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## CHEMECA

# Building industry/university partnerships

Chemical engineering in the decades to come will be dominated by several main issues including sustainability, safety, risk, energy, health, water and bioprocessing, according to Dr David Brown, chief executive of the Institution of Chemical Engineers. These areas are outlined in the "Roadmap for the 21st Century" which the IChemE has produced as part of its Golden Jubilee this year.

Chemical engineers will be challenged to make their contributions in these areas, from improving the sustainability and safety of processes to more efficient uses of energy and water, Brown told the Chemeca 2007 conference in Melbourne last month in his plenary address.

The Roadmap identifies a number of common themes including a need for improved communication between all stakeholders, a continuing high demand for chemical engineers and a need for more multiskilled engineers.



Dr David Brown

Its implementation will require, among other things, better partnerships between academia and industry, with both sides needing to develop better mutual understanding, Brown said.

For instance, universities must be more willing to share their research outputs by linking with industry and by offering more incentives and flexibility to their own research staff. Universities must become

more business friendly, with business savvy staff easily accessible for their industry partners. They must also be willing to look at a more flexible mix of arrangements for the commercial exploitation of research, for example through fixed price, licensing or joint ventures.

Companies, on the other hand, must be willing to better understand the mindset of researchers and be consistent in their efforts to tap into the university research. They need to "stick with it", Brown said.

Also, industry should see universities not just as pools of knowledge, but as pools of talent too, he pointed out.

Overall, there should be more informal networks between the two sectors and the possibility for industry and university staff to work side by side on research projects, he said.

As for communication in the public domain, he said the IChemE intends to become more vocal. It has been recruiting "envoys" from its membership who would be competent and willing to speak to the media on engineering related issues at short notice.

The Roadmap is now being carried forward with action plans being developed for the different areas with a 10-year time frame. The IChemE's Australian arm will be focusing on energy and water, he said.

## Mix of solutions for energy supply

Meeting the world's future energy needs is not a problem of resources, according to Greg Lewin, president of Shell Global Solutions. The challenge is more about meeting the increasing demand for energy in a way that takes care of the environment, he told the Chemeca conference in Melbourne last month.



Mark Nolan

"We have to recognise that fossil fuels will continue to dominate the energy scene for the next few decades, with all that implies in terms of greenhouse gas emissions," he said.

That means engineers are called on to come up with new and advanced technologies for cleaner production of energy. Examples of such tech-

nologies are carbon dioxide geosequestration and coal gasification.

However, there is not one perfect solution to the energy challenge, he said. Progress will be made through a variety of approaches including better efficiencies, better demand management, differ-

ent fuel sources, renewable energy and cleaner fossil fuel technologies.

Mark Nolan, chair of ExxonMobil Australia, while expressing similar views on the technological challenges for energy supply, also stressed that any actions to curtail greenhouse gas emissions need to be balanced against the central importance of energy to the economies of the world.

## CONTENTS

Chemeca 2007	1
Whynotchemeng	3
Chemeca Awards	4
Chem-E-Cars	9
Chemeca 2008	9
IChemE president	10
Calendar	10

### NEWS

## Mixed responses from women

While there have been gains in some areas for female engineers in the workplace in the past few years, other areas have seen little improvement, according to the latest careers review of engineering women (CREW).

On the upside, there is now much more part-time work and family support available and there is virtually no difference between women and men in their job satisfaction, said Associate Professor Julie Mills in her presentation on the review.

The first national survey, leading to the first CREW, was conducted in 1999 and the second one earlier this year. The second CREW will be published next month.

Mills, who is from the University of South Australia, said on the downside the survey found that sexual harassment had diminished only marginally, with 22% of respondents having experienced it, compared with 27% in 1999, and that discrimination on the basis of gender had actually increased, with 42% of respondents having experienced it, compared with 36% in 1999.

Bullying was reported in the 2007 survey by 28% of respondents.

Mills said these findings suggest that there might be other reasons than family be-



*The session on women in engineering was chaired by Mark Toner (third from left) and the speakers were (l-r) Associate Professor Julie Mills, Dr Karen Hapgood, Andrea Hosey, Benita Husband and Andrew Wisdom.*

hind the decision of many female engineers to leave the profession early in their careers.

Her paper was part of a session on women in engineering which was included at Chemeca for the first time. She was one of five speakers.

