

# cea

chemical engineering in australia

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**Cassini snapped this vista in 2006, showing smoggy Titan behind the small satellite Epimetheus and Saturn's A and F rings.** PHOTO: NASA/JPL

## Not as we know it

As the most Earth-like satellite in the solar system, Titan, Saturn's largest moon, has long fascinated science fiction authors with the tantalising possibility of extra-terrestrial life. Now, a team of chemical engineers and astronomers has modelled a possible type of life that could survive and reproduce on the moon's surface.

The researchers from Cornell University created a template based on methane, which is abundant in Titan's atmosphere and also thought to be present in liquid form in large seas. A theorised cell membrane, composed of small organic nitrogen compounds and capable of functioning in liquid methane temperatures of  $-180\text{ }^{\circ}\text{C}$ , was described in a paper published in *Science Advances*.

Co-author Jonathan Lunine, director for the university's Center for Radiophysics and Space Research was a scientist on the Cassini-Huygens mission, which discovered Titan's methane-ethane seas. Intrigued by the possibility of methane-based life, he sought assistance with the modelling from Cornell's chemical engineering faculty. Paulette Clancy, a Cornell professor in the Department of Chemical and Biomolecular Engineering, led the work, with first author James Stevenson, a graduate student in chemical engineering.

"We're not biologists, and we're not astronomers, but we had the right tools," Clancy said. "Perhaps it helped, because we didn't come in with any preconceptions about what should be in a membrane and what shouldn't. We just

**Inside:** Dr Andrew Jamieson takes the helm

worked with the compounds that we knew were there and asked, 'If this was your palette, what can you make out of that?'"

On Earth, life is based on the phospholipid bilayer membrane, which creates a strong, permeable vesicle to house almost every living cell – a liposome. The engineers named their theorised cell membrane an "azotosome", "azote" being the Greek-derived French word for nitrogen.

The azotosome is made from nitrogen, carbon and hydrogen molecules known to exist in the cryogenic seas of Titan, but shows the same stability and flexibility that Earth's analogous liposome does. This stability came as a surprise, according to Clancy and Stevenson, who normally study semiconductors.

The engineers employed a molecular dynamics method that screened for candidate compounds from methane for self-assembly into membrane-

like structures. The most promising compound they found was acrylonitrile, which showed good stability, a strong barrier to decomposition, and a flexibility similar to that of phospholipid membranes on Earth. The colourless, poisonous, liquid organic compound is used on Earth in the manufacture of acrylic fibres, resins and thermoplastics, and is present in Titan's atmosphere.

The next step is to try and demonstrate how these cells would behave in the methane environment, Clancy said: what might be the analogue to reproduction and metabolism in oxygen-free, methane-based cells?

Stevenson said he was in part inspired by science fiction writer Isaac Asimov, who wrote about the concept of non-water-based life in his 1962 essay *Not as We Know It*.

"Ours is the first concrete blueprint of life not as we know it," he said. ■



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# New IChemE president takes the helm

**D**r Andrew Jamieson has become the 75th president of IChemE, pledging to further advance relationships and partnerships in Africa. Jamieson, who finished his career at Royal Dutch Shell as executive vice president for gas and projects in Shell International in 2009, is a Fellow of IChemE and the Royal Academy of Engineering.

Jamieson held several managerial and directorial positions during the 35 years he spent working for the company, notably as managing director and CEO of Shell subsidiary Nigeria LNG on Bonny Island from 1999 to 2004.

In 2006, Jamieson was made an Officer of the Order of the British Empire by the UK government for "services to British business and sustainable development in Nigeria".

He currently holds non-executive director positions for Woodside Energy, Hoegh LNG Holdings and Velocys, and is also chairman of Seven Energy International. Jamieson replaces Geoff Maitland, professor of energy engineering at Imperial College London.

During his presidential address, titled 'Continuity and change – a history of the future of IChemE', Jamieson said that he was honoured to take up the position as president and pledged to continue IChemE's mission to advance chemical engineering worldwide.

"Few professional disciplines have such potential to make a positive impact on society as chemical engineering," Jamieson said. "Moving on from its genesis in wartime, the profession has demonstrated its contributions to the well-being of society in the fields of sustainable food supply, new materials, adequate and safe supply of water, advancing human health and well-being.

