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# CORROSION

& M A T E R I A L S

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**C&P  
2015  
ISSUE**

## Inside this Issue:

**Corrosion & Prevention 2015: Final Program**

**Corrosion & Prevention 2015: Sponsors & Exhibitors**

**Technical Note: Bridge Mired in Troubled Waters**

**Technical Note: Minimisation of water treatment plant degradation and chemical spills**

**University Profile: Corrosion Research at UNSW**





## CONTENTS

### Corrosion & Materials

*Corrosion & Materials* is the official publication of The Australasian Corrosion Association Inc (ACA). Published bi-monthly, *Corrosion & Materials* has a distribution of 2,500 to ACA members and other interested parties. Each issue features a range of news, information, articles, profiles and peer reviewed technical papers. *Corrosion & Materials* publishes original, previously unpublished papers under the categories 'Research' and 'Professional Practice'. All papers are peer reviewed by at least two anonymous referees prior to publication and qualify for inclusion in the list which an author and his or her institution can submit for the ARC 'Excellence in Research Australia' list of recognised research publications. Please refer to the Author Guidelines at [www.corrosion.com.au](http://www.corrosion.com.au) before you submit a paper to Brendan Pejkoivic at [bpejkovic@corrosion.com.au](mailto:bpejkovic@corrosion.com.au) with a copy to [bruce.hinton@monash.edu](mailto:bruce.hinton@monash.edu)

ACA also welcomes short articles (technical notes, practical pieces, project profiles, etc.) between 500 – 1,500 words with high resolution photos for editorial review. Please refer to the Article Guidelines at [www.corrosion.com.au](http://www.corrosion.com.au) before you submit a short article to Brendan Pejkoivic at [bpejkovic@corrosion.com.au](mailto:bpejkovic@corrosion.com.au)

### The Australasian Corrosion Association Inc

The ACA is a not-for-profit, membership Association which disseminates information on corrosion and its prevention or control by providing training, seminars, conferences, publications and other activities.

### Vision Statement

Reducing the impact of Corrosion.



THE WORLD  
CORROSION  
ORGANIZATION

The ACA is a founder member of the  
World Corrosion Organization



Front Cover Photo:

High Speed Crew Ferry.

Photo supplied by Incat Tasmania Pty Ltd  
and Jotun Australia Pty Ltd.

# CORROSION

A M A T E R I A L S

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Young Corrosion Group: Giles Harrison	61 439 513 330

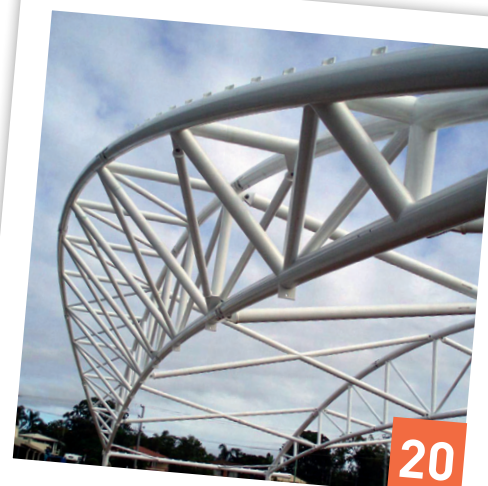
\*all the above information is accurate at the time of this issue going to press.



# CONTENTS

Vol 40  
No 5,  
October  
2015

- 4** | Chairman's Message
- 5** | ACA 2015 Calendar of Events
- 6** | Executive Officer's Message
- 7** | ACA Training Calendar 2015
- 8** | News
- 16** | Branch & YCG News
- 20** | Coatings Group Member Profile
- 21** | Corrosiword
- 22** | Technical Event Review:  
*Pipeline Corrosion Management*
- 23** | Technical Event Review:  
*Corrosion in the Oil & Gas Industries 2015*
- 24** | Technical Event Review:  
*Introductory Corrosion Seminar*
- 26** | New Product Showcase
- 28** | ACA Standards Update
- 30** | Corrosion & Prevention 2015 Final Program
- 36** | Corrosion & Prevention 2015 Sponsors & Exhibitors
- 60** | University Profile:  
*Corrosion Research at UNSW*
- 62** | Technical Note  
*Bridge Mired in Troubled Waters*
- 64** | Technical Note  
*Minimisation of water treatment plant degradation and chemical spills*
- 66** | Research Paper  
*50 Year Evaluation of St Louis' Gateway Arch*
- 70** | Suppliers and Consultants



The ACA celebrates 60 years in 2015.



## CHAIRMAN'S MESSAGE



**Paul Vince**  
Chairman

Greetings,

This is my last message as Chairman and I thought I would reflect on the ACA and on my time on the Board. It has been a pleasure to serve the ACA and our members as Chairman. Our mission is to reduce the impact of corrosion. The ACA provides a vital support role to the corrosion industry through training, networking and informing. Together we are fighting the never ending battle against corrosion.

I would like to pass on four rounds of thanks. Firstly I would like to thank all the ACA members. Your contributions to the ACA form the foundation for our ability to influence and impact our industry and our society. Whether that be volunteering for Branch committee, giving a presentation or simply

attending an event, every contribution is valuable. I have met so many great members over my time and they have all added more colour to my life.

I was talking to a colleague from Christchurch recently. The earthquake in that city caused widespread devastation and much of the infrastructure collapsed. The rebuilding process has been a long road. The first task was to rebuild the underground services and foundations. Two years into the task some workers were discouraged. They looked around and could see little visible evidence for all their work. But the infrastructure was there and it will be extremely valuable for the future. It reminded me of the work of many of our members. We work behind the scenes, assessing corrosion, setting up long term plans, providing prudent advice. Sometimes we don't see the evidence of our work and get discouraged. But I have found that the work of our members is extremely valuable. It is the foundation for a prosperous future. So my message to you is that your work is vital and appreciated.

In addition, I would like to thank the Board members and staff. I joined the Board at the start of the GFC. A significant challenge was immediately apparent to keep the association functioning successfully. That challenge was overcome due to members consistently participating in ACA activities. There have been many more challenges since and I admire the way the Board and staff have handled these. Many of the current Board members have had a difficult year; I appreciate your dedication and contribution during very tough times.

Also, during the Adelaide conference, all ACA members are invited to attend the Members Meeting which has been scheduled for Tuesday 17 November. During this meeting, the ACA will announce the new Board, following the elections at Council on Sunday 15 November.

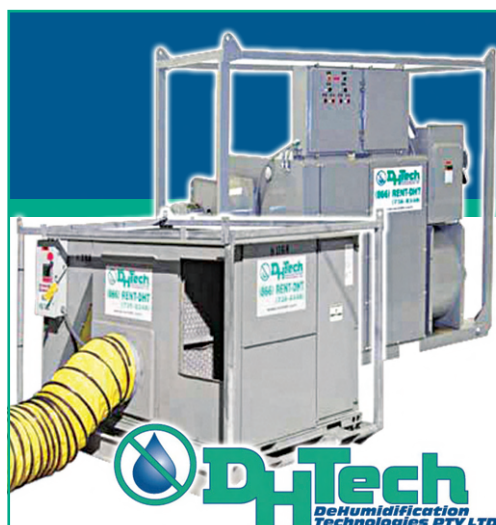
Nominations for the Board closed on the 16 September and I would like to thank all those members who have expressed interest in serving on the Board and I wish you good luck during the election process. Members can view the list of all the nominees along with their statement of introduction on the ACA website on the About Us webpage

Finally, I would like to thank the ACA Executive Officer, Wesley Fawaz. As I write this he has just completed 2 years in the job. He has managed the Association excellently and has created a stability that will serve the Association well for the future. He started in difficult circumstances but has managed to implement a complete financial review, a governance review including organisational restructure and a strategic plan which provides future direction. Well done Wes. My sincere thanks for all you have done to support the ACA.

I look forward to seeing you all in Adelaide. We can catch up and reminisce about good times.

Kind Regards

**Paul Vince**  
ACA Chairman



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# ACA Events for the balance of 2015

Part of the role of the ACA is to organise events that bring together industry experts to present on new technologies, updates to standards, and share knowledge and experiences via case studies on a variety of projects. Here are the events for the remainder of 2015.

Event Title	Event Date	Event Location
Introduction to Corrosion	30 October	Brisbane
Corrosion & Prevention 2015 Conference	15 – 18 November	Adelaide
Asset Management Forum	16 November	Adelaide
Introduction to Corrosion Seminar	17 November	Adelaide

ACA members will receive further details on each event as appropriate throughout the year, but for now, please include these in your 2015 diary. For further information on these events for 2015 please don't hesitate to contact Brendan Pejkoivic (bpejkovic@corrosion.com.au) in the ACA office on +61 3 9890 4833.

## Branch Events

Each of the 8 ACA Branches will conduct regular technical events throughout 2015. To enquire, you may contact your local Branch at the following email addresses:

New South Wales: nsw@corrosion.com.au  
 New Zealand: nz@corrosion.com.au  
 Newcastle: ncl@corrosion.com.au  
 Queensland: qld@corrosion.com.au  
 South Australia: sa@corrosion.com.au  
 Tasmania: tas@corrosion.com.au  
 Victoria: vic@corrosion.com.au  
 Western Australia: wa@corrosion.com.au



## YCG Events

Targeting individuals under 35, new to the corrosion industry and/or interested in the corrosion industry, the ACA Young Corrosion Professionals conduct regular events. For further details email ycg@corrosion.com.au or go to www.corrosion.com.au



Please refer to **www.corrosion.com.au** for up to date details on all ACA activities.



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## EXECUTIVE OFFICER'S MESSAGE



**Wesley Fawaz**  
Executive Officer

### Annual Conference

The annual ACA conference is by far the biggest event of the year for the Association. Planning for each conference starts two and half years out (I can confirm that the 2017 conference will be held at the newly built Sydney Convention Centre) and is over a half a million dollar event.

The 2015 Adelaide conference is now just a month away and the final technical program has been announced which is also published on pages 30-33 of this issue of C&M. A comprehensive list of companies exhibiting appears on pages 36-59 and the ACA has also organised an Asset Management Forum and the Introductory Corrosion Seminar (page 59) during the conference to attract additional delegates.

The annual conference is very important to the ACA and I hope to see you there!

### Industry Alliances & Agreements

An informal Industry Alliance has been developed between ACA, Galvanizers Association of Australia, Australian Steel Institute, Australian Institute of Non Destructive Testing and Welding Institute of Australia. I met with the respective CEO's of each of these organizations recently. The aim going forward, will be to support or to take the lead in issues relating to legislative change, Standards, Government Funding and cross promoting each other's events.

The ACA has been able to organise a corrosion stream within the technical program of the Australasian Oil & Gas Exhibition & Conference (24-26 February 2016) to be held in Perth as well as an exhibition booth. This event attracts over 15,000 delegates, so this is a great opportunity for the ACA to educate and promote the importance of corrosion mitigation.

The ACA will be hosting a joint 'Corrosion in the Marine Industry' technical event in March 2016 in Melbourne in conjunction with Maritime Industry Australia Ltd (MIAL). MIAL is an industry Association for those who have assets or operations in the Australian maritime industry.

### Membership Fees

I believe the ACA continues to offer great value to its members. I recently reviewed the ACA individual membership fees against 15 other similar membership Associations and the ACA had the most affordable individual membership. I also believe that the ACA would offer more benefits and activity than most of the other Associations.

The ACA policy is to increase membership fees across all categories every two years by 5%, so for example

the individual membership fee for 2016/17 will be \$187.50.

### ACA Finances

I was recently asked by a member about how the ACA and its Branches are financed and I thought other members may also wish to know. Firstly, the ACA is a self-funded organisation which in 2014 generated revenue of close to \$3.3 million. 68.5% was generated from course registrations, 18.2% from the annual conference and events, 11.7% from membership fees and 1.6% from other sources.

Many Associations rely heavily on membership fees (for some Associations, this is 80-90% of their income), but with a strong professional development training program, the ACA is able to offer value to its members through low membership fees, offering many free activities at local Branch events and more. The ACA has also been able to donate \$150,000 to The ACA Foundation, since October 2013 which continues to offer scholarship opportunities to ACA members.

