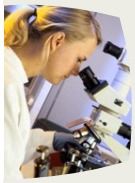


TEACHING AND RESEARCH NEWS
DEPARTMENT OF CHEMICAL ENGINEERING
MONASH UNIVERSITY

ChemEng focus

October 2013 Volume 6, Issue 3

Thanks to our Corporate Supporters

DAIRY INNOVATION AUSTRALIA

VISY

HRL Technology | HRL

AMCOR

gsk GlaxoSmithKline

Inside this issue:

Mixing drugs and alcohol for better asthma inhalers

Asthma inhalers could soon become more effective thanks to a clever new way of manufacturing the particles they deliver, developed by a Monash chemical engineer.

Current puffer designs and typical size range of particles mean a large portion of the medication propelled into a patient's throat remains there. Only a fraction reaches the lungs.

But Monash University lecturer Dr Meng Wai Woo, Department of Chemical Engineering, and his team have now developed a method of producing ultra-fine particles, which will make drug delivery more consistent and efficient.

The new method, known as anti-solvent vapour precipitation, uses ethanol to dehydrate droplets, and results in super-small particles of uniform size.

"Ultrafine uniform particles will ensure that fewer drug particles get stuck in the throat while more can reach the lower regions of the lungs," Dr Woo said.

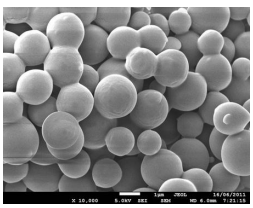
"Because we can now make the small particles more uniform, it means the inhalers will work better."

The team's work results in particles smaller than a micron (thousandth of a millimetre) in diameter – much smaller than those produced by conventional dehydrating mechanisms, which are limited by the size of the atomised droplet.

The team's discovery was unveiled at the 18th International Drying Symposium in Xiamen, China, last year. It is likely to create interest among pharmaceutical companies. Infusion devices and metered dose inhalers account for around $US20 billion in worldwide sales each year, with the key development aim being to balance improved efficiency against the cost of manufacture.

Dr Woo's method means that the pharmaceutical industry can now potentially deliver critical medicines via the airway direct into the lungs with much greater accuracy.

"From a drug manufacturer's perspective, this new approach can maintain the uniformity of the particle and yet potentially maintain commercially viable production rate," said Dr Woo.



Continued on next page…..

Continued from previous page...

Investigations into using ethanol as a means of producing ultrafine particles began in 2011, as part of Dr Woo's ongoing research into manufacturing processes in the dairy industry.

Attempting to produce lactose crystals, his team decided to reject the traditional hot air drying method and use nitrogen laced with ethanol vapour as an alternative dehydrating agent.

To their surprise, the result was not the crystals they expected, but hundreds of very tiny, very uniform lactose particles. Further testing showed that the amount of alcohol absorbed into the initial droplets was a key variable in influencing the outcome.

Assisted by a grant from the Australian Research Council, the Monash team is now testing its method on another dairy product, whey, and researching the ultrafine particle delivery of protein-based medicines. They are also building a demonstration unit to showcase the anti-solvent vapour precipitation process, which will be completed later this year.

Dr Meng Wai Woo is one of 12 early-career scientists presenting their research to the public during Fresh Science, a national program sponsored by the Australian Government.

WIN a free student registration

The Australasian Particle Technology Society (APTS) is sponsoring student registrations to the 7th World Congress on Particle Technology in Beijing 2014.

To be eligible for selection, you must be a member of APTS and are registered to attend the 7th World Congress on Particle Technology (WCPT7). Winners will be selected based on the quality of papers accepted for presentation at the conference.

Send your entry (paper submitted to WCPT7, proof of acceptance and registration to WCPT7, APTS member ID) to cordelia.selomulya@monash.edu OR roberto.moreno-atanasio@newcastle.edu.au.

Winners will be announced at the APTS website before WCPT7 in 2014. Each bursary is equivalent to US$500.

For more information on The Australasian Particle Technology Society (APTS) visit https://www.engineersaustralia.org.au/australasian-particle-technology-society/about-us

Baosteel Australia Joint Research and Development Centre grant success

The Baosteel-Australia Joint Research and Development Centre is a world-first joint venture between the Shanghai-based Baosteel Group - one of the world's largest steel companies, in collaboration with four other Australian universities.

The mission of the Centre is, through an enduring partnership, to engage in exploring and developing new knowledge and technologies within selected areas of particular significance for Baosteel's longer term, strategic development and business activities.

Baosteel and Professor Huanting Wang from the Department of Chemical Engineering will conduct research in areas of "Smart Polymer Hydrogels for Simultaneous Waste Heat Utilisation and Wastewater Treatment for Steel Industry" with a $400k grant from Baosteel Australia Joint Research and Development Centre.

Most downloaded authors for Journal of Computers & Chemical Engineering

K.B. Kabir, K. Hein, and S. Bhattacharya have been recognised as the "Most Downloaded authors for their recent article "**Process modelling of dimethyl ether production from Victorian brown coal-Integrating coal drying, gasification and synthesis processes**" appearing in Journal of Computers & Chemical Engineering, Volume 48 (2013) [http://dx.doi.org/10.1016/j.compchemeng.2012.08.008]

The authors have been invited to attend a reception in honour of Computer & Chemical Engineering's top authors and reviewers, during the forthcoming AIChE Annual Meeting in San Francisco.

The reception will take place on Wednesday 6 November.

Nurturing International research talent

The Victorian Government has recognised the outstanding calibre of nine international students, including three from Monash, who are conducting specialised doctorate-level research in Victorian universities. The nine students were successful awardees of the 2012/2013 Victorian International Research Scholarships. Of the three Monash students who received the Victorian International Research Scholarships, two of those students, **Mr Naveen Noah Jason** and **Teck Kwang Choo** are studying in the Department of Chemical Engineering. During the ceremony the students were asked to speak about their journey that brought them to study in Victoria, their PhD program and what they like about their experiences so far.