Dr Karen Hapgood, senior lecturer at Monash University, in her presentation, suggested that there is an inverse correlation between the number of women in an organisation and the number of "adverse incidents" experienced by those women – the more women in the organisation the fewer "adverse incidents" experienced by each woman.

Therefore, she said improvements in

the workplace can be achieved by both changing the culture and increasing the number of female employees.

Her advice to young female engineers was to join companies that already have a number of other women in the organisation.

The other speakers were Andrea Hosey from Shedden Uhde, who spoke on the challenges of working part-time in engineering design; Andrew Wisdom from Arup, who outlined the company's program to encourage diversity; and Benita Husband from Connell Wagner, who presented a personal approach to career issues for female engineers.



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## CHEMECA

### Launch of "Why not chemical engineering"

The Institution of Chemical Engineers (IChemE) has launched its successful whynotchemeng (WNCE) campaign, designed to attract more students to chemical engineering, in Australia.

The campaign is based on the website [www.whynotchemeng.com](http://www.whynotchemeng.com), which now has a dedicated Australian section featuring case studies of young chemical engineers across the world, with local entry requirements, links to the ten chemical engineering departments and a comprehensive employer listing.

WNCE was initially run in the UK in 2002 to address the growing decline in students choosing chemical engineering as a first degree and the negative perception of the discipline.

The campaign, which has illustrated the positive contributions chemical engineers are making all over the world, has had a positive response in the UK. In the past five years, chemical engineering applications to UK universities have risen by 70% – with admission figures up by nearly half.

Greg Lewin, immediate past IChemE president and president of Shell Global Services, launched the Australian cam-



*IChemE's immediate past international president Greg Lewin launching the Australian version of the highly successful whynotchemeng campaign at Chemeca. With him are IChemE chief executive Dr David Brown and IChemE in Australia executive director Jan Althorp.*

paign last month at Chemeca in Melbourne. "The website provides a great starting point for anyone who wants to find out more about chemical engineering," he said.

However, he stressed that the campaign needs volunteers who are willing

to go into schools and colleges to spread the message.

Lewin thanked the sponsors of the campaign, being ExxonMobil, Foster Wheeler, BP and Shell as well as all the university departments that have been involved.

## EA BOOKS

### Safety Case Guideline – Second Edition

*Victoria Chapter, Risk Engineering Society, Engineers Australia*

Managing safety is moving from the isolated application of strictly technical tools to a more robust safety case approach that applies multiple assessment methodologies to demonstrate that both technical and organisational risks are managed effectively. With the growing emphasis on performance-based legislation, the safety case is not only a mechanism for achieving safety goals but has also become an important liability management tool. Three types of risk are defined, and seven paradigms for assessing downside risk and three enquiry methods of "risk sign off" are described. This second edition has been prepared in response to significant changes made to Australian Risk Management Standard AS/NZS 4360:2004 and the Victorian Occupational Health and Safety Regulations 2007. As a result four major changes have been made # A common law 'duty of care' approach is now being taken # risk management is moving away from the concept of 'acceptable' risk to 'not intolerable' risk # All references to 'best practice' in the Guideline now read 'good practice' # Focus on Controls rather than Risk Assessment.

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### Perry's Chemical Engineers' Handbook

*Robert H Perry, D W Green*

First published in 1934, Perry's Chemical Engineers' Handbook has equipped generations of engineers and chemists with an expert source of chemical engineering information and data. Now updated to reflect the latest technology and processes of the new millennium, the Eighth Edition of this classic guide provides unsurpassed coverage of every aspect of chemical engineering – from fundamental principles to chemical processes and equipment to new computer applications.

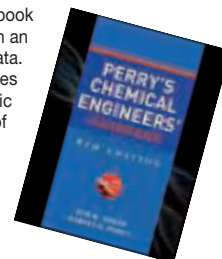
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## CHEMECA AWARDS

### Better yields needed to feed the world

As the demand for food rises due to population growth, the price of food will rise, according to Doug Rathbone, winner of the 2007 Chemeca Medal, which is the most prestigious individual award in the chemical engineering profession in Australia and New Zealand.

The world currently has four to five hectares of arable land per person, he said in his acceptance speech. At the current world population, about 3ha of arable land is available per person. However, this ratio will diminish to 1.8ha per person in 10 years, he said. This means better yields will be needed.

Another emerging pressure on the food supply is the demand for biofuels, he said, warning that new technologies must be developed to avoid valuable protein to be siphoned off for vehicle propulsion.