Branches (which are administered by local committees) receive on a quarterly basis from the ACA office in Melbourne, a percentage of membership fees and training returns. This allows the Branches to offer technical nights, site visits, trade shows, social events, scholarships, support of local Young Corrosion Group activities, etc. to members at a regular and local level at either a free or heavily subsidized rate.

For comprehensive details of the ACA finances, the 2014 Annual Report is available from the ACA website on the About Us webpage.

**Wesley Fawaz**  
Executive Officer  
wesley.fawaz@corrosion.com.au





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**TRAINING**

# ACA Training Calendar for the balance of 2015

## ACA Coating Inspection Refresher

Member \$605 Non-member \$740

Adelaide November 14

Wellington December 4

## Corrosion Technology Certificate Home Study

Member \$2220 Non-member \$2600

Start any time

## NACE CIP Level 2

Member \$3740 Non-member \$4275

Adelaide November 9 – 14

## Cathodic Protection Monitoring

Member \$1485 Non-member \$1810

Melbourne October 26 – 28

## NACE CIP Level 1

Member \$3740 Non-member \$4275

Adelaide November 2 – 7

## NACE CIP Level 3 Peer Review

Member \$1470 Non-member \$1725

Adelaide November 9 – 13

**By appointment only. Duration:** 2 hour oral exam in front of a 3 member review board. Pre-requisites apply go to Training at [www.corrosion.com.au](http://www.corrosion.com.au) for more details

## Cathodic Protection Advanced

Member \$2220 Non-member \$2600

Perth November 30 – December 4

All Australian course fees listed are GST inclusive. All NZ course fees are exempt from GST.

To calculate the fee pre-GST, divide the fee by 1.1

**ACA Training Calendar for 2016 available soon**

# IN-HOUSE TRAINING

**Did you know that you can have ACA's suite of courses come to you?**

'In-house training' offers your company the opportunity to have your employees trained at your own facility whilst eliminating travel expenses and minimising downtime.

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Please contact the ACA's training department on +61 3 9890 4833 or [aca@corrosion.com.au](mailto:aca@corrosion.com.au)





# Jotun Marine Australia leads the way with Sealion Repulse and the world's fastest work boat

On Sept. 15, the 70m fast crew boat (FCB) was christened *Muslim Magomayev* at a ceremony at the Incat shipyard in Hobart, Tasmania.

This is the first vessel that Australian Shipbuilder Incat Tasmania has purpose built for the oil and gas industry. When sea trials are completed the boat will depart later this month to Baku, Azerbaijan.

During construction over the past year the fast crew boat has been referred to simply as Incat hull 074 but is now bearing the name *Muslim Magomayev* in honor of Azerbaijan's famous opera and popular music singer Muslim Magomayev who died in 2008. Magomayev was a renowned entertainer not just in Azerbaijan but all the former Soviet states, often dubbed as their answer to Sinatra.

This first of type DP2 class 70m vessel is being delivered to Caspian Marine Services to operate fast crew transfers for 150 offshore workers to multiple installations in the Caspian Sea. The high speed of the 70m. FCB will allow operational efficiency over helicopter transfer for both passengers and cargo, while the semi-SWATH hull design, along with active ride control, will reduce stress on passengers so they arrive at an oil platform relaxed and fit to work.

*Muslim Magomayev* has approximately 200 tonnes deadweight and is capable of carrying 150 passengers and 14 crew, along with 130 tonnes of deck cargo, in up to 40-knot wind and seas of 3m significant wave height. The 275 square metre cargo deck will allow the vessel to complete cargo hot shots over a range of 740km at speeds of up to 35 knots.

Passengers are accommodated on both the main and mid-deck, the main deck also housing two VIP rooms, storage areas and an equipped workshop, while crew cabins and galley are on the mid-deck.

The vessel's 16m beam is far narrower than is usual for an Incat catamaran but

determined by the width of the Volga-Don Canal that it must transit on its delivery from Hobart, Tasmania, to Baku in Azerbaijan.

*Muslim Magomayev* will be the world's largest high speed crew catamaran vessel operating in the global oil and gas industry, according to Incat.

The power for Incat hull 074 is supplied by four 2880kW MTU engines each turning Hamilton HT 900 waterjets. Anticipated design speed was 36 knots with an efficient service speed of 30 knots at full load and 90% MCR, sea trials have not yet been completed, but on her first day on the water the vessel comfortably achieved 38.7 knots lightship.

The ship has been constructed of lightweight marine grade aluminium over the past year at Incat Tasmania's Derwent Park Hobart shipyard, with concept design by Incat Crowther of Sydney and production engineering by Revolution Design (Incat Tasmania's

design team). It is the first craft Incat has built to the DNV Clean Design notation, giving it a "Green Passport".

The vessel's electronic installations are extensive with an expansive wheelhouse to accommodate the range of high tech systems required for dynamic positioning.

Crew transfer is completed primarily by the Amplemann system, a stabilised access platform, providing a stable deck and gangway to safely transfer between the offshore platform and the vessel. The access platform compensates for the vessel's motion by using six hydraulic cylinders. The FCB will hold station with four control stations each utilizing Hamilton Jet's MECS control system integrating with a DNV DYNPOS-AUTR dynamic positioning system. This system provides improved safety during crew transfers in conditions up to sea state 4.

Report and image courtesy workboat.com







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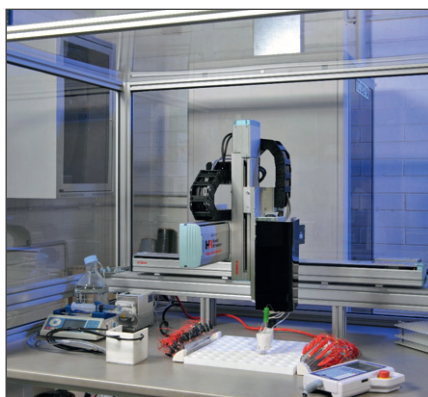
processes and products. FASTER is a set of hardware and software systems developed by CSIRO to overcome time limiting inefficiencies and human error in testing and materials validation. Using a robotically actuated sensing platform and a computer controlled liquid delivery system, we can automate routine testing tasks, enabling extensive multi-day testing cycles of up to 80 discrete electrically addressable samples, without human intervention. FASTER can also record electrochemical data using industry standard methods, ensuring that the data generated is directly comparable with well-established testing and regulatory standards. What problems will you solve FASTER™?

## CSIRO's FASTER™ Launch

3:30pm-5:00pm  
Monday 19 October 2015  
CSIRO, Gate 5, Normanby Road,  
Clayton, Victoria.







Please email **John Soccio** (Business Development Manager) on [john.soccio@csiro.au](mailto:john.soccio@csiro.au) if you would like to attend as places for this event are limited.

For more information about FASTER™ please go to: <http://research.csiro.au/metals/metal-pro/metal-production/ultrafast-discovery/faster-robotic-electrochemistry/>



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# The Australasian Industry of Surface Finishing on the Move!

The AISF Board on behalf of their members made a decision to start to build stronger relationships with a likeminded Associations. The first step in this process was to engage with the Australasian Corrosion Association Inc (ACA). The ACA is well established and offers synergies with their Association. The Board's first step in this process was to look at sharing office facilities with the ACA and this arrangement has now taken place.

The move from their Collingwood base to their offices in Blackburn in Victoria not only made good financial sense,

but gives their new Executive Officer Mark Hardy an opportunity to share ideas and work more closely with an Association that can add value to their members. They look forward to a long and fruitful working relationship.

The AISF will now be located at Level 3/ 458 Middleborough Road in Blackburn Victoria, 3129.

Their new contact details are

P: +61 03 9890 6700

F: 03 9890 6711

E: mark@aisf.org.au



## NZ Electrolysis Committee August 2015 update

This is an update of the progress made by the Electrolysis Committee since its inception.

The decision was made to run as one nationwide committee rather than 3 regional based committees.

Currently most pipelines and other structures are identified using the 'before you dig' process. The 'before you dig' process may not capture the location of anode beds and there are a few smaller asset owners not using the 'before you

dig' process. An alternative system is required to Identify CP systems.

The Electrolysis committee is proposing a register of CP systems which would capture the location of the anode beds along with the location of the structure. This would enable the designers of proposed CP systems to determine if any CP systems are in proximity. A template/spread registration sheet has been proposed which would enable the compilation of the CP system register.

Over the next few months the agenda is to:

- Approve the CP system register format.
- Determine who is responsible for registering new and existing CP systems
- Have the the Committee develop rules to protect the commercial concerns of CP contractors.
- Get the Web site up and running
- Create a logo

## Renew On Line & On Time Competition Winner Announced

**Gavin Telford**  
South Coast Surface Protection  
NSW Branch

*"It was a nice surprise to be presented with a complimentary ticket to an ACA Technical event simply by just renewing online."*

*The process was easy and I will be renewing in a similar fashion next year. It is great to see our association encouraging their members with entry to an event that will further corrosion education. Thank you."*



# Tef-Gel Enlisted to Protect Naval Frigates

TEF-GEL anti-corrosion lubricant goes into action to protect new Australian naval frigates.

TEF-GEL Pty Ltd has announced that it is now supplying its anti-corrosive, anti-seize lubricant to the Department of Defence for the assembly and installation of forward guns on new frigates being built in South Australia.

Tef-Gel is derived from a specially-formulated PTFE paste designed to stop corrosion between dissimilar metals such as aluminium and stainless steel, to prevent galling of stainless steel and act as an assembly lubricant to assist with ease of maintenance. It also has dielectric properties designed to eliminate corrosion in electrical connectors.

This is not the first time that Tef-Gel has been used on a major project

in the local marine industry. It is currently used to maintain corrosion protection on the Armidale class patrol boats for the Australian Customs and Border Protection Service. Mercedes Benz Australia also uses the product for the assembly of vehicles for the Australian Army.

Since launching Tef-Gel in Australia 17 years ago, company directors Warwick and Claudine Jonassen say they have experienced solid and consistent growth every year across the marine industry and other fields such as mining, agriculture and aviation.

"This attests to the quality product we bring to market but more importantly that Tef-Gel is performing above and beyond our customers' expectations and no doubt will continue to do so into the future."

Despite their success, the couple say they still have more work to do in terms of getting the product out into the market and would welcome new customers and retailer enquiries.

*Report and image courtesy marinebusiness.com.au*



**Select Solutions' Corrosion Protection** team is made up of 13 corrosion technicians and three corrosion engineers who provide services to asset owners of gas and water pipelines, water tanks and electrical transmission power footings.

With expertise in many areas, services include:

- cathodic protection system design, installation, investigation and monitoring
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- DCVG coating defect surveys
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- Depth Micrometer ■ Replica Tape Reader

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- Built-in ■ Separate Magnetic Probe

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# North Sea work brings world firsts for Swagelining Limited

Swagelining Limited, a recognised leader in the design and installation of polymer linings for pipeline and riser systems, has completed work across eight North Sea assets over the last 12 months, including a number of world firsts for the technology.

These contracts saw Swagelining design, fabricate and install almost 90km of polymer liners into water injection pipeline in total, and included 'first uses' of the technology by four major operators.

The work has involved the lining of a 4" line, the smallest ever subsea water injection system to be polymer lined, whilst a further project saw Swagelining's longest pulls to date for 1515m stalks on a 14" pipeline. Projects have been constructed for installation in both bundles and by reel lay vessel.

David Whittle, business development director at Swagelining Limited, said: "Polymer lining has already proven to be an effective method of providing internal corrosion protection to carbon steel pipelines and risers.

"We are seeing a marked increase in the use of polymer lining technology across North Sea assets, demonstrated by the number of projects we have been involved in over the last year and the uptake by operators using the technology for this first time. It is encouraging to see this growth, and to see the industry take advantage of the many benefits of this technology."

Since 2009, technology-focused Swagelining has grown to establish itself as the market leader for subsea polymer lining systems and has invested strategically in research and development to open up the choice of installer and construction

options, as well as potential use for hydrocarbon service.

Swagelining's Technology Development Group (TDG) currently works with operators to develop testing plans and programmes for material qualification, spearheading the development of new products and processes in polymer lining technology.