Naveen Noah Jason came to Victoria in March 2013 to start his PhD degree. It was the first time he had set foot outside of his native country of India. Naveen is far from being homesick and has lofty ambitions: "My dream is to establish a chain of top notch research institutions dedicated to tackling and resolving the problems regarding energy and medicine in third world countries."

Naveen is enjoying the journey at Monash University and he is very comfortable living the relaxed but industrious lifestyle of the people of Victoria.

"In Australia, people have a lot of freedom. I admire the work life balance in Australia which I think makes the people very happy," he said.

Naveen studied for his undergraduate degree in chemical engineering at the Indira Gandhi Institute of Technology, then completed his Masters at the National Institution of Technology in Odisha, but chose to come to Monash University because of its fine international reputation.

"I had friends who had done their Masters in Melbourne and they recommended Monash University to me because I am interested in nanotechnology research and the university has a great reputation in that field.

"It has state-of-the-art laboratories, it is internationally renowned and it has great access to industry programs. I was very happy to get selected to study in Melbourne which is a great city," he said.

"I enjoy the student culture and meeting many like-minded people who share similar passions and goals. There are lots of opportunities at Monash to network and meet other researchers in the field. "

Naveen has a strong academic track record, publishing a first-authored paper in the Royal Society of Chemistry's journal, Soft Matter. He also has two papers under preparation for publication from the work completed during his Masters.

Naveen's PhD research aims to develop a matrix of mini solar cells which can be used in a form of paint to generate green energy. The mini solar cells that make up the matrix can store energy.

"Now, theoretically this matrix can be used like regular paint to coat, say, the roof of a house. What that would do is transform the roof into a giant solar cell, generating and storing electrical energy. Technically anyone with a roof over their head would have sustainable electrical power."

Naveen says the project will also contribute to the enhancement of Victoria's standing in the area of nanotechnology for clean energy.

"It will lead to the advancement of knowledge of nanoparticle paints for solar cell applications and may incubate patentable technologies in solar paints development," he said.

Naveen has nothing but encouragement to other students from overseas to take up the opportunity to study in Victoria—a place where he has been made to feel comfortable and wanted.

But he has one important piece of advice to incoming students: "Stay focused and you'll achieve your goals. Work hard!"

Continued next page

Nurturing International research talent continued.....

Teck Kwang Choo came to Melbourne in 2009 from his home city of Kuala Lumpur, Malaysia after beginning his undergraduate degree in chemical engineering at Monash University's Malaysian campus, graduating with first class honours.

"Monash Univesity is very well known in Malaysia and has an excellent reputation. Several of my family members have studied at Monash University in Malaysia as well," said Teck.

Teck enjoys his lifestyle in Melbourne and outside of this study commitments, manages to lead a very active lifestyle by regularly swimming, running and playing tennis.

Teck loves Victoria's coastline, having visited both the Mornington Peninsula and the Great Ocean Road several times.

"One of my most favourite memories of my time in Victoria was picking cherries at a farm on the Mornington Peninsula.

I absolutely love the trams as well! I spend a lot of my weekends exploring the city on them."

As a major recognition for his talent and effort Teck was awarded a Victorian Internal research Scholarship in 2012, after being nominated by Monash University.

I have a great passion for chemistry and I am determined to make a contribution to the environment and to industry.

In my final undergraduate year, I was able to do an internship at South East Water, which provides water services to a large part of Melbourne. There, I was able to use my skills and knowledge as a chemical engineer which made me realize that I had developed a passion for research.

So I decided to put a career in industry on hold for a while because I have plans to involve myself in some ground breaking research surrounding coal which is a significant component of the energy generation industry here in Victoria," he said.

Teck said his PhD project revolved around converting the industrial waste product, know as brown coal fly ash, from the Gippsland region of Victoria, to a high value magnesium product.

Teck Kwang Choo giving a speech to distinguished guests and the scholarship recipients at the award ceremony at Parliament House

"Recovering magnesium from brown coal fly ash has great potential to benefit the manufacturing and clean energy industries.

Coal ash currently has no value of its own—but it can be used to generate high value magnesium metal.

It could also develop Victoria's magnesium industry. Magnesium is 40 per cent lighter than aluminum and as strong as steel.

So it could be very useful to a broad cross section of industries which are always on the lookout for lighter and more efficient materials in their production process" he said.

Innovation, Services and Small Business Minister Ms Asher, presented Victorian International Research Scholarships recipients with their awards at a ceremony at Parliament House held on 27th August 2013.

Success for Monash chemical engineers in prestigious awards

Three Monash engineers have been recognised for their contributions to the field of chemical engineering at the annual Chemeca conference held in Brisbane last week.

The awards, by the Australian and New Zealand Federation of Chemical Engineers, were presented to Associate Professor Karen Hapgood, Dr Mark Toner and Dr Sarah Sinclair. Chemeca is the premier chemical engineering conference for the Asia Pacific region.

The annual awards recognise leaders in chemical engineering in Australia and New Zealand and are designed to encourage and recognise excellence and to highlight the contribution made to the community by Australian and New Zealand chemical engineers.

Associate Professor Hapgood, the head of the Department of Chemical Engineering and a previous award winner, received the Caltex Teaching Award for outstanding achievements in the teaching of chemical engineers.

Dr Sinclair, a lecturer of design project and safety courses, received the WorleyParsons Award, which recognises personal commitment and leadership in the area of safety and/or the environment.

Dr Toner, a consultant to the Faculty of Engineering in leadership training, received the Fluor Award for exceptional management and leadership that has directly resulted in a sustained corporate success over a significant period.

Associate Professor Bradley Ladewig from the University's Department of Chemical Engineering said it was pleasing to see three Monash chemical engineers recognised.

"All three are exceptional engineers in their own right and these awards recognise their outstanding contribution across the breadth of the profession, ranging from chemical engineering education, to corporate leadership at the highest levels in the case of Dr Toner, and the critical field of engineering safety," Associate Professor Ladewig said.

"This success highlights the quality of our staff within the Department of Chemical Engineering, all of whom are working to educate and develop the next generation of engineering leaders."