"More complex challenges remain to be tackled, and perhaps pre-eminently, the challenge of reshaping the world's energy mix, while keeping the lights on and the wheels of economies turning, will demand that chemical engineers rise to the occasion."



**Former IChemE president Geoff Maitland (L) and 75th president Dr Andrew Jamieson.**

PHOTO: IChemE

Jamieson is keen to advance IChemE's work in Africa, where the institution has recently launched a partnership with the South African Institution of Chemical Engineers, and in Nigeria, where membership is rapidly expanding.

"Africa is the global economy's last frontier and we should not ignore it," Jamieson said. "It is my aim to use my experience and enthusiasm for Nigeria to explore avenues to advance our relationships with the Nigerian chemical engineering community.

"I am keen to see the appointment of senior ambassadors in that country and I want to see what more can be done to develop IChemE's community in a country with enormous potential." ■

**Jonathan Seville**, executive dean of the faculty of engineering and physical sciences at the University of Surrey, has joined the IChemE council and was appointed IChemE deputy president. Also joining IChemE's Council in 2015 is Australian engineer **Rose Amal**, scientia professor at the University of New South Wales, and New Zealander **David Platts**, managing director of PDV Consultants.



PHOTO: RAYMOND BRYSON VIA FLICKR

## Chemical industry gets a boost

**A** new initiative has been launched with the aim of boosting innovation in the Australian chemical industry, with the support of the Victorian government.

The Chemicals and Plastics Manufacturing Innovation Network and Training Program is led by Monash University and the Plastics and Chemicals Industries Association (PACIA), underpinned by the state's Department of Economic Development, Jobs, Transport and Resources.

The partnership has an initial investment of \$5.9 million.

Victoria's minister for industry and for energy and resources Lily D'Ambrosio said the program would spur growth in the sector.

"The Australian chemistry industry is the second largest manufacturing sector in Australia," D'Ambrosio said, adding the new initiative would act as a catalyst for global investment, innovation and productivity.

The program aims to bring multinational firms, SMEs and PACIA together with research organisations to create opportunities, increase collaboration, enhance manufacturing, and deliver a new generation of industry professionals.

Joseph Lawrence, Monash University's director of industry partnerships, said students would benefit from the joint influence of academia and industry.

"The program gives industry a role in fostering the next

generation of chemical scientists and engineers," he said.

PACIA CEO Samantha Read said the Australian chemistry industry provides products and services that feed into 109 of 111 industry sectors, creating a multiplier effect in jobs and investment.

"Collaborative innovation in science and industry is key to driving manufacturing growth, improving products and processes, and contributing to sustainable economic growth into the future," Read said.

More than 20 industry participants have joined the initiative, including BASF, Procter & Gamble, Dulux Group, CSIRO and the Australian Nuclear Science and Technology Organisation. ■

# Projects offer safety lessons

Process safety issues were a major factor in the world's two most controversial projects last year, according to a new report.

Number one on RepRisk's *Most Controversial Projects* list was the Zhongrong Metal Production Company's factory in Kunshan, China, which suffered a dust explosion in August that killed 146 workers and injured 114 others. Grupo Mexico's Buenavista del Cobre mine in Mexico came in second, which RepRisk attributed to a major spill of sulphuric acid into the Sonara and Bacanuchi rivers, also in August.

Australia's Abbot Point Port Expansion made equal third on the list, with RepRisk stating ecosystem and community impact, waste and pollution were issues linked to the project.

The report identified the 10 projects most exposed to environmental, social and governance (ESG) risks in 2014. The firm screened data from a range of public sources in order to quantify ESG risks and express them using a Reputational Risk Index (RRI).

The Zhongrong factory saw its RRI peak at 83 out of a possible 100 after the explosion, which was caused by the spontaneous combustion of aluminium dust that had accumulated on the premises.

Chinese authorities accused the company of failing to prevent the build-up of dust. RepRisk stated there had been another dust-related fire at the site two months before the blast, and the company repeatedly ignored warnings from local authorities about the risks associated with metal dust. The firm was also criticised for environmental and safety issues related to its waste gas and water discharges.