One project currently being undertaken by Swagelining's TDG is a Joint Industry Project with Saudi Aramco and The Welding Institute, which is investigating the extent of corrosion in a polymer lined pipeline when subjected to a sour hydrocarbon fluid environment. The TDG is also working on a materials testing programme in conjunction with two major operators to extend the boundaries for higher temperature water injection service, whilst incorporating the LinerBridge®, Swagelining's weldable polymer connector, into the test programme.

Mr Whittle continued: "Polymer lining technology is a well-established and cost-effective method of preventing internal corrosion in carbon steel pipelines, however its full potential for use in the oil and gas industry, particularly for hydrocarbon service and in high temperature environments, is still relatively untapped.

"Swagelining aims to continue working closely with the industry and professional bodies, encouraging operators to consider the use of polymer lining when planning and designing new pipeline systems."

Swagelining has a number of further projects booked throughout this year and into 2016 for North Sea and West African assets.

*Report and image courtesy PennEnergy.*



## Ashley Fletcher

Ashley Fletcher has joined the ACA as an individual member after representing Steel Mains (and antecedents Pentair, Tyco & Tubemakers) since 1982. Ashley has worked in the Water, Oil & Gas

pipeline industries for more than 37 years in materials selection, specification, QC, testing, inspection, coatings and linings development, standards development, etc. He is now an independent consultant.





# New sensor can detect concrete corrosion

Researchers of the Universitat Politecnica de Valencia have developed a new sensor system able to quickly and non-destructively detect the risk of corrosion in the concrete structure of buildings and do so when the first symptoms appear.

The information provided by this system, which has been patented by the UPV, is of particular significance for building safety. It enables any necessary intervention to be made sufficiently in advance, reducing, at the same time, repair and maintaining costs.



The system also includes a pulse voltammetry unit, which provides information on the intensity of the corrosion for every point in the network of sensors of the structure analysed, and specific software for analysing the electrical response from each sensor.

Today, the most common way to determine the corrosion speed of the rebars in a reinforced concrete structure is based on destructive techniques, for which it is necessary to expose the rebars at a certain distance in order to electrochemically measure the intensity of the corrosion. It is then necessary to repair the area with mortars.

Its benefits include a reduction in the time and cost of the diagnosis of the structure. In addition, it is able to register in real time the state of maintenance and the speed of corrosion of the rebars at several points of the structure, even in non-accessible areas.

## Application

The system could be installed both in new constructions and restoration projects. In the first case, it must be incorporated when the concrete is poured in those areas of the structure most exposed to corrosion caused by humidity, carbon dioxide or chlorides. In restoration projects, it permits a non-destructive control and monitoring of the effectiveness of the restoration.

Miguel Alcaniz, Roman Bataller, Jose Manuel Gandia, Jose Enrique Ramon and Juan Soto, researchers at the Centre for Molecular Recognition and Technological Development (IDM, in Spanish), together with Manuel Valcuende, from the Grupo de Recuperacion del Patrimonio Cultural of the Universitat Politecnica de Valencia have taken part in the development of this project.

*Report and image courtesy Bangalore Mirror.*

# ACA Welcomes New Members

## Corporate Gold

### DEHN Australia

[www.dehn.com.au](http://www.dehn.com.au)

DEHN Australia focuses on the reliable protection of buildings, electrical and electronic systems and human life. Their pioneering spirit and innovative ideas have defined the company for more than 100 years and made them a global market leader for surge protection, lightning protection/earthing as well as safety equipment.

## Corporate Bronze

### Camplin MCI

[www.camplin.com.au](http://www.camplin.com.au)

Camplin MCI is a leading provider of marine and subsea services throughout Australia and the Pacific Rim with a Head Office in Cairns and Regional Support Bases in Gladstone and Perth. Focusing on safety, efficiency and customer responsiveness, Camplin MCI offers world-class integrated solutions aiding in the timely completion of any project.

### Deakin University

[www.choose.deakin.edu.au](http://www.choose.deakin.edu.au)

Deakin is forging a new path both locally and globally as a leading provider of innovative learning and a positive university experience. They are proud to be in the top 3% of universities across all three of the major international university ranking systems (the Academic Ranking of World Universities, Times Higher Education World University Rankings and QS World University Rankings), assessed from 17 000 universities worldwide.

### CBI Constructors

[www.cbi.com](http://www.cbi.com)

CBI is one of the world's leading engineering, procurement and construction companies. They provide a comprehensive range of solutions to customers in the energy and natural resource industries. Drawing upon the expertise of more than 16,000 employees worldwide, CBI offers a full scope of services, from conceptual design and technology licensing, through to engineering, procurement, fabrication and construction. With engineering offices and projects located around the world, CBI has the global

experience and local expertise to safely deliver superior results even in the most challenging environments.

### Independent Maintenance Services Ltd

[www.imsLtd.com.au](http://www.imsLtd.com.au)

Independent Maintenance Services Ltd specialises in Surface Preparation & Industrial Coating applications, Building & Structures Inspections and Surveys. Their staff are all Rope Access and Confined Space Rescue trained. This enables them to complete tasks safely in difficult to access areas. Independent Maintenance Services Ltd and its staff have an abundance of experience in providing services to the Oil & Gas industry as well as in the urban environment across Australia.

### Prompt Engineering

[www.promptengineering.com.au](http://www.promptengineering.com.au)

Prompt Engineering (previously Prompt Certification) is an engineering company with a focus on applying advanced technology solutions to engineering projects. The technology arm aids them in providing fast and reliable engineering results. They are a rapidly growing company and continually improve their online tools to further assist their clients.

# ACA Auckland Division Site visit and YCG Meeting

On August 19 the Auckland Division held a well-attended site visit and YCG meeting at Auckland University's **NZ Product Accelerator** campus in Newmarket, Auckland. NZ Product Accelerator is a government-funded organisation that bridges the gap between basic research and industry by providing a fast track for new products and services to commercialisation. In 2015 the NZPA has completed 80 projects for a wide variety of NZ and overseas-based manufacturers and clients. The meeting commenced with an outline of the NZPA services

by Professor Mark Taylor, Director of NZPA. This was followed by an outline of recent PA projects by Dr Balan Zhu, who described product testing involving a salt spray chamber, metallurgical investigation of weld cracking on a steel bridge, and failure investigation of stainless steel hangers at a cement manufacturing company.

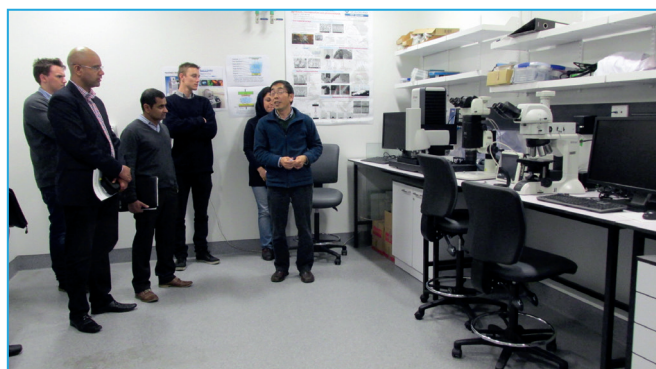
The attendees were then given a tour of the NZPA laboratory facilities, including corrosion assessment of coatings and thin films, metallurgical assessments, analytical laboratories,

research into light metals, plastics manufacture, mechanical testing and composite materials research. At the end of a lengthy tour John Duncan thanked Graeme Finch (NZPA Business Development Manager) and the other NZPA research staff for an excellent introduction to NZPA and its extensive facilities. As is always the case at YCG events, the group of attendees then retired to the Doolan Brothers public establishment near to NZPA for a social gathering and refreshments.

*Attendees enjoy refreshments at the Doolan Brothers pub after the YCG site meeting.*



*NZ Product Accelerator staff.*







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# Newcastle Branch Technical Night - Stainless Steel Grades

On September 9 the Newcastle Branch ran a technical night that proved interest in stainless steel was alive and well in the steel city. With forty five registrations to hear Ken Hayes from Outokumpu deliver a talk on some aspects of stainless steel, it was one of the bigger presentations Newcastle Branch has run in recent months.

Ken has been in the stainless industry for 43 years having worked first for Sandvik and now for Outokumpu. He has presented papers around the world and was very well received in Newcastle.

Ken's presentation covered various stainless steel grades, types of corrosion and a brief update on some new additions to the duplex family. Ken kindly gave permission to distribute his presentation to all members of the Newcastle Branch.

The staff at the venue, Brown Sugar at Warners Bay were extremely accommodating and did everything possible to make the night a success. It is one of the Branches regular venues and for a very good reason as the food is spectacular.



*Ken Hayes - Presenting (Outokumpu).*



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# Toys of the Trade – QLD YCG Tool Box Talk

The Queensland ACA YCG committee hosted 3 speakers on the 13 August at GHD's offices. The group was hosted by Brodie Chan from GHD, Nick Doblo, APA Group and Rebecca Newby, ALS. Nick welcomed the enthusiastic attendees. Rebecca began by introducing the speakers. First to talk was Sean Fogarty from Olympus who introduced the group to a method of Non Destructive Testing (NDT) through a phased array probe. This operates by emitting ultrasound through the probe and measuring a background echo to build a picture of the material being tested. For example, as the probe is moved over a weld the background echo may reveal imperfections or inclusions. When applied over a coated surface, this system will pick up corroded areas. Using a 64 element multiplex probe and combining different means of interpreting this data, a more complete picture of the type of flaw is able to be observed. In Sean's opinion, this is able to remove the 'Jedi Knight' requirement for interpreting measured data.

Fittingly, the next speaker, Josh Logan from Anode Engineering explained how a field computer is able to gather data from coating surveys, such as Closed Interval Potential Surveys (CIPS). Josh demonstrated how a field computer such as the Allegro unit can enable the corrosion professional to speed up the assembling of data such as potentials, location and induced voltage control into one database rather than writing down the measurements and entering the data into a spreadsheet at a later stage. Furthermore, Josh explained how this data is able to be analysed once the corrosion professional is back in the office. With Josh performing a live demonstration, the audience was able to appreciate the benefit of this technology.

Rebecca then introduced Dr John Colwell from QUT who explained how a Fourier Transfer Infrared Spectroscopy (FTIR) unit is able to analyse the chemical structure of a coating. John took the audience through a Chemical

Structure of Coatings 101 course in 5 minutes. But it is the measuring of the degradation of this coating due to UV and heat which is where the FTIR equipment is used. The example John used was analysing the surface coating of jet fighters for the Australian Defence Force. Key to using this equipment in the field is bare pre-programming the units (such as the Agilent 4300) for the type of coating being examined, keeping it stable and working with the stakeholders to ensure the integrity of the data.

The three talks from the 'Jedi Knights' of the industry left the audience (padawans?) in no doubt that there are easier ways to not only measure asset integrity through the use of technology but to also present and analyse the data in a far more efficient manner. The evening concluded with some welcome refreshments and further discussion where fellow corrosion professionals felt the 'force' of knowledge was with them.



# Tranzblast Coating Services Aust Pty Ltd

**Q:** In what year was your company established?

**A:** Tranzblast commenced operations as Yatkin Pty Ltd in 1983

**Q:** How many employees did you employ when you first started the business?

**A:** 6

**Q:** How many do you currently employ?

**A:** 44

**Q:** Do you operate from a number of locations in Australia?

**A:** Tranzblast operates from two facilities located in Carole Park, Queensland.

**Q:** What is your core business? (e.g. blasting and painting, rubber lining, waterjetting, laminating, insulation, flooring etc.)

**A:** Abrasive Blasting and Protective Coatings

**Q:** What markets do you cover with your products or services? eg: oil & gas, marine, chemical process, general fabrication, tank lining, offshore etc.

**A:** Tranzblast services, but is not limited to the Mining, Oil and Gas, Construction and Infrastructure Industries.

**Q:** Is the business yard based, site based or both?

**A:** We operated both on and off site.

**Q:** What is your monthly capacity or tonnage that you can blast and prime?

**A:** Our operations have the capacity to blast and prime a minimum of 1500 tonnes per month.

**Q:** Do you offer any specialty services outside your core business? (eg. primary yard based but will do site touch up etc.)