Bradley Ladewig awarded a 2013 Victoria Fellowship

In a ceremony at the Victorian Parliament House on 8 October 2013, Bradley Ladewig was awarded a prestigious Victoria Fellowship from VESKI and the Victorian Government.

The Hon Louise Asher and Bradley Ladewig

This fellowship, worth up to $18,000, supports recipients to undertake a short-term study mission abroad, to access research facilities, learn new techniques, attend conferences and bring knowledge and skills back to Victoria.

Bradley will use the fellowship to spend time working at the Leibniz Institute for Polymer Research in Dresden, where he has a research collaboration for the joint development of novel polymer materials that can be utilised in advanced, low-energy consumption desalination technologies. Following that, Bradley will survey a number of high tech start-up companies in Berlin, a city that now hosts the highest number of startup companies of any city in Europe. The aim of this part of the fellowship is to identify the unique aspects of the entrepreneurial atmosphere in Berlin that makes is so conducive to establishing startup companies, and report on what could be done in Victoria to encourage a similar effort in commercialising research discoveries.

Stefan Smith's winning paper for the Shell Australia "Where should the world get its future energy from?" competition

Introduction: Demand

The global population is projected to reach 9 billion by 2050, and with rapidly expanding middle class populations in many developing countries; the global energy demand is set to grow to 2-3 times its current levels in less than 40 years. However, unlike much of the 20th century, where there was always more fossil fuel in the ground, global shortage and climate change are rapidly closing the option to consume these fuels as our primary energy source and the world will face significant challenges meeting its future energy needs. In considering *where the world should get its future energy from*; it is less important to argue the merits of one technology over another, than it is to understand the issues impeding a complete transition to alternative energy sources in a world that is ruled by fossil fuels.

The End of Fossil Fuels

The turn of the 20th century and the Industrial revolution saw a boom in fossil fuel consumption, and historically the adverse environmental effects of emissions (e.g. acid rain and smog) have always been an issue. However the introduction and continuous improvement of various combustion technologies perpetuated the illusion that pollution was under control. It is only in the last few decades that the world has realized the adverse effect carbon dioxide emissions are causing on Earth's climate; i.e. global temperatures are increasing, polar icecaps are melting, and extreme weather events are worsening.

Many scientists are claiming an atmospheric carbon dioxide concentration of 450ppm is the tipping point for irreversible climate change, with a 2004 paper reporting that avoiding this requires that 70% of known fossil fuel reserves are left untouched [1]. However with the level of investment in infrastructure and the global economy so heavily reliant on oil and gas it is not difficult to imagine that there is too much invested interest in fossil fuels for society to readily stop using them in favor of less convenient alternatives.

Sustainable Energy

In a future without abundant fossil fuels, and the need to control greenhouse gas emissions for climate stability, the world should look towards a sustainable energy system for its future energy needs. Modern technology already allows humanity to utilize the huge abundance of sustainable energy generated by nature through biological growth, solar radiation, wind, natural water flows, and even the decay of unstable isotopes. Like fossil fuel combustion, the technologies exploiting these energy sources (bio-fuels, solar, wind turbine, hydro and nuclear power) are not without their own disadvantages, such as location restrictions, intermittent generation, high land use and limited scale. However, with ongoing efficiency and cost improvements, a mixture of these technologies should be capable of meeting the capacity and flexibility requirements of the world's future energy demands. Yet against this progress, Energy Demand Models predict that fossil fuel use will continue to rise over the next few decades [2].

When the global environment is also considered, the future of the world's energy supply is no longer as simple as gradually replacing fossil fuel combustion plants with renewable energy. Even today, a carbon-neutral energy industry alone would be insufficient to prevent further climate change as power generation accounts for less than half of total carbon dioxide emissions.

Although carbon neutrality is not universally possible, reducing anthropogenic greenhouse gas emissions will require a united effort. Major industries such as power, steel and alumina smelting can implement renewable or mitigation technologies, while transportation and other small release points must adopt alternative energy sources. Yet in some industries (concrete, agriculture) emissions are by-products that cannot be avoided by switching to alternative energy and so must instead be offset by technologies with negative carbon emissions - processes which permanently reduce atmospheric carbon dioxide. With so many complications, the transition to a completely sustainable energy system will take decades, during which carbon emissions would continue causing untold damage to the global ecosystem.

Other Factors

The direction of the future energy situation is clear: sustainable energy technologies need to replace existing fossil fuel combustion energy; however the greatest obstacle facing the world's energy system change is not technological but societal. Sustainable energy technologies often face fierce resistance due to perceived safety or environmental risks, high capital investment, or the projected impact on the cost of electricity; supporting a political defense for those whom consider the impacts too great. As such, the use of many of these established alternative technologies is not widespread, nor is the rate of installation particularly high, which is troubling considering the immediacy of many climate change predictions. In 2010, the World Bank reported that the Kyoto Protocol, a near-global agreement to reduce emissions and prevent further climate change, had failed citing instead an increase of 25% since its establishment [3], while on-going atmospheric monitoring reveals that CO_2 emission rates have continued to increase [4].

Stefan Smith's winning paper for the Shell Australia "Where should the world get its future energy from?" competition continued….

To oppose societal delays, the world should be looking to implement an energy 'bridging' technology between the current and future energy systems, to ensure an ongoing supply and begin to reduce emissions to limit environmental damage. Post-Combustion Carbon Capture and Sequestration (post-CCS) is a promising candidate for a 'bridging' technology as it is already being demonstrated in a number of locations around the world, allowing rapid and widespread installation; and holds both immediate and long term value to the world's energy system. Coal and natural gas plants with CCS can operate as carbon neutral during the transition, reducing the immediate demand for renewable energy installations, but then as bio-fuels become more readily available, the conversion of these plants to Biomass Energy (BECCS) would provide carbon-negative energy sources to offset the emissions from other uncontrolled emission sources and reduce atmospheric CO_2.

While revolutionizing the way we use and generate energy is guaranteed to be expensive, with carbon taxes (or other funding vehicles) invariably set to increase the cost of living; the impact of delaying or even ignoring the necessary steps to toward a new energy system will be far greater. Nonetheless, it is not only cost and supply restrictions that will hinder a new environmentally friendly energy system; with demand set to grow so rapidly, the success of the world's future will also depend on reducing our individual energy requirements, improving energy efficiency, and accepting lifestyles which are more economical on the world's resources.

