. It was a breakthrough – and we were over the moon," recalls Mainak.

And Mainak could sense the commercial applications too.

The new membrane was better at filtering out small molecules, and it was easier to clean and remove trapped pollutants.

On top of these improved safety measures, it was also much more energy efficient. Traditional membranes require expensive, inefficient pumps. Whereas graphene membranes can operate at domestic water pressure.

"All these benefits are because of graphene's unique properties at the atomic level. Not only is it super thin, which lowers the energy required, it delivers what's known as high water recovery."

Polymer membranes only allow about a third of the water through. (The rest passes, unfiltered, over the membrane.) With graphene, the recovery rate jumps to over 75% – which means less water and energy is needed to output the same volume of clean water.

But could the membrane be produced at scale using Mainak's new process? Well, it was time to take the idea from lab to industry.

NEW BUSINESS AND ENTREPRENEURS

Ongoing support from lab to industry

Mainak continued to develop the technology in a Monash research lab. He collaborated with bright PhD students and received on-campus marketing support to spread the word throughout the industry.

To further the industrial applications, Monash's business development team prepared compelling project proposals with Mainak. And in 2017 he was awarded a major grant from Cooperative Research Centres Projects (CRC-P) to commercialise the membranes.

"In the lab, we could produce and demonstrate the technology in principle. But the CRC-P grant was the catalyst we needed to move out of the lab and into industry."

The project was a success. And, as a result, Mainak's industry partners Clean TeQ and Ionic Industries took license of the intellectual property from Monash to form a joint venture in 2018. (Now a wholly owned subsidiary of Clean TeQ).

NematiQ was born and expanded operations off-campus into a fitted-out warehouse. And Mainak remains an active scientific advisor to guide the technology's development.

"It's a dream for scientists to be able to move from a lab to a commercial reality. It's the first step towards their research making a real difference in people's lives."

> *"It's a dream for scientists to be able to move from a lab to a commercial reality. It's the first step towards their research making a real difference in people's lives."*

TRANSFORMED INDUSTRY

Seamless integration, with major savings

"We are now competing with really big players in the field. MIT has a start-up and so too does ETH Zurich," says Mainak.

"It's a very hot area simply because of the industry-shifting possibilities on offer. But with that competition comes opportunity to take our technology to market and revolutionise clean water –in Australia and overseas."

NematiQ is still a start-up venture, but its sights are set on becoming self-sustainable, with industry contracts spurring its growth and profitability.

The nanotechnology will deliver businesses major savings across maintenance and operations – and seamlessly integrate with existing filtration systems. The team is moving to demonstration level to showcase the technology's potential with water utilities and manufactures.

> *"We are now competing with really big players in the field."*

THE VISION

Untapped potential to solve next-gen problems

Mainak is far from finished exploring the technology's applications. As Professor with the Department of Mechanical and Aerospace Engineering, and Director of the ARC Research Hub for Advanced Manufacturing with 2D Materials, Mainak continues to tinker with graphene's potential in Monash labs.

"We could expand the same nanotechnology to tackle other problems. For example, desalination remains a challenge and so does removing heavy metals. We've only started exploring these next generation problems. It's still exciting to be making new discoveries alongside my PhD students."

"My students and I will continue researching the technology, while NematiQ will focus on commercialisation and scaling up manufacturing."

Mainak has a few words for budding entrepreneurs aspiring to create the next big thing through the Monash ecosystem.

"In Australia, there are many opportunities for entrepreneurship. So you've got to try a few things. Some of them will work. Some of them may not.

"The important thing is to not fear failure. It may seem daunting, but as students, you can afford take a risk. You're still young. You're still learning. So take the risk. Go for it."