**A:** In addition to site touch up, Tranzblast also offer the services of Mobile Crane Hire and Transport.

**Q:** What is the most satisfying project that you have completed in the past two years and why?

**A:** Brisbane City Ferry Terminal Upgrade. It's an iconic structure that is along the Brisbane river that is seen by all.

**Q:** What positive advice can you pass on to the Coatings Group from that satisfying project or job?

**A:** To keep specifications simple and to take in consideration the complexity of the item to be painted.

**Q:** Do you have an internal training scheme or do you outsource training for your employees?

**A:** In support of our internal qualified trainer Tranzblast also utilised an external training provider to perform training.

**Contact:**

Tranzblast Coating Services Aust Pty Ltd.  
24 Mica Street, Carole Park, QLD, 4300

**Telephone:** (07) 3271 3100

**Facsimile:** (07) 3271 3162

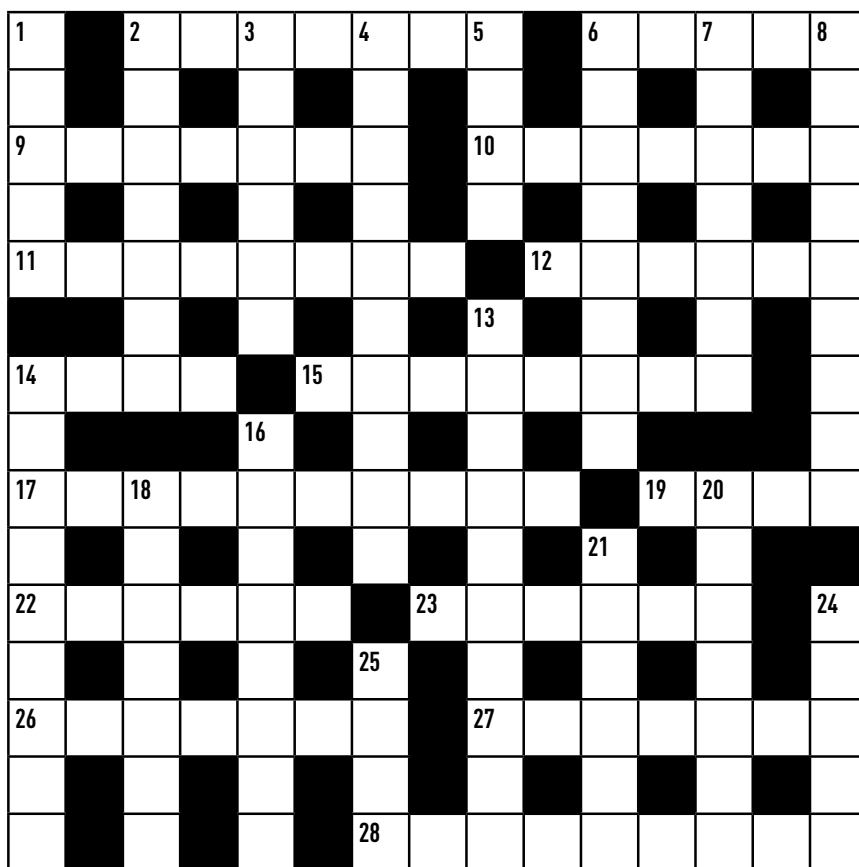
**Email:** [office@tranzblast.com.au](mailto:office@tranzblast.com.au)

**Website:** [www.tranzblast.com.au](http://www.tranzblast.com.au)





# CORROSIWORD

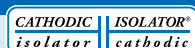


## CORROSIWORD

Reproduced from Conference Proceedings *Corrosion Science in Action*. Adelaide, South Australia 13–17 November 1972.



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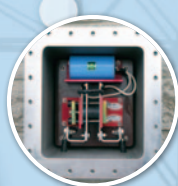
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### CLUES – Across

2. Sounds a dangerous place for corrosion (4,3)
6. Coating formed by poetic cricket team (5)
9. 4 down usually does it to corrosion (7)
10. One way street of non rust variety (2,5)
11. Ninth degree or French for scientist (8)
12. Films are usually more protective thus (6)
14. Perished after anodising, one hears (4)
15. Complete armour for protection (8)
17. They waste away on the job (4,6)
19. Is the Queen but a zinc coater on 20 down (2,1,1)
22. The idea is not a wanderer in solution (6)
23. Followed by other plated coatings and down ten pins (6)
26. Precious, looks like steel but about four times 12 across (8)
27. What a finish! (2,5)
28. Pigments in paint hang thus (9)

### CLUES – Down

1. Remove paint largely with an alloy of Pt and 26 across (5)
- 2 and 5. Colour anodiser and ex-blond have this in common (4,3,4)
3. This organism is not likely to cause corrosion in waterlogged clay (6)
4. Chromate solution is on galvanised steel (10)
5. See 2 down
6. Potassium's place at the table of gold is at the bottom of it (2,3,3)
7. Exists as iron coated with hydrated oxide (2,5)
8. Is this a problem capable of simple solution by a motorcyclist? (4,5)
13. The electrochemical series has possibilities (10)
14. Corrosion method by which vulcanize changes to mixed value (9)
16. Coat steel with aluminium using heat units (8)
18. Sounds like a hard finish to a nocturnal trip (7)
20. Cowper – Cowles to his friends (7)
21. Give D.C. a little wave? (6)
24. Starting point for deformation (6)
25. Controlled in plating each morning as an afterthought?

# Pipeline Corrosion Management

23 July 2015 Brisbane

Hosted by:



Sponsors:



Cocktail Function Sponsor:



The Australian Pipelines & Gas Association (APGA) and The Australasian Corrosion Association (ACA) joined together for the first time to host a technical seminar in Brisbane on 23 July to discuss the challenges and solutions for preventing corrosion in our pipelines, some of our most vital infrastructure.

Over 90 delegates from a broad cross section of the industry attended this full day technical event. Presentations covered a range of topics including, an overview of why corrosion prevention is important to the pipelines industry, materials selection, coatings solutions and cathodic protection. The presentations were all aimed at explaining different corrosion prevention measures used to attain the desired design life of our assets.

At the conclusion of the event an open floor forum chaired by Geoffrey Will, provided much discussion on the issues facing the industry. This was followed by a cocktail function where further discussion on corrosion prevention occurred.

The ACA would like to thank the APGA, all the speakers and their companies (listed below), sponsors and delegates who attended this event and for making the day a huge success!

- Francis Carroll, APA Group
- Wayne Thomson, Anode Engineering
- Raj Jeyarajah, Jemena
- David Anderson, UCC-Canusa
- Peter Jones, Anti-Corrosion Technologies
- Paul Mitchell, Quadrant Energy
- Mick Illidge, NuSpec
- John Grapiglia, Corrosion Control Engineering
- Colin Braganza, ALS Industrial
- Sander Hofstee, Seal for Life Industries





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# Corrosion in the Oil & Gas Industries 2015

27 August New Plymouth  
New Zealand

Following up from a successful 2014 Oil & Gas event in New Plymouth, one of the Australasian Corrosion Association's (ACA) goals was to continue the momentum gained in the region by continuing to run corrosion events and promote the ACA as leaders in corrosion mitigation

The New Plymouth Corrosion in the Oil & Gas Industries 2015 event took place on the 27 August with the help and support of the ACANZ Branch committee & the PCPI Technical Group committee. The event was a stellar success. Over 90 delegates, exhibitors and speakers descended on the Quality Hotel New Plymouth for a full day of learning, networking and camaraderie.

Supported by key sponsors International Paint & Olympus, the ACA got together speakers from across Australia and New Zealand. Delegates not only hailed from New Plymouth, but also from Auckland, Wellington, Christchurch and Australia.

This year 16 exhibitors joined the event, which allowed delegates to talk to some

of the leading suppliers of corrosion prevention technologies.

The carefully chosen speakers gave informed presentations about risk based Inspection methodologies, protective coatings, water jetting, case studies on corrosion control for critical infrastructure, corrosion under insulation, ultrasonic inspection techniques, acoustic emissions, corrosion monitoring and cathodic protection all interlinked with case studies.

The formal proceedings of the day concluded with a presenter's forum.

Once the full program of 10 speakers and the forum had concluded thanks

were expressed to the sponsors, exhibitors, delegates and their companies for their time and effort. The day then ended with refreshments at the event exhibition. The networking and fellowship continued until late into the evening.

- Michael Ellem, Shell Todd Oil Services
- Richard Milgate, International Paint
- Hamish Coop, Aquamax
- Phil Fleming, A.S. Harrison
- Shane Coleman, Fitzroy Engineering
- Richard Nowak, Olympus
- Ry Collier, Balance Agri-Nutrients
- David Lake, ATTAR
- Wayne Thomson, Anode Engineering
- Grant Chamberlin, Electrix



## Exhibitors





# Introductory Corrosion Seminar Protective Coatings & Cathodic Protection

Proudly presented by:



**Thursday 30 July 2015**

**Melbourne** - Hotel Mercure  
13 Spring Street,  
Melbourne VIC

**Sydney** - Engineers Australia  
Sydney Division, 8 Thomas St  
Chatswood NSW

Sponsored by:



On 30 July, simultaneously at two locations in Melbourne and Sydney the ACA held a Introductory Corrosion Seminar where over 90 delegates attended.

After the ACA Queensland Branch developed the concept in 2013, the ACA recognised the need for introductory level awareness and training on corrosion prevention. The seminar investigated the basic concepts of both protective coatings and cathodic protection. This seminar was aimed at people starting off in the corrosion industry or those wanting a refresher.

The ACA would like to thank Industrial Galvanizers for sponsoring the 2015 Introductory Corrosion Seminar series as well as the following speakers.

**Melbourne:** Robert Francis, David Reilly & Bruce Ackland

**Sydney:** Sandy McPherson, Alex Spillett & Allan Sterling

Following the success of these two seminars, two more seminars will be held in 2015. The first being on Friday 30 October in Brisbane (sponsored by Industrial Galvanizers) and the second being held on Tuesday 17 November in Adelaide (sponsored by Dulux) in conjunction with Corrosion & Prevention 2015 conference.



Below is an overview of the seminar to be run in Brisbane and Adelaide.

## Protective Coatings (3 hours)

This session provides an introduction to basic concepts of protective coatings; including the various types of coatings, the inspection requirements and considerations when selecting such products.

This session is designed for those working outside the corrosion or protective coatings industry, such as engineers and architects, but would be suitable for anyone requiring a brief introduction to the subject. Attendees will have the opportunity to raise questions and discuss issues and experiences.

### Highlights:

- Types of Coatings
- Coating Inspection
- Coating Maintenance
- Coating Selection

## Sponsors Session (30 minutes)

The sponsor's session will be a technical case study outlining the practical use of protective coatings.



## Cathodic Protection (3 hours)

This session will cover the basic corrosion theory and the principles and monitoring methods used in cathodic protection followed by a cathodic protection demonstration.

The session will enable participants to develop an awareness of the importance of cathodic protection to the maintenance and management of assets and an understanding of the basic principles of corrosion and cathodic protection.

### Highlights:

- Cathodic Protection
- Measurement Equipment
- Field Measurement Techniques
- Cathodic Protection Demonstration

Further information on the Introductory Corrosion Seminar can be found at [www.corrosion.com.au](http://www.corrosion.com.au) or by contacting the ACA Office on +61 3 9890 4833 or [aca@corrosion.com.au](mailto:aca@corrosion.com.au)





# CORROSION 2016

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# NEW PRODUCT SHOWCASE

The ACA does not officially endorse any of the products advertised in *Corrosion & Materials*.



## The Lixi Profiler System

The Lixi Profiler is used to inspect the condition of insulated industrial piping to find corrosion, erosion and blockage. Additionally, pipe fill levels can be determined and locate welds and fittings on both insulated and bare pipes.

Industries that benefit from inspection with the Lixi Profiler include; ammonia refrigeration, petrochemical, fire suppression and water distribution, lumber/timber, utilities, pulp and paper, chemical and any industry using industrial piping.

### Applications:

- Petrochemical
- High Temperature Sulfidation Corrosion (HTSC) programs find pipes subject to significant thinning due to low silicon content.
- Corrosion under Insulation (CUI) programs locate externally corroded areas under insulation.
- Positive Metal Identification (PMI) begins by locating all the welds in the system.