Conclusion

"*Where should the world get its future energy from?*" is not a question of the required advancements in technology, a range of sustainable energy sources already exist; but how the world should approach the transition to a new energy system that ensures a sufficient and continuous supply to the world's expanding population, while minimizing the environmental impact from our obsession with the earth's remaining fossil fuels.

References

1. Anderson, S. and R. Newell, PROSPECTS FOR CARBON CAPTURE AND STORAGE TECHNOLOGIES. Annual Review of Environment and Resources, 2004. 29(1): p. 109-142.
2. Konstas, K., et al., Methane storage in metal organic frameworks. Journal of Materials Chemistry, 2012. 22(33): p. 16698. Fig. 1, top
3. World Bank, Part II: "5. Integrating development into a global climate regime"-World Development Report 2010: Development and Climate Change, Washington DC, USA, 2010, p. 233-235
4. Earth System Research Laboratory, USA, Annual Mean Growth Rate of CO2 at Mauna Loa, Hawaii. Retrieved 19/09/2013 http://www.esrl.noaa.gov/gmd/ccgg/trends/

Local Monash University student shares energy supply solutions at the Shell Global Energy Forum

Local Monash University student, Stefan Smith, took centre stage at the 2013 Global Energy Forum in Sydney this week, sharing his response to the question 'Where should the world get its future energy from?'

Stefan and three other students from universities across Australian Capital Territory, Victoria and Queensland were selected from a wealth of applicants across the country to present their ideas to key leaders from the energy and resources sector.

Stefan, who is completing his PhD in Chemical Engineering at Monash University, said "Global energy needs and Climate Change are fascinating issues because they are fundamentally scientific, yet central to the continued success of human civilization."

"These are the greatest challenges our generation will face and I am excited to be involved with Carbon Capture technologies, an emerging industry which I believe will play a major role in preventing the approaching crisis," said Stefan.

Andrew Smith, country chair of Shell Australia, said Shell was very impressed at the talent and innovative thinking of the students involved.

"Our aim for these forums was to encourage the leaders of tomorrow to be active in conversations about our future, and challenge them to consider possible solutions to the world's energy supply issues."

With global population predicted to grow from 7 billion in 2012 to 9 billion in 2050, the world's energy demand is set to double in less than a century, placing significant stress on energy and resources.

"Shell recognises that in order to address these challenges in the most socially, environmentally, and economically responsible way we must leverage the full power of innovation: the capacity for doing things differently and better than before," said Andrew.

"The conversation being held with students, both now and in years to come, is vital," he added.

Facilitated by Shell Australia, the Global Energy Forums are a series of worldwide debates on the world's future energy demand, which provide students and industry leaders an opportunity to examine differing views on future energy supplies and their associated complexities and challenges.

For further information, please contact: Emma Mikus, Edelman

International collaborative PhD research - opportunities and advantages

Joanne Tanner [Ph.D]
BCIA Scholarship recipient (2011)

As part of her BCIA-funded Ph.D. project, Joanne had the opportunity earlier this year to travel to Europe and the USA on a two-month collaborative research trip. Here she describes the aims and outcomes of the expedition, and demonstrates the many advantages to be gained by international collaborative activities at Ph.D. level.

I am currently in the second year of my doctoral research project "Brown coal-derived syngas generation for higher value product processes". My scholarship is sponsored by Brown Coal Innovation Australia (BCIA) and my research focuses on the need for reliable fundamental data concerning the behaviour of Victorian brown coals (VBC) under high temperature, entrained flow gasification conditions.

To supplement the research capabilities available to me at Monash and to foster international relationships, this year I was lucky enough to be able to conduct some of the experimental work related to my Ph.D. project in Germany at Forschungszentrum Jülich GmbH (FZJ, Research Institute of Jülich) and Karlsruhe Institute of Technology (KIT). As part of the same expedition, I also attended the 38th International Technical Conference on Clean Coal and Fuel Systems in Florida, colloquially known as The Clearwater Clean Coal Conference, to present my project to an international audience. The funding for my trip was provided by a grant from the Go8/DAAD Joint Research Co-operation Scheme, by BCIA and by MIGR.

Through my visits to the two research institutes in Germany, I was fortunate enough to be able to experience first-hand the differences in culture and attitudes to academic and everyday life in comparison to ours in Australia. I found the academic system to be well-structured and comprehensive, giving the doctoral students a good grounding in management, supervision, budgeting and administration as well as research activities.

My German colleagues and host families were welcoming and extremely willing to help. I managed to make good use of the excellent facilities (German engineering at its finest) to generate some data that will enhance my Ph.D. thesis. But my time in Germany was not all "long days in the lab". Thanks to the excellent Deutsche Bahn rail system, I managed to fit in a few weekend trips to nearby cities and towns. I even picked up a basic understanding of the German language, which helped make me feel more comfortable during the numerous social events and certainly helped with communication in the general community!

Clearwater, Florida, was very different to Germany. In appearance, Florida is very much like the Australian Gold Coast but with much friendlier people (maybe because they all work for tips!). The Clearwater conference was a great mixture of representatives from academia, industry and politics with interests in all aspects of coal processing and utilisation. Also attending the conference were several dozen student delegates presenting their research. For the first time, a student panel was also convened to present the topic "The International Carbon Research Network" to the wider conference community. Participation in the student panel gave me an excellent opportunity to experience another aspect of the conference, apart from the usual attendance at panels and presentations.

Overall, I had a wonderful time and I feel that being able to experience research in another country and culture has broadened my understanding of what opportunities are out there and which ones might be potential future career paths for me.

Joanne on a weekend trip to Heidelberg, with its ruined castle and beautiful, Baroque-style Old Town on the banks of the River Neckar

126th BASF International Summer Course, Ludwigshafen

by David Barling [Ph.D]

In August 2013, I was fortunate to be invited to attend the 126th BASF International Summer Course which was held in Ludwigshafen, Germany.