Rathbone is the managing director and chief executive of Melbourne-based crop protection company Nufarm Limited. The group now employs more than 2500 people and presently generates an annual turnover of \$1.7 billion worldwide.



Doug Rathbone (l) receiving the Chemeca Medal from IChemE in Australia deputy chair Russell Scott.

ALL CHEMECA AWARD PHOTOS BY VICKY JONES

### Celebrating excellence

Several awards for excellence in chemical engineering were presented at this year's Chemeca Conference in Melbourne last month.

#### AKER KVAERNER DESIGN PRIZE

This prize recognises the outstanding final year design project from Australia and New Zealand chemical engineering departments.

**Winners: Adam Carr, Jemma Nokes, Lillian de Melo, Yi-Hsia Koh, William Naderi, and Ven Chian Quek**

The team from Sydney University won this award for the design of a sulfuric acid plant at Phosphate Hill. They carried out the project under the supervision of Assoc Prof Don White.

#### ALSTOM AWARD (\$3000 and certificate)

This award recognises outstanding contributions in the industrial field from a chemical engineer under 30 years of age. A candidate must be a member of Engineers Australia, IChemE, SCENZ or RACI.

#### Winner: Ross Dunbar

Ross Dunbar joined ExxonMobil Australia in 2003 after graduating from the University of New South Wales with honours and the University Medal in Engineering (Industrial Chemistry). He has worked in several engineering roles in oil and gas production operations in Australia. He has developed a reputation for his depth of technical understanding of complex plant operations. During his time with ExxonMobil, Dunbar has progressed a broad range of projects across the Longford plant operations to increase efficiency, improve liquids processing, and reduce fuel usage and flaring.



Receiving their Aker Kvaerner Design Prize were (l-r) Jemma Nokes, Adam Carr and William Naderi, shown here with Associate Professor Don White (second from left).



Ross Dunbar (r) receiving his Alstom Award from John Barnard, Alstom general manager for sales.



## CHEMECA AWARDS

### CALTEX TEACHING AWARD (\$5000 and certificate)

This award recognises outstanding achievements in the teaching of chemical engineers.

#### Winner: Sandra Kentish

Dr Sandra Kentish is a senior lecturer at the University of Melbourne. Her focus, particularly in her teaching of the final year design project, is to prepare students for the challenging workplace they are about to enter. She is involved in a wide range of other teaching activities, including working with high school teachers, teaching at the postgraduate level, student mentoring and career advice, and speaking within teaching-related conference programs.

### EXXONMOBIL AWARD (\$5000 and certificate)

This award recognises significant ongoing contributions to chemical engineering through innovations or a series of related publications over a number of years.

#### Winner: Max Lu

Prof Max Lu is a Federation Fellow and professor of nanotechnology in chemical engineering at the University of Queensland. He is director of the ARC Centre of Excellence for Functional Nanomaterials. His research experience is in nanoparticles and nanoporous materials for clean energy and water purification. He is among the highest cited researchers in the world in chemical engineering and materials science, and has received many national and international awards.



*Dr Sandra Kentish receiving her Caltex Teaching Award from Caltex CEO Desmond King.*



*Prof Max Lu (r) receiving his ExxonMobil Award from ExxonMobil Australia chairman Mark Nolan.*

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### CHEMECA AWARDS

#### FLUOR AWARD (\$5000 and certificate)

This award recognises exceptional management and leadership talent that has directly resulted in a sustained corporate success over a significant period.

#### Winner: Louise McKenzie

Louise McKenzie joined ExxonMobil Australia in 1992 after graduating from the University of Melbourne with honours in chemical engineering. She has worked in engineering, planning and management roles in oil and gas production operations, in Australia and the US.

She became the first female manager of Esso Australia's Gippsland operations.

#### FONTERRA AWARD (NZ\$4500 and certificate)

This award recognises outstanding contributions in the industrial application of novel technology in the bioprocessing field from an individual or group of chemical engineers in Australia or New Zealand. Achievements may be in technical or management fields. The candidate must be a member of Engineers Australia, IChemE, SCENZ, or RACI, and under 50 years of age.

#### Winner: Conan Fee


Prof Conan Fee is internationally recognised for his theoretical and applied research in bioprocess engineering, especially in the areas of



Fluor Australia's Dr David Dolan presenting the Fluor Award to Louise McKenzie.



Hugh Waters (l), Fonterra's process support manager, presenting the Fonterra Award to Professor Conan Fee.