### Radiometric Profiling:

Traditional NDT techniques are not sufficient for solving all inspection problems. While other NDT techniques have significant limitations, the Lixi Profiler uses a technique known as Radiometric Profiling. The Profiler uses radioactive energies that detect changes in thickness as they pass

through insulation and pipes. Radiometric Profiling can identify the following indications:

- Pipe wall loss – internal & external
- Corrosion under insulation (CUI)
- Wet insulation and icing
- Blockage and verification of empty lines
- Locate welds in preparation for PMI
- Changes in pipe size or schedule that may not be on drawings.

### Some advantages of the Profiler:

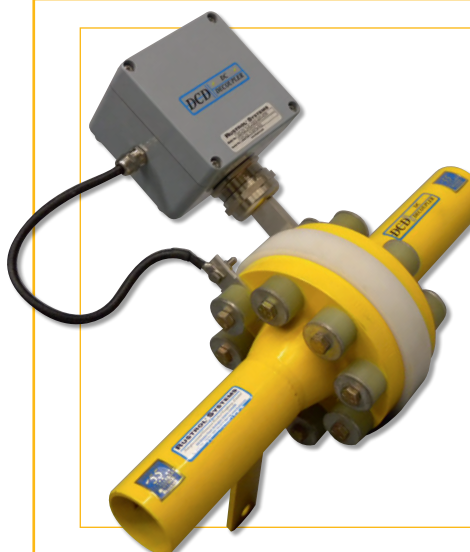
**Fast** - Inspection of up to 200 locations per day compared to 20-50 locations by ultrasonic or radiography methods.

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For further information please contact: **NDT Equipment Sales:**  
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F: (61-2) 9524 0560  
E: [ndt@ndt.com.au](mailto:ndt@ndt.com.au)  
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Fax: 905-333-4313  
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## AM4815ZT Dino-Lite Digital Microscope

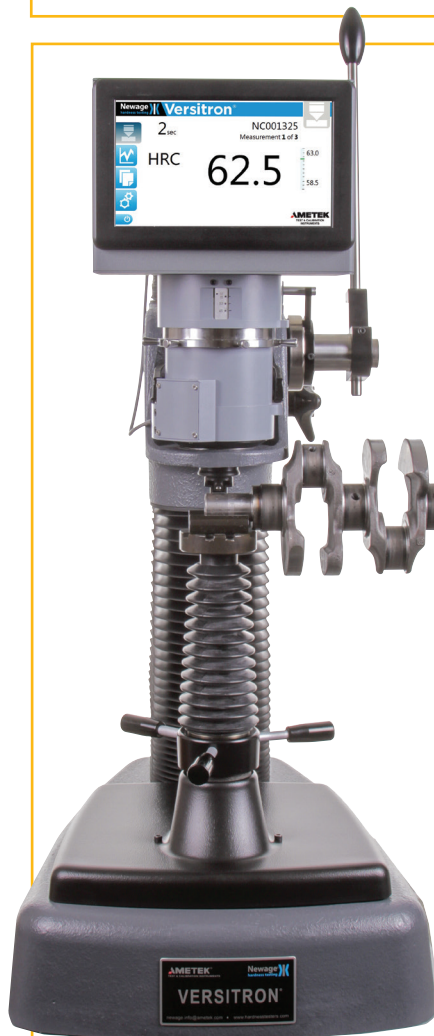
The NEW AM4815ZT Dino-Lite Edge Digital Microscope comes fully loaded, packed with features to confront even the most complex of image capture challenges head-on. The AM4815ZT Dino-Lite Edge exceeds expectations with 1.3MP Product Resolution, Extended Depth of Field (EDOF) and Extended Dynamic Range (EDR). EDOF image capture mode can take several pictures at different focus' and then stack them automatically while the EDR feature assists in revealing fine details of both dark and bright areas which would normally be lost in normal capture. The AM4815ZT Dino-Lite Edge achieves this by stacking images taken at different exposure levels.

The amalgamation of these special functions along with state-of-the-art lens design provides the

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## Versitron™ Rockwell Hardness Testing System

Is it possible to conduct Rockwell hardness tests in just seconds on large, long and unsupported specimens? It is with the new generation Versitron Series of Rockwell Hardness Testers.

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**Contact:** Russell Fraser Sales Pty Ltd  
T: +612 9545 4433 F: +612 9545 4218  
E: rfs@rfsales.com.au  
Web: www.rfsales.com.au

# ACA Standards Update

Welcome to the 5th corrosion related standards report for 2015.

The standards reporting for 2015 is scheduled against Technical Groups (TG) as indicated below:

Issue 2015	Standards search for TG interests	Issue 2015	Standards search for TG interests
Feb	Concrete Structures & Buildings	August	Cathodic Protection
April	Coatings	October	Mining Industry
June	Petroleum & Chemical Process Industries	December	Water & Waste Water

This Issue is for the **Mining Industry** Technical Group. As previously this report is in two stages, namely:

## Stage 1

A global standards and publication focus, searching through SAIGLOBAL Publications at <https://infostore.saiglobal.com/store>, for all current publications and standards relating to one of the ACA Technical Groups, with this editions group focus being the 'Mining Industry' Technical Group.

## Stage 2

A SAI Global search, as previously, at <http://www.saiglobal.com/online/> for new standards, amendments or drafts for AS, AS/NZS, EN, ANSI, ASTM, BSI, DIN, ETSI, JSA, NSAI and standards and amendments for ISO & IEC published from 16 July 2015 to 9 September 2015, using the key words and key word groups:

- 'durability'.
- 'corrosion' or 'corrosivity' or 'corrosive'; but not 'anodizing' or 'anodize(d)'.
- 'paint' or 'coating'; but not 'anodizing' or 'anodize(d)'.
- 'galvanize' or 'galvanized' or galvanizing'.
- 'electrochemical' or 'electrolysis' or 'electroplated'.
- 'cathode' or 'cathodic'.
- 'anode' or 'anodic'.
- 'corrosion' and 'concrete' or 'concrete' and 'coatings'.

## Summary

### Stage 1 Report

1. Through SAIGLOBAL Publications at <https://infostore.saiglobal.com/store> there were 2 Titles, all from Australian Standards as shown in **Table 1** below.

## Stage 2 Report

1. Across SAIGLOBAL online Standards Publications there was 15 new standards since 16 July – 9 September 2015 (**Table 2** below), with 1 Draft AS/NZS Standard, namely;

DR2 AS/NZS 1214:2015	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series) (ISO 10684:2004, MOD)
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Reader feedback and interaction is welcomed to enable focus improvement and better minimisation of corrosion.

## Stage 1 Report

**Stage 1 Report on SAIGLOBAL Publications at <https://infostore.saiglobal.com/store>, for all current publications and standards relating to 'Corrosion and Mining' for the 'Mining Industry' Technical Group TG.**

## Table 1

For a search on 'Mining' there were 2835 (56 more than last year) with 65 AS, AS/NZS titles (same as last year); on "Corrosion" there were 7476 (111 more than last year) with 35 AS, AS/NZS titles (down 2 from last year); on 'Corrosion and Mining' there were 2 titles, all from AS, AS/NZS as shown below.

HB 13-2007	Electrical equipment for hazardous areas
AS/NZS 3584 Set:2012	Diesel engine systems for underground coal mines Set

## Stage 2 Report

**Table 2.** Corrosion Related Standards for AS, AS/NZS, EN, ANSI, ASTM, BSI, DIN, ETSI, JSA, NSAI and Standards and Amendments for ISO & IEC Published from 16 July 2015 to 9 September 2015 for:

**New standards, amendments or drafts for AS, AS/NZS, EN, ANSI, ASTM, BSI, DIN, ETSI, JSA, NSAI and Standards or Amendments for ISO & IEC PUBLISHED between 16 July 2015 to 9 September 2015**

**Key word search on 'durability' - 2 citations found possibly related to corrosion**

ISO 15928-3:2015	Houses - Description of performance - Part 3: Structural durability
ISO 19095-4:2015	Plastics - Evaluation of the adhesion interface performance in plastic-metal assemblies - Part 4: Environmental conditions for durability

**Key word search on 'corrosion' or 'corrosivity' or 'corrosive'; but not 'anodizing' or 'anodize(d)' - 5 corrosion related Publications found; none from AS/NZS.**

ISO 15156-3:2015	Petroleum and natural gas industries - Materials for use in H <sub>2</sub> S-containing environments in oil and gas production - Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys
ISO 8044:2015	Corrosion of metals and alloys - Basic terms and definitions
ISO/DIS 6509-2.2	Corrosion of metals and alloys - Determination of dezincification resistance of copper alloys with zinc - Part 2: Assessment criteria



ISO/DIS 9227	Corrosion tests in artificial atmospheres - Salt spray tests
DIN EN ISO 17945 (2015-08)	Petroleum, petrochemical and natural gas industries - Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments (ISO 17945:2015)
<b>Key word search on 'paint' and or 'coating' and corrosion; but not 'anodizing' or 'anodize(d)' - 5 corrosion related Publications found; 1 AS/NZS draft.</b>	
DIN EN ISO 11126-10 (2015-08) (Draft)	Preparation of steel substrates before application of paints and related products - Specifications for non-metallic blast-cleaning abrasives - Part 10: Almandite garnet (ISO/DIS 11126-10:2015); German and English version prEN ISO 11126-10:2015
I.S. EN ISO 16961:2015	Petroleum, Petrochemical and Natural gas Industries - Internal Coating and Lining of Steel Storage Tanks (ISO 16961:2015)
ISO 16961:2015	Petroleum, petrochemical and natural gas industries - Internal coating and lining of steel storage tanks
ISO/DIS 19487	Metallic and other inorganic coatings - Electrodeposited nickel-ceramics composite coating
DR2 AS/NZS 1214:2015	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series) (ISO 10684:2004, MOD)
<b>Key word search on 'galvanize' or 'galvanized' or galvanizing' - 2 Standard Publications found, 1 AS/NZS Draft</b>	
DR2 AS/NZS 1214:2015	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series) (ISO 10684:2004, MOD)
JIS G 3442:2015	Galvanized steel pipes for ordinary piping
<b>Key word search on 'corrosion' with examination for concrete related standards - 0 Standard Publications found.</b>	
<b>Key word search on 'cathode' or 'cathodic' - 0 Standard Publications found related to corrosion</b>	
<b>Key word search on 'anode' or 'anodes' or 'anodic' - 1 Standard Publications found related to corrosion.</b>	
I.S. EN 1754:2015	Magnesium and Magnesium Alloys - Designation System for Anodes, Ingots and Castings - Material Symbols and Material Numbers
<b>Keyword Search on 'electrochemical' or 'electrolysis' or 'electroplated' - 1 corrosion related Standard Publications found related to electrical storage</b>	
IEC/TS 62607-4-1 Ed. 2.0 (English 2015)	Nanomanufacturing - Key control characteristics - Part 4-1: Cathode nanomaterials for nano-enabled electrical energy storage - Electrochemical characterisation, 2-electrode cell method
<b>Keyword Search on 'anodize' or 'anodized' - 0 Publications found</b>	



Arthur Austin  
ACA Standards Officer



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# Corrosion & Prevention 2015 Program

The ACA reserve the right to exclude any paper and to alter without notice any of the arrangements, timetables & programs relating to the conference.