The two week course brought in chemical engineers and chemistry PhD students from all over the world to learn about the operations of BASF and their career options at their company. When I say "fortunate", I mean I was VERY fortunate to be invited, as only one slot is offered to an Australian PhD student every 2 years!

The BASF headquarters in Ludwigshafen is certainly a sight to behold. I was blown away by its sheer scale – it is literally a small town in itself! It has its own railway stations, bus services, harbour and fire brigade. My visit included several site tours of various plants on site and opportunities to speak to lead engineers on how the Verbund system is implemented, adjusted and controlled. Verbund processing is certainly a feat of engineering and adds an extra level of complexity to the site which showcases BASF's solutions to innovation and sustainability. As part of the ten day Summer Course, we were able to cover an immense amount of information about BASF's core values and strategic principles, and how BASF is meeting them through new innovative materials and customer-tailored solutions. I was very impressed to learn that BASF invests over €1.7bn into its global R&D operations annually which in turn produce volumes of patents and innovations.

During the program we were also able to view new materials that BASF have been developing, including the OLEDs and the collaborative all plastic SmartforVision car (worth a visit on Google images!), as well as finding out more about its non-plastic competencies, including oil and gas and agricultural solutions.

The course, whilst intense was very rewarding. We were given lectures by senior employees of BASF, all of which were very accommodating and open. I also had the opportunity to meet some of the Members of the Board of Directors. Each night of the course involved extracurricular activities including networking nights and social events. These events allowed us to informally meet more BASF employees and get to know the Summer Course leaders and other students. By the end of the course each student was very relaxed and knew each well. Needless to say we were spoiled by the organisers each and every day and night, with great food and wine. We even had the pleasure to tour the BASF wine cellar, which is the largest in Germany and holds over 1 million bottles of wine!

There are plenty of career opportunities at BASF both at their headquarters in Ludwigshafen and all around the world – particularly in their growing regions of China and India.

One thing I have learnt is that employees at BASF have many opportunities to change jobs within the company and even change locations. As BASF is a global giant (with over 110,000 employees), there are engineers there that have spent their first few years in a similar field to their PhD, but then ventured into a completely different area within the company such as accounting and upper management.

The summer course was a real eye-opener for me and I hope that another Monash chemical engineer is selected to attend in 2015!"

David and the other participants/group leaders at the 126th BASF International Summer Course

Dr Meng Wai Woo and Associate Professor Cordelia Selomulya invited to join the Australia-China Young Researchers Exchange Program

Dr Meng Wai Woo and Associate Professor Cordelia Selomulya were selected for the Australia-China Young Researcher Exchange Fellowships and were a part of a delegation who went to China during September 2013.

The Australia-China Young Researcher Exchange Fellowships is an annual exchange scheme for young researchers between Australia and China. In 2013, it supported exchange between the two countries of up to 16 Chinese participants and up to 16 Australian participants from all universities/research institutions which meet the eligibility criteria.

This program is a joint initiative and is funded by the Australian Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE) and the Chinese Ministry of Science and Technology (MOST). It is supported by the Australia-China Science and Research Fund.

The objectivities of the program is to facilitate future long term science and research collaboration between Australia and China by bringing together future research leaders from both countries in order to foster long term relationships and develop early and mid-career Australian and Chinese researchers by increasing their understanding of the cultures, and particularly the science and research practices and systems, of the two countries and developing their leadership skills as future "science ambassadors" for Australia and China.

Success for first Chemical Engineering IITB-Monash Research Academy graduate

The innovative, transnational IITB-Monash Research Academy has produced its first Chemical Engineering PhD graduate with the inaugural graduation ceremony being held in August 2013 at the IIT Bombay campus.

During his research degree, **Dr Siddharth Gadkari** was supervised by Ravi Jagadeeshan (Chemical Engineering), Prabhakar Ranganathan (Mechanical & Aerospace Engineering), Papanasamoorthy Sunthar (IITB India) and Rochish Thaokar (IITB India).

His PhD research topic was "Viscous liquid jets and filaments in electric fields: stability analysis and role of viscoelasticity".

Based in Mumbai, the Academy was established in 2008 by Monash University and Indian Institute of Technology (IIT) Bombay with the aim of tackling the grand challenges facing both India and Australia.

Academy students reap the benefits of supervisors in two countries, exposure to industry and a jointly badged PhD.

From L-R: Vikram Vishal, Chancellor Alan Finkel, **Siddharth Gadkari**, Mohan Krishnamoorthy Shamsuddin.N. Ladha

The Academy has established a number of industry and research partnerships, including with CSIRO, BHPB and Orica Mining Services in Australia, and Infosys, Reliance Industries, Jindal Steel Works and Tata Consultancy Services (TCS) in India.

Since completing his PhD, Dr Gadkari has gained employment with COMSOL.

Meet our new staff member
Associate Professor Xiwang Zhang
Australian Research Fellowship/Monash Larkins Fellowship

The Department of Chemical Engineering is pleased to announce that Associate Professor Xiwang Zhang has joined the Department.

A/Prof Zhang holds an Australian Research Fellowship and a Monash Larkins fellowship, and will add to the department's overall expertise in membranes research. Specifically, his research is functional materials and membrane processes for water treatment (e.g. photocatalytic membrane, nanostructured sorbents, forward osmosis)

http://www.linkedin.com/pub/xiwang-zhang/21/63/ab4

After obtaining his Ph.D degree from Research Centre of Eco-Environmental Sciences, Chinese Academy of Sciences, in 2006, A/Prof Zhang joined Nanyang Technological University, Singapore as a Research Fellow and was then promoted to a Senior Research Fellow in July, 2009.

In 2010, A/Prof Zhang joined Keppel, a multinational corporation in Singapore as R&D Manager in Keppel's research centre, leading a research team for water treatment.

A/Prof Zhang was awarded a prestigious ARC Australia Research Fellowship in November 2010 and commenced his ARC fellowship at the University of Queensland in October 2011. This fellowship is internationally competitive, and only given to researchers of extremely high calibre, with quality research productivity.