At the end of August, the Zhongrong chairman, general manager, and production manager were arrested, and 15 Kunshan city officials are also facing prosecution. The NGO China Labor Watch argued that General Motors and its subsidiary General Motors China were also partly responsible, because the factory was their second-tier supplier.

Around the same time, 40,000 m<sup>3</sup> of sulphuric



**Contaminants from the Buenavista del Cobre mine turned local waterways orange. Mexico's environment secretary called it the "worst natural disaster provoked by the mining industry in the modern history of Mexico".**

PHOTO: JESUS BALLESTEROS/EXPRESO-CUARTOSCURO.COM

acid were spilled into Mexican rivers as a result of a defective pipe seal at the Buenavista del Cobre mine. According to RepRisk, the spill deprived 20,000 people of water, destroyed crops and cattle, and contaminated wells and soil.

Grupo Mexico originally stated the accident had been caused by an "unusual amount of rain", a claim that was rejected by Mexico's Ministry of the Environment. Profepa, the country's environmental protection agency, filed charges against Buenavista del Cobre SA for violating environmental laws and for possible negligence in the handling of hazardous substances.

Toxic spills also led to controversy around the Mount Polley mine in Canada and the Dan River Steam Station in the US, which were listed at sixth and eighth respectively.

Trish Kerin, director of the IChemE Safety Centre, told *The Chemical Engineer* the events could not be considered "black swans".

"This means each of them was absolutely preventable, had the principles of good process safety engineering been applied," she said. "There are clear lessons for all of us working in engineering fields." ■

# IChemE Australasian training & events 2015

## June

Layer of Protection Analysis  
15 - 16 June, Melbourne, VIC

## July

HAZOP Study for Team Leaders & Team Members  
7 - 9 July, Melbourne, VIC

Fundamentals of Process Safety  
13 - 17 July, Brisbane, QLD

## August

Energy Cost Reduction  
4 August, Brisbane, QLD

Process Safety & the Board  
5 August, Melbourne, VIC

Human Factors Analysis Tools  
18 - 19 August, Melbourne, VIC

Fundamentals of Process Safety  
24 - 28 August, New Plymouth, NZ

## September

APCCChE 2015 Congress  
27 Sept - 1 Oct, Melbourne, VIC

International conference on Coal Science & Technology  
27 Sept - 1 Oct, Melbourne, VIC

## October

Fundamentals of Process Safety  
12 - 16 October, Melbourne, VIC

Layer of Protection Analysis  
20 - 21 October, Hamilton, New Zealand

HAZOP Study for Team Leaders & Team Members  
20 - 22 October, Perth, WA

## November

Process Safety Awareness  
4-5 November, Perth, WA

HAZOP Awareness  
10 November, Brisbane, QLD

Chemical Engineering for Non-Chemical Engineers  
18 - 20 November, Perth, WA

Establishing & Maintaining a Safety Culture  
24 - 26 November, Brisbane, QLD

## In-company training

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# Shell resumes US Arctic drilling

Energy giant Shell has received permission from the US government to resume drilling in the nation's Arctic territory, after the firm's troubled exploration efforts in 2012.

The firm still requires permits from a number of other federal regulatory agencies, as well as the State of Alaska, but the recent signal from the US Interior Department's Bureau of Ocean Energy Management (BOEM) indicates the government's approval and removes a major hurdle.

"We have taken a thoughtful approach to carefully considering potential exploration in the Chukchi Sea," BOEM director Abigail Ross Hopper said.

The drilling would be consistent with "high standards for the protection of this critical ecosystem, our Arctic communities, and the subsistence needs and cultural traditions of Alaska natives," she added.

The Chukchi Sea, which lies off the coasts of Alaska and Siberia, and is believed to be rich in oil reserves, was one target of Shell's Arctic exploration efforts three years ago.

The multi-billion dollar campaign was beset by difficulties. The containment dome, intended to counter potential underwater blowouts, was "crushed like a beer can" by deep sea pressures, according to federal Bureau of Safety and Environmental Enforcement inspector Mark Fesmire.

At the end of the drilling season, Shell's plans were left in tatters when the Kulluk, a drilling barge, broke away from its towing vessel in the Gulf of Alaska and ran aground on an island in the Kodiak Archipelago.