## Sunday 15 November 2015

12:00 – 17:00	<b>Registration Desk Open</b> Western Foyer, Adelaide Convention Centre	
17:00-17:45	<b>First Time Delegates Function</b> City Foyer, Upper Level, Adelaide Convention Centre <i>Sponsored by Galvanizers Association of Australia &amp; Adelaide Galvanising Industries</i>	<b>galvanizers</b> ASSOCIATION OF AUSTRALIA 
18:00 – 21:00	<b>Welcome Reception</b> First Lounge & Bar, Hotel Richmond 128 Rundle Mall, Adelaide <i>Sponsored by Incospec &amp; Associates Australia</i>	<b>INCOSPEC</b>  CORROSION ENGINEERS

## Monday 16 November 2015

9:00	<b>Opening Address and Starting of Ed Potter Corrosion Clock</b> Room - Hall N			
9:30	<b>Plenary 1:</b> <b>Markus Buchler, Swiss Society for Corrosion Protection, Switzerland</b> A Discussion of Mechanisms Involved in Cathodic Protection <i>Sponsored by Freyssinet Australia</i> Room - Hall N			 <b>FREYSSINET</b> AUSTRALIA
10:15	<b>Plenary 2:</b> <b>Miles Buckhurst, Jotun Performance Coatings, Norway</b> The True Cost of Paint, A Life Cycle Philosophy <i>Sponsored by Jotun</i> Room - Hall N			
11:00	<b>Morning Tea</b>			
	<b>Stream A - Assets</b> <b>Chair: Willie Mandeno</b> Room - Hall N	<b>Stream B - Coatings</b> <b>Chair: Geoff White</b> Room - L1	<b>Stream C- Advanced Sensing</b> <b>Chair: Erwin Gamboa</b> Room - L2	<b>Stream D - Cathodic Protection</b> <b>Chair: Jim Galanos</b> Room - L3
11:30	Protecting Public Art Against Corrosion <b>L. Boulton</b> Les Boulton & Associates <b>010</b>	Using Intumescent Coatings to Achieve Building Code Compliance on Steel Structures <b>C. Partington</b> International Paint <b>014</b>	Structural Health Monitoring: A Practical Approach to Achieving In-Situ and Site-Specific Warning of Pipeline Corrosion and Coating Failure <b>M. Tan</b> Deakin University <b>032</b>	Investigations into the Effects of Interrupted Cathodic Protection - A Review <b>C. Christodoulou</b> AECOM <b>005</b>
12:00	Extending the Service Life of Coatings through Maintenance. Tales from the Field - 2 Case Studies <b>J. Rigby</b> Remedy Asset Protection <b>015</b>	Smart Anti-Corrosive Self-Healing Coatings using Halloysite Nanotubes as Host for Entrapment of Corrosion Inhibitors <b>K. Thanawala</b> IITB-Monash Research Academy <b>017</b>	Using Open-Source Geographical Information Systems for Pipelines <b>G. Gummow</b> G Squared Consultants <b>039</b>	Case for a Critical Review of ICCP of Steel Pipelines <b>R. Vukcevic</b> Infoware Consulting <b>056</b>
12:30	Corrosion & Asset Protection in the HVAC&R Industry - Forgotten Issue <b>M. Weir</b> Blygold Oceania <b>027</b>	One Visit Tank Lining <b>M. Buckhurst</b> Jotun Performance Coatings Norway <b>059</b>	Design Challenges Associated with the Use of Non-Metallic Materials in Marine Sheet Pile Walls <b>D. Ferguson</b> Infracorr Consulting <b>130</b>	A Review of the Design Philosophy for the Cathodic Protection Systems of FPSO/FSO and the Inherent Problems with the Approach <b>J. Grapiglia</b> Corrosion Control Engineering <b>061</b>
13:00	<b>Lunch</b>			
13:15	<b>ACA Foundation Ltd AGM</b> Room - L1			
	<b>Stream A - Assets</b> <b>Chair: Paul Vince</b> Room - Hall N	<b>Stream B - Coatings</b> <b>Chair: Ted Riding</b> Room - L1	<b>Stream C - NDT</b> <b>Chair: Mark Dragar</b> Room - L2	<b>Stream D - Cathodic Protection/Coatings</b> <b>Chair: Mohammad Ali</b> Room - L3
14:00	Structural Risk Assessment of Corroding Infrastructure <b>B. Dockrill</b> Vinsi Partners <b>034</b>	Hydrothermal Ageing of 100% Solids Epoxy for Pipelines <b>E. Gamboa</b> The University of Adelaide <b>086</b>	The Importance of Certification within the Inspection Industry <b>P. Milligan</b> AINDT <b>088</b>	Quantifying the Effects of Major Factors Affecting the Effectiveness of Cathodic Protection of Pipelines <b>M. Tan</b> Deakin University <b>030</b>



14:30	Development of a Galvanized Highway Structure Maintenance Strategy <b>R. El Sarraf</b> Opus International Consultants <b>100</b>	The Effect of Post Deposition Treatments on the Corrosion Behaviour of PVD TiN Coatings in Acidic and Saline Solutions <b>L. Ward</b> RMIT University <b>064</b>	Corrosion Everywhere - Why do we have Difficulty Finding and Sizing it? Ultrasonic Testing <b>D. Lake</b> ATTAR <b>101</b>	Selecting Reinforced Concrete Cathodic Protection Systems <b>J. Dyson</b> BCRC <b>062</b>
15:00	Role of Surveillance in Quality Assurance <b>N. Tripathi</b> Roads and Maritime Services <b>067</b>	Specifying Climate Control for Blasting and Coating Projects <b>W. Clark</b> Dehumidification Technologies <b>104</b>	When Cheaper is Better: Stress Corrosion Cracking in Hanger Rods <b>D. Cram</b> ATTAR <b>142</b>	Pull-Off Adhesion Testing of Coatings – Improve Your Technique <b>J. Fletcher</b> Elcometer <b>093</b>
15:30	Afternoon Tea			
	<b>Stream A - Forum</b> Chair: Warren Green Room – Hall N	<b>Stream B - Forum</b> Chair: Justin Rigby Room - L1	<b>Stream C - Concrete</b> Chair: Peter Johnsson Room - L2	<b>Stream D - Forum</b> Chair: Bruce Ackland Room - L3
16:00	<b>Asset Management Forum</b>  Protecting Assets Against Corrosion - Asset Management Case Studies & Panel Discussion	<b>Protective Coatings Forum</b>  <i>Future of the Coatings Industry</i>	Study on Concrete Durability in Presence of Sulphates Using Silane-Based Hydrophobic Impregnation <b>P. Mojarad</b> Sika Australia <b>040</b>	<b>Australian Electrolysis Committee Forum</b>  Welcome and Opening
16:30	<b>Case Studies</b> SA Water and Santos	<b>Topics</b> Products – Nano-technology, Microbes that self-repair, 3D-printing	Corrosion Risk Testing on Existing Reinforced Concrete Structures <b>F. Papworth</b> BCRC <b>074</b>	Activities of the SA Electrolysis Committee - <b>R. Schmidt</b> (SA Water)
17:00	Panel will include: SA Water, Santos, Roads and Maritime Services, Vinsi Partners, Opus International Consultants	Fabricators – Will there be any?  Engineers – Will it be all done off-shore?	Maintenance of Concrete Wharf Structures: West Basin Berths 3 & 4, Newcastle Port, Australia <b>A. Bird</b> Marine & Civil Maintenance <b>085</b>	Deakin Research Update - <b>M. Tan</b> (Deakin University)  The new ISO 18086: Mitigation of AC Corrosion by Means of Weakening the CP - <b>M. Buchler</b> (SGK – Swiss Society for Corrosion Protection)
17:30-19:30	<b>Exhibition Opening</b> Exhibition Hall L & M, Adelaide Convention Centre			
18:30-21:30	<b>Young Corrosion Group Event</b> The Little Hunter, 25 Victoria St, Adelaide <i>Sponsored by Galvanizers Association of Australia &amp; Korvest Galvanisers</i>			 
Tuesday 17 November 2015				
9:00	<b>Plenary 3 - PF Thompson Lecture:</b> <b>Robert Francis, R A Francis Consulting Services</b> Who Rusts First: Revisiting Galvanic Corrosion Room - Hall N			
9:45	<b>Plenary 4:</b> <b>Baldev Raj, National Institute of Advanced Studies, India</b> Corrosion Mitigation, Monitoring and Inspection Technologies Room - Hall N			
10:30	Morning Tea			
	<b>Stream A - Assets</b> Chair: James Wu Room – Hall N	<b>Stream B - Coatings</b> Chair: Dean Wall Room - L1	<b>Stream C - Research</b> Chair: Alex Shepherd Room - L2	<b>Stream D – Cathodic Protection / Concrete</b> Chair: Alan Bird Room - L3
11:00	Corrosion Under Insulation on Process Towers - Assessment and Mitigation <b>P. Panicker</b> Santos <b>063</b>	The Complexities of Global Supply and Control of Protective Coatings <b>R. Moore</b> Jotun Performance Coatings Norway <b>073</b>	Atmospheric Corrosion of Mild Steel Vertical Prisms, Rounds and Flat Coupons of Different Shape and Size <b>R. Jeffrey</b> The University of Newcastle <b>139</b>	Automating Cathodic Protection Inspection Cycles through use of Technology <b>P. Martin</b> Anode Engineering <b>095</b>

11:30	Financial Benefit to a Corrosion Aware Mine Site Culture <b>W. Gray</b> Extrin <b>121</b>	Replica Tape - Relating Surface Profile Height and Peak Density to Pull-Off Adhesion <b>D. Beamish</b> DeFelsko <b>078</b>	Corrosion Expertise Survey in South Australia <b>T. Bettison</b> The University of Adelaide <b>066</b>	Mitigation of Accelerated Low Water Corrosion by Cathodic Protection - Background, Challenges, Examples <b>U. Kreher</b> Aurecon Australasia <b>126</b>
12:00	Electronic Forms and Data Collection in the Field – Automate Inspections using Mobile Devices <b>N. Shibi</b> Techs4biz Australia <b>076</b>	Leaching Performance of a Rare-Earth-Containing Epoxy Polyamide Primer <b>A. Sudholz</b> Defence Science and Technology Group <b>082</b>	Corrosion of Iron Steamships: Longitudinal Studies of the <i>SS Xantho</i> (1872) and the <i>City of Launceston</i> (1865) <b>I. MacLeod</b> Western Australia Maritime Museum <b>133</b>	Investigations into the Cause and Consequence of Incipient Anodes in Repaired Concrete Structures <b>C. Christodoulou</b> AECOM <b>003</b>
12:30	Lunch			
12:45	ACA Members Meeting Room - L1			
	<b>Stream A - Assets</b> Chair: Graham Sussex Room - Hall N	<b>Stream B - Research</b> Chair: Rolf Gubner Room - L1	<b>Stream C - Case Studies / Research</b> Chair: Jianqiang Zhang Room - L2	<b>Stream D - Cathodic Protection / Concrete</b> Chair: Brian Hickinbottom Room - L3
13:30	An Approach for Condition Assessment of Reinforced Earth Retaining Walls <b>V. Afshari</b> GHD <b>081</b>	Reliable Durability Prediction of Polymeric Materials <b>P. Shaw</b> BRANZ <b>007</b>	Inspection of Hot Dip Galvanizing and Common Misconceptions <b>A. Sheehan</b> Galvanizers Association of Australia <b>084</b>	Acid Neutralisation Behaviour of Concrete Sewer Pipes <b>T. Wells</b> The University of Newcastle <b>009</b>
14:00	Corrosion Induced Failures of Rail Tracks <b>S. Ali</b> Bureau Veritas <b>087</b>	Hydrogen Embrittlement of Austenitic Stainless Steel/Carbon Steel Dissimilar Metal Welds <b>M. Alelayni</b> University of New South Wales <b>128</b>	Internal Corrosion of Parked Steel Oil Pipelines <b>R. Melchers</b> The University of Newcastle <b>055</b>	Review of Cathodic Protection Systems for Concrete Structures in Australia. Lessons Learnt and Future Directions <b>A. Cheaitani</b> Remedial Technology <b>070</b>
14:30	Wet Scrubber Corrosion <b>K. Emseis</b> ALS Industrial <b>117</b>	Corrosion and Assisted-Cracking of Magnesium Alloys in Bioreplant Applications: Challenges and Opportunities <b>R. Singh</b> Monash University <b>112</b>	Investigation of Corrosion of Diesel Engine Aftercoolers <b>R. Jeffrey</b> Pacific Testing <b>052</b>	Use of Hot Dip Galvanized Steel Reinforcement for Increased Durability of Concrete Structures <b>B. Redwood</b> Galvanizers Association of Australia <b>044</b>
15:00	Afternoon Tea			
	<b>Stream A - Forum</b> Chair: Warren Green Room - Hall N	<b>Stream B - Forum</b> Chair: Fikry Barouky Room - L1	<b>Stream C - Research / Forum</b> Chair: Timothy Khoo Room - L2	<b>Stream D - Assets and Coatings</b> Chair: Justin Rigby Room - L3
15:30	<b>Concrete Structures &amp; Buildings Forum</b> <i>An Update &amp; Discussion of some Aspects of Concrete Durability, Repair &amp; Protection</i>	<b>Oil &amp; Gas Forum</b> <i>Corrosion Under Insulation (CUI)</i>	Thiourea Formaldehyde as an Effective Corrosion Inhibitor for N80 steel in 3.5% NaCl Solution Saturated with CO <sub>2</sub> <b>A. Singh</b> Southwest Petroleum University <b>004</b>	Service Life of Pitted Pipes subject to Pressure Fluctuations and Hydrogen Embrittlement <b>A. Rajabipour</b> The University of Newcastle <b>140</b>
16:00	<b>Topics</b> Concrete Durability - Australian Recommended Practice Publications	What is best practice for initial installation to prevent CUI?	<b>Research Forum</b> Discussion of new research techniques	Are Today's Coatings too Good? <b>B. Lindell</b> 3CCC
16:30	Structural Strengthening Methods and Design  Hybrid Treatment of Concrete Structures	When inspecting a plant what is the best technique/method for detecting CUI?  Once corrosion is identified how do we assess it?  How do we deal with CUI once detected and assessed?	Encouraging paper submissions and presentations from students and postgraduates  Future Research Technical Events  Research stream structure v research papers across the C&P conference	Lead Abatement Works - Case Study, Dry Ice and Grit Blasting to Structural Steel during Heritage Refurbishment at Roseberry NSW <b>T. Fraatz</b> Cryoprep Australia
19:00-24:00	ACA Annual Awards Dinner Hall F, Adelaide Convention Centre <i>Sponsored by Denso Australia</i>			