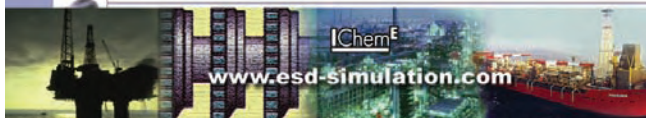


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### CHEMECA AWARDS

therapeutic protein PEGylation and protein purification.

In 2006 he was appointed professor at the Department of Chemical & Process Engineering at the University of Canterbury.

**RIO TINTO AWARD** (\$5000 and certificate)

This award recognises outstanding applied chemical engineering.

**Winner: Peter Beckingham**

In a career spanning more than 30 years, Peter Beckingham has played a significant role in the petrochemical industry in Australia.

Most recently he played a lead role in the conversion of the number one Qenos steam cracker plant in Altona.

**WORLEYPARSONS AWARD** (\$5000 and certificate)

This award recognises personal commitment and leadership by a chemical engineer in the area of safety and/or the environment.

**Winner: Ian Lake**

Ian Lake has spent more than 20 years undertaking specialist risk management work for ICI/Orica and as a risk consultant to many other companies and organisations.

He has authored an extensive number of hazard analysis reports and quantitative risk studies, and has presented training courses throughout the world.



*Peter Beckingham receiving his Rio Tinto Award from Dewetia Latti, Rio Tinto's principal adviser for external technology.*



*Ian Lake (l) receiving his WorleyParsons Award from Lindsay Wheeler, WorleyParsons director engineering corporate.*



Industries + Universities —————> Better Graduates

## Participate and Help Drive this Reaction!

**IChemE Chemical Engineering Education Subject Group Forum**

Saturday 1st December 2007, University of Queensland Staff Club

9 – 5pm,

Opening speaker: Professor Ian Cameron:

"Chemical Engineering Education: Past, Present and Future Curricula"

followed by dinner 6.30pm

Dinner speaker: Professor Paul Greenfield

Senior Deputy Vice-Chancellor University of Queensland

**Register to attend...**

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### CHEMECA AWARDS

#### **SHEDDEN UHDE AWARD** (\$4000 and medal)

This award recognises practical services to the profession and to the practice of chemical engineering in Australia or New Zealand. A candidate must be a member of Engineers Australia, IChemE, SCENZ or RACI and must be under 40 years of age.

#### **Winner: Katie Brown**

Since joining ExxonMobil Australia in 1999, Brown has excelled in a broad range of engineering, strategic planning and management roles within ExxonMobil oil and gas production operations, in Australia and Malaysia.

She has been a valuable mentor and has provided development support for many young engineers, and has taken a leading role in ExxonMobil's university graduate recruitment program.

She was unavailable to receive her award in person.

#### **RK MURPHY MEDAL**

The RK Murphy Medal is the most prestigious award presented by the Royal Australian Chemical Institute (RACI), Industrial Chemistry Division, for high achievements in chemical engineering, process chemistry or areas related to the chemical industry.



#### **Winner: Milton Hearn**

Dr Milton Hearn was honoured for his achievements and contributions to structural chemistry and its applications in industry and biotechnology. A graduate from the University of Adelaide, he is a recipient of a number of awards for his work on separation and biotechnology.

*Dr Milton Hearn receiving his RK Murphy Medal*

#### **JOHN A BRODIE MEDAL**

This medal is awarded by Engineers Australia's Chemical College for the best paper in chemical engineering presented at the Chemeca Conference.

#### **Winners: Nurul Widiastuti, Hongwei Wu, Ming Ang, and Dr Dong-ke Zhang**

The team from the Centre for Fuels and Energy and the Department of Chemical Engineering, Curtin University of Technology, Western Australia, won the medal for their paper titled "Preparation and FTIR study of organo-zeolite for the removal of phosphate in greywater".



*Dr Dong-ke Zhang (r) receiving the John Brodie Medal on behalf of his team from Chemical College chair John Waanders.*

#### **GRAEME JAMESON AWARD** (\$1000 and certificate)

This award is offered by the Australasian Particle Technology Society for the best paper at Chemeca in the area of particle technology, by a postgraduate student. The award is named after the Society's founding president, Prof Graeme Jameson of the University of Newcastle.

#### **Winner: Marc Hampton**

Marc Hampton from the University of Queensland won the award for his paper titled "Nanoscale friction forces between hydrophobic surfaces".