After the disaster Shell announced a pause in the drilling operations off the Alaskan coast, to allow the company to review its plans for the Arctic.

The firm's revised exploration plan proposes the drilling of up to six wells within the Burger Prospect, located in approximately 43 m of water about 113 km northwest of the village

of Wainwright, Alaska. Shell will conduct its operations using the drillship *Noble Discoverer*, part of the original 2012 effort, and the semi-submersible drilling unit *Transocean Polar Pioneer*, with each vessel providing relief-well capability for the other. The two drilling units and their supporting vessels will depart the Chukchi Sea at the conclusion of each exploration drilling season.

"The approval of our Revised Chukchi Sea Exploration Plan is an important milestone and signals the confidence regulators have in our plan," Shell spokesman Curtis Smith said.

The Interior Department is currently working through a reform agenda aimed at modernising and strengthening the Outer Continental Shelf (OCS) energy regulations, which govern drilling off the Alaskan coast.

In April, the Department announced proposed measures that include more stringent design requirements and operational procedures for critical well control equipment used in OCS oil and gas operations. The measures are designed to improve equipment reliability, and build on industry standards for blowout preventers and blowout prevention technologies, according to the BOEM. ■

Shell's drilling platform, the Kulluk, ran aground on Sitkalidak Island in 2012.

PHOTO: US COAST GUARD



# Hazards Australasia 2015 highlights

**C**lear communication, improving safety culture and turning complex issues into simple messages were some of the key points from this year's Hazards Australasia 2015, held last month in Brisbane.

A range of speakers shared their lessons learned from areas including oil and gas, water, polyethylene manufacturing, aviation, risk management, regulatory and insurance.

The Mary Kay O'Connor Process Safety Centre's Sam Mannan gave the inaugural Trevor Kletz lecture. Mannan's lecture covered some of Kletz's achievements and fundamental messages such as converting what appears to be common sense into practical philosophy. He also pointed out that industry should give equal importance to process safety issues as they give to production.

IChemE director for Australasia Peter Slane said the event saw a 20% increase in delegate participation from the inaugural 2013 event, an indication of how important Hazards Australasia is in the region.

"Each presentation was reinforced by another, and a well-received highlight of the event included a very emotional address by Beaconsfield mine disaster rescuer Darren Flanagan," Slane said.

"Darren's presentation drove home the reason why we do what we do – we want workers to be safe and to go home at the end of the day to their families."

The third Hazards Australasia conference will take place in Q4 2016. For more information, contact [April Hinde](#). ■

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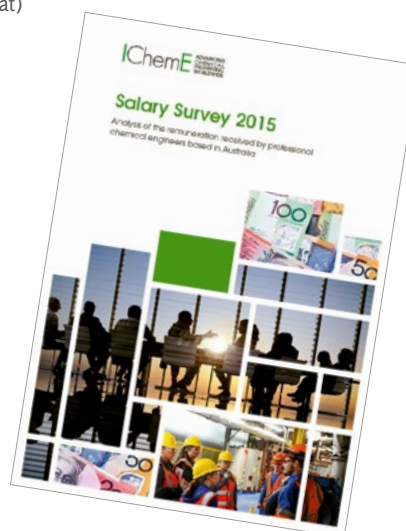
## 2015 Australian salary survey report – now available

IChemE's 2015 Australian salary survey report (in e-report or hardcopy format) is available for purchase at [www.icheme.org/shop](http://www.icheme.org/shop).

The report provides the most comprehensive salary data and trends of the Australian chemical and process engineering profession across all job levels and features detailed information on:

- salary trends over the years
- comparison by industry sector
- median salaries by region
- comparisons by type of work
- salary comparisons by education level
- employee benefits

For all other enquiries regarding the survey, please contact [Trish Dwyer \(tdwyer@icheme.org\)](mailto:Trish.Dwyer@icheme.org).





# The early history of process control teaching

by Mike Brisk

Control systems topics in undergraduate engineering education were first introduced in Australia about six years after the first US course in 1942, and only two years after the first UK undergraduate course. Some “automatic control” topics in undergraduate courses appeared in 1948 simultaneously, but independently, at the University of Adelaide, in electrical engineering; at the University of Queensland, also in electrical engineering but available to all final year engineering students; and the University of Sydney (USYD), where they were available to chemical engineering and electrical engineering students.