**Wednesday 18 November 2015**

	<b>Stream A – Research / MIC</b> <b>Chair: Brian Kinsella</b> Room – Hall N	<b>Stream B – Research / Magnesium</b> <b>Chair: Bruce Hinton</b> Room – L1	<b>Stream C – Materials Selection</b> <b>Chair: Les Boulton</b> Room – L2	<b>Stream D – Concrete</b> <b>Chair: Atef Cheaitani</b> Room – L3
9:00	Effect of Mn on Corrosion of Fe-Cr and Fe-Cr-Ni Alloys in Dry CO <sub>2</sub> Gas at 650°C <b>T. Nguyen</b> University of New South Wales <b>046</b>	Corrosion of Carbon Steel under Mixed Deposits in Simulated Deoxygenated Seawater Environment <b>X. Wang</b> The University of Newcastle <b>071</b>	On the Effect of Hydrogen on the Corrosion and Electrochemistry of AISI 410 and F22 Steels <b>S. Thomas</b> Monash University <b>135</b>	Electrokinetic Review and Appraisal of Steel Reinforcement Corrosion in Concrete <b>H. Flitt</b> Queensland University of Technology <b>016</b>
9:30	Effect of Metal Substrate on Initial Attachment of E. coli Bacteria and Subsequent Microbiologically Influenced Corrosion <b>S. Wade</b> Swinburne University of Technology <b>049</b>	Drug Delivery in Bioresorbable Orthopaedic Magnesium Implants <b>J. Lyndon</b> Monash University <b>110</b>	Cost Effective Use of Duplex Stainless Steel in Structural Applications <b>C. Tigerstrand</b> Outokumpu <b>033</b>	Corrosion Protection of Sydney Water's Sewers – Sacrificial Alkali Coating <b>B. Murray</b> IXOM Operations <b>105</b>
10:00	A Case Study of a Corroded Cast Iron Water Main on Bridge Rd, Richmond <b>A. Spark</b> RMIT University <b>065</b>	Oxygen Solubility in Fe-Ni Alloys at High Temperature in Rhines Packs and in Gas Mixtures <b>D. Julian</b> University of New South Wales <b>057</b>	Weld Corrosion - An Overview <b>I. Chaves</b> The University of Newcastle <b>054</b>	Advanced Polymer Encapsulation to Protect and Repair RC Marine Structures <b>A. Sarkady</b> BASF Australia <b>127</b>
10:30	Clarke's Solution Cleaning used for Corrosion Product Removal: Effects on Carbon Steel Substrate <b>S. Wade</b> Swinburne University of Technology <b>050</b>	The Synthesis, Matching and Deconvolution of Magnesium/Magnesium Alloy Active Corrosion Polarization Curves <b>D. Northwood</b> University of Windsor <b>026</b>	Improving Subsea Pipeline Cathodic Protection Surveys <b>D. Flanery</b> Deepwater Australasia <b>125</b>	Coating Damp Concrete: Water Based, Solvent Based or Solvent Free? <b>L. Edmond</b> Peerless Industrial Systems <b>132</b>
11:00	<b>Morning Tea</b>			
11:30	<b>Plenary 5:</b> <b>Srdjan Nesic, Ohio University, USA</b> Localized Corrosion of Mild Steel in a CO <sub>2</sub> Aqueous Environment – An Overview Room – Hall N			
12:15	<b>Plenary 6:</b> <b>Frank Collins, Deakin University</b> 3D Visualisation of Reinforcement Corrosion within Concrete Marine Structures Room – Hall N			
13:00	<b>Lunch</b>			
	<b>Stream A - Other</b> <b>Chair: Narendra Tripathi</b> Room – Hall N	<b>Stream B - Modelling</b> <b>Chair: David Nicholas</b> Room – L1	<b>Stream C - Modelling</b> <b>Chair: Robert Jeffrey</b> Room – L2	<b>Stream D - Research</b> <b>Chair: Mike Tan</b> Room – L3
14:00	Coating Deterioration and Corrosion Mechanisms in Leaching and Adsorption Tanks in Gold Mining <b>G. Harrison</b> Extrin <b>120</b>	On the Bi-Modal Long-Term Characteristic for Metallic Corrosion <b>R. Melchers</b> The University of Newcastle <b>041</b>	Imidazolinium Inhibitor for Mild Steel in Aggressive Conditions <b>A. Somers</b> Deakin University <b>115</b>	Corrosion Behaviour of Ferritic Fe-Cr Alloys in CO <sub>2</sub> – H <sub>2</sub> O – SO <sub>2</sub> Gases at 800°C <b>C. Yu</b> University of New South Wales <b>072</b>
14:30	Business Growth in the Corrosion and Prevention Industry <b>W. Thomson</b> Anode Engineering <b>036</b>	Pitting Corrosion of Cast Iron Pipes <b>P. Ferguson</b> PCA-Echologics <b>038</b>	Influence of Climate Change on Long-Term Marine Corrosion Prediction <b>I. Chaves</b> The University of Newcastle <b>051</b>	Factors Contributing to the Corrosivity of Seawater and Brine in UAE <b>M. Suleiman</b> TAKREER <b>077</b>
15:00	U.S. Corrosion Program and International Defense Cooperation <b>R. Gubner</b> Curtin University <b>037</b>	The Bi-Modal Corrosion Behaviour of Ferrous Metals Buried in Soil <b>R. Petersen</b> The University of Newcastle <b>013</b>	Probabilistic Modelling of Pit Area in Corroded Cast Iron Pipes <b>Z. Soltani Asadi</b> The University of Newcastle <b>043</b>	Efficiently Monitoring Corrosion Inhibitors of Carbon Steel in Seawater <b>A. Fakhraldeen</b> EBR Center <b>006</b>
15:30	<b>Closing Session</b> Room – Hall N			
16:00-18:00	<b>Farewell Function</b> Panorama Room, Upper Level, Adelaide Convention Centre			



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Email: jonsweet@abss.net.au or johnb@abss.net.au



**AEGIS**

[www.aegis.net.au](http://www.aegis.net.au)

**Stand Number: 29**

For more than 80 years Aegis has designed and manufactured test equipment for utility companies worldwide. Aegis strives to maximise the life of a utility network, seeking continuous reliable operation and performance. From contractors to network owners, Aegis provides test and measurement solutions for daily use.

Aegis is transforming the corrosion protection industry by providing 24/7 monitoring of your protection systems. No longer need you wonder whether your network is being protected, let the DataCell product range do it for you. Sit at your desk and analyse the data, react to alarms only as required, and proactively maintain your asset efficiently.

Contact: Matthew Mitchell or Steve Watt

Phone: 1300 723 447

Email: [m.mitchell@aegis.net.au](mailto:m.mitchell@aegis.net.au) or [s.watt@aegis.net.au](mailto:s.watt@aegis.net.au)

**Airblast Australia**

[www.airblastaustralia.com](http://www.airblastaustralia.com)

**Stand Number: 2**

For more than 40 years, Airblast has been the world leader in providing blasting and painting solutions to the anticorrosion industry. With an unparalleled network of offices around the world Airblast works closely with our customers and distribution partners providing tried and tested equipment as well as developing customized solutions for specific applications. With world class products come world class solutions, which include but are not restricted to Airblast Abrasives, Airblast blast room facilities, Airblast high production wheel blasting machines, Dust collection, abrasive recycling, Blastrac and Graco.

With branches located in Western Australia, Queensland and Victoria, for all your surface preparation and coating application solutions, we have the best products to achieve the best results.

Contact: David Pocock

Phone: +61 8 9271 2265

Email: [david@airblastwa.com.au](mailto:david@airblastwa.com.au)

**AMAC Corrosion**

[www.amacgroup.com.au](http://www.amacgroup.com.au)

**Stand Number: 4**

Since 1974, we have been manufacturing cathodic protection systems in Melbourne. We specialise in producing the highest quality Aluminium, Magnesium and Zinc sacrificial anodes as well as impressed current anodes and related cathodic protection materials and equipment. Our continued accreditation to **ISO9001** (since 1997) is testament to our product quality.

We continue design and manufacture products to suit every application and industry, while providing customers with a friendly and sincere service. Nothing is impossible for our diverse manufacturing team, and we welcome your enquiries.

Please come and have a chat at our stand in the exhibition.

Contact: Mark Rigg, General Manager

Phone: +61 3 9729 8888

Email: [markrigg@amacgroup.com.au](mailto:markrigg@amacgroup.com.au)

**Anode Engineering**

[www.anodeengineering.com](http://www.anodeengineering.com)

**Stand Number: 62**

Anode Engineering Pty Ltd is a specialist product and service provider to the corrosion industry in Australasia. We pride ourselves on being able to provide complete corrosion management solutions. Our team leads the industry in design, installation, commissioning and management of CP systems. Our long standing association with the industry has allows us to provide cutting edge products, services and technology for corrosion management and prevention needs.

- Anodes
- CP Systems, Instrumentation & Materials
- Coating Assessment, Equipment & Services
- Survey Equipment
- Remote Monitoring Systems
- Corrosion Monitoring
- Earthing/Surge Equipment
- CP Backfills
- Exothermic Welding
- Holiday Detectors
- MIJ's and Flange Isolation
- Pile Protection & Anti-Fouling
- Nut and Bolt Protection

## || C&P 2015 EXHIBITORS

- Staff Training
- Swain Meters
- Thermoelectric Generators (TEGs)
- Vapour Phase Corrosion Inhibitors

**Come and see us at Booth No 62 in Adelaide**

Contact: Wayne Thomson, Managing Director  
Phone: 1800 446 400 or +61 400 960 043  
Email: sales@anodeengineering.com

### Anti Corrosion Technology

www.anticorrosiontechnology.com



**Stand Number: 58**

Anti Corrosion Technology (ACT) is an Australian-based engineering company that specializes in providing sustainable solutions in materials engineering and corrosion control by senior specialists for the oil & gas, water, mining, marine and power generation industries.

ACT is also the authorised and sole distributor of STOPAQ visco elastic systems in Australia offering unique and cost effective solutions for external pipeline corrosion protection including factory applied mainline coating, field joint coating, flange and valve protection, HDD, steel pipe casings under road & rail crossings as well as corrosion protection of tank bottoms and offshore/submerged structures such as platform risers, wharf piles and jacket legs.

Phone: +61 7 3344 4434  
Email: info@anticorrosiontechnology.com

### BASF Australia

www.master.builders.solutions.basf.com.au



**Stand Number: 59**

With Master Builders Solutions, BASF introduces a global brand of advanced chemical solutions for construction. The brand builds on the strengths of many existing BASF brands and products and represents our experience of more than 100 years in the construction industry.