*Marc Hampton (l) receiving his Graeme Jameson Award from Professor Clive Davies, president of the Australasian Particle Society.*

### Prize for innovation

The inaugural Freehills Prize for Innovation was awarded at the Young Engineers Forum held in conjunction with Chemeca 2007 in Melbourne. The winner was Dr Gareth Forde from Monash University. His submission covered purification methods for the production of clinical grade DNA.

Freehills partner Brett Connor, in presenting the award, described Forde's accomplishment as "a remarkable achievement which reflects a bright future for young engineers in this country as they forge new directions in innovation".

The Freehills award is targeted at chemical engineering innovations that have been developed by young chemical engineers. It was launched this year through the Joint Victorian Chemical Engineering Committee and it is hoped the award will go national in 2008.



*Brett Connor (l) handing the prize to Dr Gareth Forde.*

### CHEM-E-CAR

## Team Mad takes the prize

A team of chemical engineering students from Adelaide University has won this year's Chem-E-Car competition.

Run on 25 September in Melbourne as part of Chemeca 2007, the student competition attracted five teams – two from Adelaide University, and one each from the University of Canterbury, Auckland University and Queensland University.

In the competition small model vehicles that would fit into a shoebox had to travel a certain distance, carry a specific load and stop as closely as possible to the finish line. Each car development had to cost no more than \$500. Both the distance – 10m – and the load – 200g of water – were given to the teams just before the race.

The challenge was to devise a propulsion system based on a chemical reaction as well as a stopping system that would cut the propulsion once the required distance was reached.

That means each team had to run a series of calculations and tests with their chosen vehicle to determine how much propellant was needed to travel a required distance with a set load.

Once the distance and load were announced on the day of the race, the teams would then be able to adjust their propulsion and stopping mechanisms accordingly.

The teams also had to document their research and present it in poster form at the competition to be judged separately.

The winning team was determined from the best of two runs, with Team Mad's car stopping at only 12cm from the finish line. Runner-up was the team from Auckland University whose car stopped 33cm short of the finish line.

Team Mad used a fuel cell for propulsion with a magnesium ribbon strip as the conductor for the electricity to the motor. The ribbon was immersed in an acid bath, with the strength of the acid determining the time it took for the ribbon to dissolve.

The winning team consisted of Marc Kretschmann, Andrew Cunningham, Duo



*The winning team from Adelaide University consisted of (l-r in white coats) Andrew Cunningham, Zaidah Alwi, Marc Kretschmann and Duo Xu (holding the winning car). With them are their lecturer Kristen Bremmel, Prof Keith King and competition organiser Prof Martin Rhodes (holding the prize of a model Ford Mustang).*

Xu and Zaidah Alwi. They also won the poster competition.

The Chem-E-Car competition has been run at every Chemeca conference since the

World Congress in Melbourne in 2001. It was introduced to Australia by Prof Martin Rhodes from Monash University, who has been organising the event ever since.

### Chemeca 2008

Chemeca 2008 will be held in Newcastle from 28 September to 1 October. The conference theme will be "Towards a sustainable environment".

"Chemical engineers are playing a major role in the efficient use of water and energy, and in the development of alternatives, while minimising the impact on the environment," conference chair Professor Graeme Jameson says in the invitation brochure.

"We've put together a program that should engender discussion of current practice, debate and, above all, new ideas," he says.

Abstracts are now invited for papers and poster presentations. The deadline for abstract submissions is Friday 15 February 2008, with the deadline for paper submissions being Friday 16 May.

More information on the length and format of abstracts can be obtained at [www.chemeca2008.com](http://www.chemeca2008.com). Submissions can also be made at the same website.

## ICHEME

### Linking with India and China

Ramesh Mashelkar took over as the new international president of IChemE earlier this year. Being from India, he is the first IChemE president from a developing country.

He has had a distinguished career, both in academia and as a consultant on behalf of government organisations. Apart from his role at IChemE, he is currently also president of the Indian National Science Academy and the Global Research Alliance – a network of publicly funded research and development centres in nine countries across five continents.

Mashelkar wants to build on his predecessor Greg Lewin's notion of chemical engineering being a "boundaryless" profession. "I want to take this issue forward and break geographical boundaries as well as those of discipline."

He is particularly interested in extending links with India and China.

He is also looking at connections outside engineering, for instance the World Economic Forum and international development banks, or corporate leaders, government chief scientists and national parliaments. "I see no reason why IChemE



Ramesh Mashelkar

should not be able to make its presence felt and have its voice heard where it matters; I can't see why we shouldn't partner widely with those who can influence the thinking."