In 2012, A/Prof Zhang was granted a prestigious Larkins Fellowship by Monash University, which allowed him to join Monash University. A/Prof Zhang brings to the Department a team of 5 [3 PhD students, one Posdoc and one Occupational Trainee].

A/Prof Zhang has published 48 peer-reviewed journal papers with a total citation of over 1000 [H-index: 18].

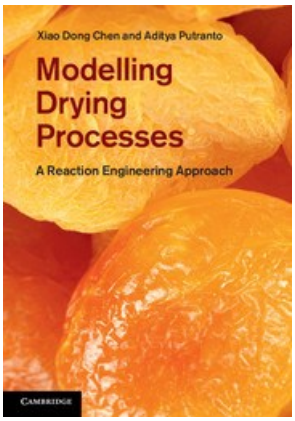
News in brief

- Congratulations to **Tarrant J. Falcke, Andrew F.A. Hoadley, David J. Brennan, Sarah E. Sinclair** for the award of "Process Safety and Environmental Protection Top Cited Papers for 2010 and 2011" for the paper: "The sustainability of clean coal technology: IGCC with/without CCS". This paper was published in: Process Safety and Environmental Protection, Volume 89, 2011
- **A/Prof Karen Hapgood** from the Department of Chemical Engineering in collaboration with Asst/Prof David A Morton, Prof Peter J Stewart, and Dr Stephanie J Parker have been successful in the Linkage Projects which were awarded in July 2013. Their project title is "Powder blending for dry powder inhalers: A new approach for direct control of powder structure"
- **A/Prof Cordelia Selomulya** from the Department of Chemical Engineering in collaboration with A/Prof John S Forsythe, Prof George P Simon, Prof Richard L Boyd, A/Prof David C Connell, and Dr Dan M Bates have been successful in the Linkage Projects awarded in July 2013 "Switching the light on cartilage repair"
- **A/Prof Cordelia Selomulya** has been appointed as Adjunct Professor of Chemical Engineering at the School of Chemical and Environmental Engineering, Soochow University, Suzhou, Jiangsu Province, P.R. China
- **A/Prof Andrew Hoadley** received the Senior Moulton Medal for the paper - Dr David Brennan, Dr Sarah Sinclair and Tarrant Falke are the co-awardees.
- **World rankings rise for Monash.** Monash remains in the 91-100 band with a rank of 91, representing an improvement of eight places since 2012. Monash is ranked in the top 50 in the world in three disciplines - Clinical, Pre-Clinical and Health (38); Arts and Humanities (45); and Engineering (49) in the world and fifth in Australia.
- **A/Prof Karen Hapgood** is now a Fellow of the Institution of Chemical Engineers. She received her Fellow pin from Judith Hackitt, CBE and President of IChemE, in Brisbane in September 2013.

PhD thesis now a successful textbook

Modeling Drying Processes, A Reaction Engineering Approach

By Xiao Dong Chen and Aditya Putranto, Monash University, Victoria



Aditya Putranto, a recently graduated PhD student of the department has successfully published his PhD thesis (based on 14 peer-reviewed top journal papers) as a textbook.

Professor Xiao Dong Chen, who was Aditya's principle supervisor, said that "The thesis is a comprehensive summary of the state-of-the-art and the ideas behind the reaction engineering approach (REA) to drying processes is an ideal resource for researchers, academics and industry practitioners. Starting with the formulation, modelling and applications of the lumped-REA, it goes on to detail the use of the REA to describe local evaporation and condensation, and its coupling with equations of conservation of heat and mass transfer, called the spatial-REA, to model non-equilibrium multiphase drying. Finally, it summarises other established drying models, discussing their features, limitations and comparisons with the REA. Application examples featured throughout help fine-tune the models and implement them for process design and the evaluation of existing drying processes and product quality during drying. Further uses of the principles of REA are demonstrated, including computational fluid dynamics-based modelling, and further expanded to model other simultaneous heat and mass transfer processes."

A Book Review by Professor Arun S. Mujumdar of the National University of Singapore [Drying Technology, DOI: 10.1080/07373937.2013.839288] states the "*book is a welcome addition to the technical literature. This is a simple but effective approach to mathematical modeling of an important unit operation—drying. For improved design and scale up of dryers at reduced cost, it is important to have relatively simple yet reliable mathematical models.*

This book makes a definitive contribution to this important area. The entire content of this book is based on the senior author's original proposal to use the basic principles of the chemical reaction engineering concept to model drying kinetics. Basically, the authors model evaporation as a zero-order reaction with activation energy. Condensation is treated as a first-order wetting reaction with respect to drying air vapor concentration without activation energy. The result of this approach to modeling is that the resulting equations are ordinary, which are easier to solve, as opposed to partial differential equations. More recently, this main advantage is less critical with the availability of suitable software to solve complex PDEs. This book has a total of four chapters. The first chapter gives an overview of the drying process and presents the basics of the senior author's own rreaction engineering approach to drying model. The next two chapters discuss two REA models, namely, the lumped-REA (L-REA) and the spatial-REA (S-REA). The application of these two approaches to various drying processes is discussed and applied to convective drying, intermittent drying, infrared drying, etc. The final chapter covers a comparison between the REA and other approaches such as the diffusion model, and Luikov and Whitaker's approaches. According to the authors, the REA model works as well as the diffusion model—and sometimes even better. Of course the relative precision will depend on the accuracy of the regressed parameters needed in both approaches. The REA approach has the obvious advantage of simplicity. The REA approach is being tested by many researchers around the world to model different drying operations subject to various boundary conditions. The jury is still out as to whether this approach will "disrupt" traditional approaches to semi-empirical modeling of dryers and drying. It doe how merit, as is shown in this concise monograph. This book is well written and highly readable, for which the authors must be applauded. I hope it will kindle the interest of new entrants to the drying R&D arena. To sum, this handy book can be a good reference for researchers working in the area of drying and those who want to try this approach in their research and development efforts. The production editors must be congratulated for an excellent editorial job and the publishers for producing a very attractive book. It is recommended for individuals working in drying as well as libraries servicing drying R&D in academia and industry."