In 1948, USYD’s Department of Engineering Technology was renamed the Department of Chemical Engineering following the appointment of Australia’s first professor of chemical engineering, Tom Hunter, in 1947. Hunter was interested in automatic control, and introduced a course named Measurement and Instrumentation, covering the measurement and control of pressure, temperature, fluid flow, and liquid levels, together with automatic control theory, into the final year in 1948.

In 1950, half of the Industrial Chemistry course became Instruments and Process Control, with Donald Eckman’s 1945 book *Principles of Industrial Process Control* as a text. Apart from a shift in the balance towards PID control theory from instrumentation, there was little change until 1958, when Charles Sinclair, fresh from a master’s degree in chemical engineering at Edmonton, Canada, was appointed a lecturer. He introduced and taught a full final year subject on process control. In his own words, “... in best university lecturer’s style, set out to master transforms and block diagrams by keeping one step ahead of the poor students who had to suffer my learning process”. The initial text was *Automatic Process Control for Chemical*

*Engineers* by Norman Ceaglske. This proved too mathematical and was replaced by Eckman’s 1958 text *Automatic Process Control*.

This was the first full undergraduate course in process control in chemical engineering in Australia. Sinclair extended it in 1959 with the introduction of analogue computing for dynamic simulation of control loops (using two Systron-Donner 10 amplifier valve computers), and introduced a separate course in digital computing using the University’s SILLIAC computer. In 1959, as a final year student I wrote a SILLIAC assembler language program to simulate a feedback control system for my undergraduate thesis. This was the first use of a digital computer for an undergraduate chemical engineering thesis in Australia, and may have been the first engineering undergraduate thesis to use a digital computer.

Sinclair left Sydney at the end of 1960 to establish chemical engineering at Monash University. Hunter, in a typical “god professor” action of the time, appointed me, then a PhD student, as a temporary lecturer to teach process control in 1961 – two weeks before the start of first term! The subject developed progressively from then, with myself until 1965, then David Tolmie from 1966 to 1970, myself again from 1971 to 1982, followed by Geoff Barton from 1983. From 1986 John Perkins, and then Jose Romagnoli, successive holders of the ICIA Chair in Process Systems Engineering at Sydney, and both internationally known for research in process control, contributed. The modest start by Hunter had grown indeed! ■

**Mike Brisk is an emeritus professor and former dean to the Faculty of Engineering at Monash University.**

# Barry Collins receives AM honour

Former IChemE Australian board chair and Fellow Barry Collins has been named in this year's Queen's Birthday Honours list. Collins was recognised for his significant service to chemical engineering, through contributions to the mining, paper and steel industries, and to the community.

He is also responsible for introducing domestic production of catalysts for crude oil production, which previously had to be imported.

Prior to retirement, Collins was managing director and CEO of Catoleum Catalysts, and he served as chair on various industry, education and service organisation boards.

Collins said he was quite surprised to receive the honour, as he thought time had long past for such recognition.

"I guess I was lucky in my working life to be in the right place at the right time, during a period of major industrial expansion and where I always worked with good people," he said.

IChemE director for Australasia Peter Slane said Collins joined a growing list of chemical engineers who have been recognised for their achievements and contributions to industry and the community.

"Barry is an example of how leadership drives the profession forward and whose legacy will inspire others," Slane said.

## In brief

IChemE Fellow Prof Eric May from the University of Western Australia (UWA) and his co-authors have won best paper at the recent APPEA conference in Melbourne. May's presentation was on 'Attributes and behaviours of crude oils that naturally inhibit hydrate plug formation'.

The UWA IChemE Prize in Chemical Engineering Design Project 1 & 2 was awarded to Myles Hollingworth.

## Excellence awards

Nominations for the 2015 Awards of Excellence in Chemical Engineering are now open. The Awards are a joint effort by the EA Chemical College, IChemE in Australia, SCENZ-IChemE in New Zealand and RACI.

For more information, go to [www.anzfche.org/awards-of-excellence.php](http://www.anzfche.org/awards-of-excellence.php).

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