Mashelkar is also passionate about

creating a more inclusive society. "It is a personal thing for me. I was born in a very poor family. I walked barefoot until I was 12 and studied under the streetlights. During my tenure as president I would like to sensitise the chemical engineering community to those at the bottom of the pyramid."

"It is the duty of the chemical engineering community to think about this. I believe that if I can create this sensitivity then I'll be very happy."

As an example of how chemical engineering can be used to help poor communities he pointed to a recent development at the National Chemical Laboratory in Pune where he works.

He said the laboratory has developed a microfiltration device for water which filters out bacteria and viruses to produce clean potable water. "It costs four paise – 100 paise is a rupee, and 80 rupees is £1 – so you can see how cheap it is. This is being put to use in villages, and because they don't have electricity we have created hand pumped devices. This has given clean water to homes and schools."

*This story is an edited excerpt from an article that appeared in the June issue of tce.*

## CONFERENCES SEMINARS EXHIBITIONS

### AUSTRALIA

#### Chemical engineering

**Courses: Liquid piping fundamentals** (2 days) Perth 1 Nov. Inquiries: 02 9868 1111, fax 02 8246 6387, email [info@kasa.com.au](mailto:info@kasa.com.au), web [www.kasa.com.au](http://www.kasa.com.au)

**Conference: 9th China international chemical industry fair** (3 days) Shanghai Apr 23, 2008. Inquiries: email [mokai@ccpitchem.org.cn](mailto:mokai@ccpitchem.org.cn), web [www.icif.org.cn](http://www.icif.org.cn)

**Conference: 2nd annual GPCA forum** (3 days) Dubai, United Arab Emirates 11 Dec. Inquiries: Gulf Petrochemicals and Chemicals Association +971 4 321 74 44, fax +971 4 321 76 77, web [www.gpca.org.ae](http://www.gpca.org.ae)

#### Energy

**Conference: 17th world hydrogen energy conference** (5 days) Brisbane 15 Jun, 2008. Inquiries: ICMS 07 3307 4000, fax 07 3844 0909, email [whec2008@icms.com.au](mailto:whec2008@icms.com.au), web [www.whec2008.com](http://www.whec2008.com)

#### Resources

**Symposium: 30th Australian Academy of Technological Sciences and Engineering symposium – resources boom: Opportunities and consequences** (2 days) Perth 19 Nov. Inquiries: 03 9340 1200, web [www.atse.org.au/index.php?sectionid=1019](http://www.atse.org.au/index.php?sectionid=1019)

### OVERSEAS

#### Chemical engineering

**Conference: Inchem Tokyo** (4 days) Tokyo 6 Nov. Inquiries: +81 3 3434 1391, fax +81 3 3434 8076, web [www.jma.or.jp/INCHEM/en/index.html](http://www.jma.or.jp/INCHEM/en/index.html)

**Conference: 24th international carbohydrate symposium** (6 days) Oslo, Norway 27 Jul, 2008. Inquiries: +47 225 55011, fax +47 225 63510, email [ICS-2008@meeting-management.no](mailto:ICS-2008@meeting-management.no), web [www.ics2008.uio.no](http://www.ics2008.uio.no)

#### Minerals processing

**Conference: Flotation 2007** (5 days) Cape Town, South Africa 5 Nov. Inquiries: email [amanda@min-eng.com](mailto:amanda@min-eng.com), web [www.min-eng.com/flotation07/index.html](http://www.min-eng.com/flotation07/index.html)

**Conference: Processing of nickel ores & concentrates 07** (2 days) Cape Town, South Africa 12 Nov. Inquiries: email [amanda@min-eng.com](mailto:amanda@min-eng.com), web [www.min-eng.com/nickel07/index.html](http://www.min-eng.com/nickel07/index.html)

**Conference: Solid-liquid separation 07** (2 days) Cape Town, South Africa 14 Nov. Inquiries: email [amanda@min-eng.com](mailto:amanda@min-eng.com), web [www.min-eng.com/sls07/index.html](http://www.min-eng.com/sls07/index.html)

**Conference: Magnetic & electrical separation 08** (1 day) Falmouth, UK 5 May, 2008. Inquiries: Minerals Engineering International, email [amanda@min-eng.com](mailto:amanda@min-eng.com), web [www.min-eng.com/magnetic08/index.html](http://www.min-eng.com/magnetic08/index.html)