Congratulations Xiao Dong and Aditya on their success!

Oxford Summer School on Neutron Scattering, 2nd to 13th September 2013 by Huazhen Li

Since the discovery of neutron by James Chadwick in 1932, neutron scattering techniques have become powerful tools that allow scientists to explore the unknown in the fields of materials science and engineering, physics, chemistry, earth science and biology, at atomic or molecular levels.

I was lucky to be one of the 50 participants selected worldwide to attend the 13th Oxford Summer School on Neutron Scattering, which was organized by ISIS and held at St. Anne's College, University of Oxford, from 2nd to 13th September.

As one of the top summer schools on neutron scattering in the world, this Oxford summer school aimed at delivering an ideal introduction to the theory, techniques and applications of neutron scattering, by providing an intensive series of lectures, exercise classes and tutorials in the area of neutron scattering.

Given by 22 lecturers who were all acknowledged as international experts in their field, the lectures offered comprehensive exposure to neutron scattering from the theoretical background, through to neutron sources and instrumentation and the application of these techniques to a diverse range of disciplines.

Topics covered during the school included:

- The properties and sources of neutrons
- Neutron Instrumentation
- Theoretical description of neutron scattering
- Elastic scattering and spectroscopy
- Polarized techniques
- Hard and Soft condensed matter, biology and engineering research using neutrons

The topics were backed up by tutorial sessions in small groups with the course lecturers. This offered the best opportunity to discuss the course material with the lecturers, to work through examples drawn from the course material, as well as to share research experiences with other course participants.

Was it all about lectures? Of course not! While at the Oxford Summer School, a tour was arranged to visit the ISIS facility which is situated at the Rutherford Appleton Laboratory on the Harwell Science and Innovation Campus in Oxfordshire, where all participants enjoyed a unique experience at the neutron beam lines.

The highlight of the program was the interactive session on Scientific Communication which provided some hands on experience of how science can be communicated. This amazing session covered topics including an introduction to science communication theory and practice, demos for explaining science to the public, and an introduction to working with the media, capturing the interest of journalists and inspiring the public through quality media coverage.

Attending this school was the best chance for me to learn this technique at the early stage of my PhD, kick starting neutron scattering study, the key part of my PhD research. Also this was a great opportunity for me to meet top scientists working in the same area and have communication and interaction with them. Click here for more information about the Oxford School on Neutron Scattering.

Society of Monash University Chemical Engineers (SMUCE) President—Rhett Richardson, 2013

As 2013 comes to an end, I thought I would share with you the achievements of SMUCE during 2013 and on a more personal note, I thought I would share with you my experience of SMUCE.

About 3 years ago, I was sitting in my 2nd year Thermodynamics lecture and witnessed Dr. Adam Rady himself come in and spruik SMUCE to all of my year level. I remember sitting there and thinking to myself "Hmmm, SMUCE ey, that sounds pretty kool, I wonder if I could be president of that club one day?" And so that semester I volunteered as a 2nd year representative, eager to begin working towards this goal. In the next year, I had the chance to continue my role as a 3rd year representative however in my 4th year of the double degree, I took the opportunity to go on study exchange to Sweden and travel around Europe. That's all well and good, an amazing story for another time, but it is the three weeks prior to my landing in Stockholm that I wish to focus upon. Here, I spent the Christmas and New Year of 2011 in Mumbai seeing some of my family for the first time. Needless to say, this was an eye-opening experience for me. Just as it is impossible for me to fully communicate how amazing it is to see the aurora borealis or climb to the top of the Eiffel Tower, the same goes for communicating the pain and suffering I saw first hand on the streets in India. This experience changed me. I fully believe that the next step after we have found our dream jobs and settled into lavish lifestyles is giving back to those less fortunate than us!

Coming home at the end of my travels abroad, I sought to contribute in my own way to the people around me. In my final year of chemical engineering, I became the president of SMUCE. I achieved my re-defined goal of contribution and giving back. And I hope that this contribution, albeit small and simple in its own way, has genuinely helped all of you.

THE WHAT, THE HOW AND THE WHY OF SMUCE IN 2013!

Firstly, **THE WHAT**: the exhaustive list of achievements and events of the SMUCE club:

- In 2013, SMUCE increased in membership with approxmately 160 members signed up to the club,
- Our weekly lunchtime industry seminars featured over 12 different companies,
- Our Trivia night at Sir John's Bar was a success,
- New this year, our Chemical Engineering Careers Guide proved to be a valuable resource for students,
- We continued to take unit evaluation feedback for all chemical engineering units,
- We held combined lectures with other universities,
- Mentoring program,
- Sustainable Beer Brewing BBQ, and
- of course the amazing SMUCE Gala Dinner.

The list of achievements is numerous.

THE HOW: How did SMUCE successfully achieve each of these events this year? With the tireless efforts of an extremely hardworking and dedicated committee!

- William Huggett, the Social VP who was responsible for organising all the social events and SMUCE's amazing Annual Dinner,
- Jerard Koon, the Academic VP.
- Julia Mardjetko, the SMUCE Secretary and Priya Khanna, Treasurer both responsbile for handling the administration aspects of the club.
- The 4th year representatives, Liam Cullen, David De La Cruz and Karinna Saxby
- The 3rd year representatives, James Cavallo, Alexandra Gummer, Clare Keogh and Fatema Husain for diligently and effectively completing all tasks.
- The 2nd year representatives, Georgia Jaffray, Ilia Lyamin and Kim Boon Sho.

SMUCE has an amazing working relationship with the Department of Chemical Engineering and specifically I would like to thank A/Prof Karen Hapgood, Dr. Esther Ventura-Medina, Chloe Priebee, Wren Schoppe, Lilyanne Price, Ronald Graham, Kim Phu and Helen Bean for all of the support they have given to SMUCE this year.

THE WHY (Why do we SMUCE)?
A core mentality of the 2013 SMUCE committee was striving to increase the opportunities and awareness of our student members. And finally to all of the SMUCE members for coming along to our events, our SMUCE Annual dinner and the student support for the club. I sincerely thank-you on behalf of everyone you have helped. Ultimately all of this hard work was for you and thank-you so much to everyone for your participation during 2013.

"All our dreams can come true...if we have the courage to pursue them." - Walt Disney

James Cavallo

Academic Vice President [2014]

SMUCE

Society of Monash University Chemical Engineers

C/O Department of Chemical Engineering,

Building 35, Room 226

Monash University, Clayton Campus 3800

Society of Monash University Chemical Engineers (SMUCE) 2014 Committee

President	William Huggett
Vice President (Social)	Alexandra Gummer
Vice President (Academic)	James Cavallo
Vice President (Industry)	Kim Sho
Treasurer	Ilia Lyamin
Secretary	Georgia Jaffray
4th Year Reps	Fatema Abbas Husain Monica Montanaro Timothy Cottew
3rd Year Reps	Cameron Ekins Alex Grufas Jason Wu
2nd Year Reps	Laura De Rango Michael Lam James Ng
SMUCE office	located opposite the E1-E3 lecture theatres (ground floor of Building 32)
Email	smuce@monashclubs.org
Check out SMUCE on	Facebook

Connecting Monash Chemical Engineering students with Industry

The Society of Monash University Chemical Engineers (SMUCE) is the student organisation responsible for linking together industry, the Monash Chemical Engineering Department and Monash students. Throughout the year, SMUCE invites industry members to talk to students about their company, being a chemical engineer and to inform students about possible career opportunities. There are also promotional opportunities available such as listing in the **SMUCE 2014 Careers Guide**. If your company would like to connect with SMUCE and Monash Chemical Engineering students, please contact Kim Sho, Industry Vice President.

Kim Sho

Industry Vice President [2014]

SMUCE

Society of Monash University Chemical Engineers

C/O Department of Chemical Engineering,

Building 35, Room 226

Monash University, Clayton Campus 3800

The Department welcomes the following new HDR students starting their degree [July—October 2013]

PhD:

- **Ms Azila Azura Juma'at** [Supervisors: Cordelia Selomulya, Dong Chen] **Research Topic:** Towards Energy-Efficient Manufactire of Dairy Powders via Spray Drying
- **Mr Tao Xu** [Supervisors: Sankar Bhattacharya, Klaus Hein] **Research Topic:** Study on Ni-based catalyst for syngas production from Biomass gasification
- **Mr Huiyuan Liu** [Supervisors: Xiwang Zhang, Huanting Wang] **Research Topic:** The effect of microstructure on the photocatalytic activity of grapheme-TiO2 composites
- **Miss Zhouyou Wang** [Supervisors: Xiwang Zhang, Huanting Wang] **Research Topic:** Photocatalysts with Visible and Near Infrared Light Response: Multifunctional Materials for Energy Conversion and Environmental Treatment
- **Mr Xiangkang Zeng** [Supervisors: Xiwang Zhang, Huanting Wang] **Research Topic:** Development of iron oxide based nanostructured biosorbents and biocatalyst for wastewater treatment

PhD (Dual Award - International) (Fudan/Moansh University):

- **Mr Biao [Andrew] Kong** [Supervisors: Cordelia Selomulya, Dongyuan Zhao] **Research Topic:** Design and preparation of novel mesoporous materials by microfluidic spray for energy and catalytic

Masters:

- **Mr Boyu Han** [Huanting Wang, Kun Wang] **Research Topic:** The application of polymer membranes and nanoporous membranes in fuel cells
- **Ms Krystel [Yen-Yen] Li Pin Hiung** [Cordelia Selomulya, Dong Chen] **Research Topic:** Microfluidic drying as an efficient route to manufacture high-value nutraceutical products
- **Ms Sheryl [Soo Fun] Moh** [Akshat Tanksale, Gil Garnier] **Research Topic:** Fundamental Understanding of the Effect of Promoters for Nickel based Catalysts

Congratulations to the following HDR students completing their degree [July—October 2013]

PhD:

- **Dr Abhishek Saxena**, Thesis Title: "Laser-assisted surface modification and organo-silane coatings for corrosion resistance of magnesium alloy AZ91D" [Supervisor: Raman Singh]
- **Dr Aditya Putranto**, Thesis Title: "Theoretical extension and innovative applications of reaction engineering approach to modeling drying and other transport processes" [Supervisor: Xiao Dong Chen]
- **Dr Siew Pei Hoo,** Thesis Title: 'Development of a novel 3D hydrogel for tissue engineering and microfluidics applications' [Supervisor: Peggy (Pui Yik) Chan]
- **Dr Ronald Halim,** Thesis Title: "Lipid extraction from microalgae for biodiesel production" [Supervisor: Paul Webley]
- **Dr Aashish Jain,** Thesis Title: Unravelling the dynamics of semidilute polymer solutions using Brownian dynamics [Supervisors: Ravi Jagadeeshan]
- **Dr Fatin Muhammed Nawwab Al-Deen** Thesis Title: "On the delivery of blood stage malaria DNA vaccine using magnetic nanoparticles" [Supervisors: Cordelia Selomulya, Ross Coppel (Microbiology)]

PhD (IITB/Moansh):

- **Dr Siddharth Gadkari** Thesis Title: "Viscous liquid jets and filaments in electric fields: stability analysis and role of viscoelasticity" [Supervisors: Ravi Jagadeeshan, Prabhakar Ranganathan (Mech Eng), P. Sunthar (IITB India), Rochish Thaokar (IITB India)]

Company participation?

Would your company like to offer any of the following?

- **Vacation Work Experience to our undergraduate students**
- **Graduate Positions (Undergraduate and Postgraduate)**
- **Speak to undergraduate students at a lunch time seminar about your company**
- **Become a corporate sponsor or donate a student prize**

***Would you like to receive future issues of ChemEng Focus?* If so, please email lilyanne.price@monash.edu and we will add you to our newsletter mailing list.**

Department of Chemical Engineering
Monash University
PO Box 36
Clayton Victoria 3800
Tel: +61 3 9905 1872
Fax: +61 3 9905 5686