The Master Builders Solutions brand brings all of BASF's expertise together to create chemical solutions for new construction, maintenance, repair and renovation of structures.

Master Builders Solutions is built on the experience gained from more than a century in the construction industry.

Contact: Andrew Sarkady  
Phone: +61 418 530 763  
Email: andrew.sarkady@basf.com

### Blast-One International

www.blast-one.com.au



**Stand Number: 12**

Blast-One is specialist supplier of equipment and consumables to the protective coatings and corrosion control industry. With over 50 years of experience in supporting the war on rust, we have evolved to the point where we can supply your corrosion control operations globally with a complete range of quality spray, blasting and abrasive products... all backed with a technical support team that can advise you on optimising your whole process/project for better outcomes for all stakeholders. Our dedicated and ongoing research and development program ensures that we continue to introduce new and innovative products that allow our customers to achieve the most professional and cost-effective surface preparation and coating solutions outcomes.

Contact: Jim Gooden  
Phone: +61 8 8292 2000  
Email: Jim.Gooden@blastmaster.com.au

### Blygold

www.blygold.com.au



**Stand Number: 31**

Blygold prevents and stops corrosion in air conditioning systems with our unique anti-corrosion coating products.

Blygold Oceania is part of Blygold International, which has been established for over 36 years with a reputation for excellence and quality of products and services. Blygold services many clients such as offices, retail, airports, hospitals, hotels, and many industries.

#### Benefits Blygold treatment:

- save up to 20% on energy
- double the lifespan
- increase reliability
- provide cleaner air



**Specifications Blygold treatment:**

- salt and acid resistant over 4000 hours
- coating 25 to 30 microns
- full coverage, fins and the copper tubes plus the connection between the fins and tubes
- metal pigmentation, conductivity stays high
- can be applied and maintained on site

Contact: Mark Weir, Managing Director

Phone: 1300 271 115 (Australia only)

or +61 7 3807 0660 (International)

Email: admin@blygold.com.au

**Bristle Blaster® Australia**

www.bristleblaster.com.au

**BRISTLE  
BLASTER®**

**Stand Number: 34 & 35**

Bristle Blaster® Australia Pty Ltd is the proud Monti Partner for Australia, New Zealand, Papua New Guinea and New Caledonia. Monti is the manufacturer of Bristle Blaster® Surface Preparation Technologies.

Bristle Blaster® Australia Pty Ltd supplies and supports the Bristle Blaster® throughout a variety of industries, including pipeline, oil & gas, marine / shipyards, bridge maintenance, mining and construction, to mention a few. Based in Melbourne, we work closely with select local partners throughout the region to provide on-site service, training and support.

Contact the team at Bristle Blaster® Australia today to find out more about products and services.

Name: Phil Chester, Managing Director

Phone: + 61 3 9737 2800

Email: info@bristleblaster.com.au

**Bureau Veritas**

www.bureauveritas.com.au



**BUREAU  
VERITAS**

**Stand Number: 53**

Bureau Veritas AIRS provides asset reliability management services which include condition monitoring, non-destructive testing, structural integrity, metallurgical engineering, root cause failure analysis, risk based analysis & inspection, and finite element analysis. The Materials Science and Engineering group is comprised of over 30 engineers located in labs across Australia. The services provided include:

- Root cause failure analysis of plant and equipment
- Identification of corrosion failure modes
- NATA accredited chemical analysis and mechanical testing
- Optical microscopy, scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) for forensic analyses
- Preparation of material specifications and Inspection and Test Plans (ITP's)
- In-situ metallurgical testing: metallographic replication, hardness testing, and positive material identification

Contact: Roger Costanzi

Phone: +61 2 4908 2500 or +61 427 141 356

Email: roger.costanzi@au.bureauveritas.com

**Carboline**

www.carboline.com



**Stand Number: 9 & 10**

Carboline is a global supplier of coatings, linings and fireproofing.

The company was founded in 1947 in the USA, more than 60 years later Carboline have expanded with offices and Manufacturing plants across the globe.

Solving customers problems is how Carboline got started and this is still our focus. Our goal is to meet the needs and expectations of customers by recommending products that provide the right solutions. By doing this Carboline has become the global standard of quality when it comes to high performance coatings, linings and fireproofing.

Today is no different than when we started, solving customers problems drives our approach to everything we do ... that's Coatings Done Right.

Contact: Karen Edwards – Senior Business Consultant - Projects

Phone: +61 406 774 211

Email: Karene@carboline.com.au

**Cathodic Anodes Australasia**

www.cathodicanodes.com.au



**Stand Number: 60**

Since commencing manufacturing in 1984, we have established ourselves as Australia's largest galvanic anode manufacturer. Our foundry is designed based on Lean Manufacturing principles, where work flow efficiency gains and minimal down time has led to significantly shorter lead times and reduced energy use.

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Our anodes protect billions of dollar's worth of infrastructure around Australia, the South Pacific and South East Asia including industrial anodes for offshore oil rigs, floating FPSOs, mining, construction and pipelines as well as for the protection of infrastructure such as ports, wharves, sheet pile walls and desalination plants. Our anodes also protect ships, yachts, marine motors, tanks and hot water systems.

Contact: Brent Linde, Business Development Manager  
Phone: +61 7 5476 9788  
Email: [brent@cathodicanodes.com.au](mailto:brent@cathodicanodes.com.au)

### Cathodic Protection Company

[www.cathodic.co.uk](http://www.cathodic.co.uk)



**Stand Number: 65**

**Cathodic Protection Co Ltd**, founded in 1950, was one of the first companies in the United Kingdom set up specifically to provide equipment and engineering services for the cathodic protection of pipelines, storage tanks, well casings, steel in concrete and marine structures for the oil, gas, petrochemical, water and power industries. With clients worldwide, our NACE and iCorr qualified engineers provide a full design, project management and procurement service for CP applications, as well as site survey services, consultation and training. Our anti-fouling department is responsible for the design, manufacture, supply, installation and commissioning of Cuprion automatic marine anti-fouling systems.

Contact: Ed Sparks, Sales Manager  
Phone: +44 1476 590 666  
Email: [cpc@cathodic.co.uk](mailto:cpc@cathodic.co.uk)

### Coating Supplies Australasia

[www.coating-supplies.com.au](http://www.coating-supplies.com.au)



**Stand Number: 37**

Coating Supplies Australasia Pty Ltd is a privately held and independently operated Australian company.

Coating Supplies Australasia Pty Ltd is proud to be the distributors in Australia and New Zealand of **TQC Testing**

**Instruments, QNix™ Coating Thickness Gauges and Elmed isotest Holiday Detectors.** We also are proud to be authorised distributors of **Graco** wet spray and **Gema** powder coating equipment. Other brands in our stable include **3M**, **Sundstrom** and **Frontier Safety** equipment.

Coating Supplies Australasia is pleased to offer a range of world leading salt testing solutions such as the **Chlor\*Rid CSN** and **Bresle Kit** and Surface passivator solutions such as **Hold Blast**.

**WE ARE COMMITTED TO YOUR BUSINESS SUCCESS!**

Contact: Guy Vissel  
Phone: +61 2 9881 5710  
Email: [Sales@coating-supplies.com.au](mailto:Sales@coating-supplies.com.au)

### Corrosion Control Engineering

[www.cceng.com.au](http://www.cceng.com.au)



**Stand Number: 13**

CORROSION CONTROL ENGINEERING (CCE) is Australia's largest Cathodic Protection specialist. CCE has 7 offices throughout Australia and New Zealand that are managed by Principal Engineers, each of whom have in excess of 30 years' experience in the corrosion control industry.

The CCE team consists of qualified professional engineers and technicians who have specialised in the field of corrosion mitigation and Cathodic Protection for many years, and who are certified with the Australasian Corrosion Association (ACA) and/or NACE International and Institute of Engineers Australia.

CCE specialises in the design, supply, installation and monitoring of cathodic protection systems for:

- Pipelines
- Ports, wharves and jetties
- Storage tanks
- Mine sites
- Steel reinforced concrete
- Marine vessels
- Offshore structures

Contact: Jason Paterson  
Phone: +61 499 499 301  
Email: [jasonpaterson@cceng.com.au](mailto:jasonpaterson@cceng.com.au)



**Corrosion Control Services**

www.corrosioncontrolservices.com.au

**Stand Number: 44**

Corrosion Control Services are specialist service providers in the preparation and application of high performance advanced speciality coating systems. We specialise in the protection and remediation of pumps, valves, HVAC equipment, tanks, pipes, etc.

Our main line of coatings include Chemco International with wide variety of products including solvent free rust and wet tolerant range.

We are in business of supplying Chemco products to applicators or handling the applications utilising our own team.

Industries we serve are the Mining, Oil & Gas, Power, Chemical, Marine, Water Utilities, HVAC and many more.

Contact: Jan Bilinski

Phone: +61 408 808 190 or 1300 337 436

Email: info@corrosioncontrolservices.com.au

**Cryoprep Surface Preparation Solutions**

www.cryoprep.com

**Stand Number: 18**

Cryoprep are specialists in removing lead based paints and various other coatings where alternative methods are unsuitable. Cryoprep uses a blast process which employs a combination of dry ice pellets and a range of conventional grit media. Dry ice sublimates on contact with a surface leaving it dry, clean and paint ready. A significantly reduced amount of selected abrasive media is used to create the specified profile suited to the coating system being applied. Because only these small amounts of grit and the removed coating remains to be controlled Cryoprep is a superior environmental solution.

Contact: Tim Fraatz

Phone: 1300 884 841

Email: cryoprep@gmail.com

**Deanmac Emergency Services**

www.deanmac.com.au

**Stand Number: 6**

Deanmac Emergency Services have over 25 years experience supporting and assisting clients (and their complex/high risk facilities) with the provision of fire protection services, life safety and emergency management.

Corrosion is potentially a major problem for all sprinkler and deluge systems causing plugged piping, clogging of control valve or simply non opening sprinkler and deluge head. This could lead to problems with operational and performance reliability.

Deanmac and its partner Huguenot Laboratories can offer guaranteed corrosion control using environmentally friendly chemical treatment and nitrogen generators by providing internal assessments, detection and testing for corrosion (MIC within wet and dry fire protection systems), cleaning, treatment and ongoing management.

Contact: John Macleod, Fire Engineer

Phone: +61 418 518 292

Email: jmacleod@deanmac.com.au

**DeFelsko Corporation**

www.defelsko.com

**Stand Number: 11**

U.S. manufacturer of coating thickness gages and inspection instruments including the **PosiTector® 6000** and **PosiTector® 200** series of coating thickness gages. The simple, durable and accurate **PosiTector® 6000 Series** are ideal for measuring coating thickness on all metal substrates while the **PosiTector® 200** series measure coatings on non-metals. The New **PosiTector® RTR** Replica Tape Reader measures peak to valley surface profile height using replica tape while the **PosiTector® SPG** measures peak to valley surface profile height using a durable tungsten carbide tip. Also featured are the **PosiTest® Adhesion Tester**, **PosiTector® Dew Point Meter** and the **PosiTector® Ultrasonic Thickness Gage**.

Contact: Richard Northrop, Marketing Manager

Phone: +1 315 393 4450

Email: rnorthrop@defelsko.com

## DeHumidification Technologies

[www.rentdh.com.au](http://www.rentdh.com.au)



### Stand Number: 36

Dehumidification Technologies Pty Ltd (DH Tech) is a provider of temporary dehumidification, heating and cooling equipment. DH Tech manufactures Desiccant Dehumidifiers in its head office in Houston Texas USA, which exhibit the latest technology in desiccant rotor technology and electronic controls.

Industries served include industrial painting, commercial building construction, water damage restoration and a variety of industrial, food processing and manufacturing processes where precise humidity and temperature control are critical. The company operates from nine offices in the USA, one in Canada, three in Australia and one in Thailand.

DH Tech maintains an extensive fleet of mobile climate control equipment in the US and Australia with a focus on desiccant dehumidification. In Australia, the company is represented by David Dawson, James Smith & Warren Clark

Contact: David Dawson, Australian Director

Phone: +61 450 008 259

Email: [ddawson@rentdh.com](mailto:ddawson@rentdh.com)

## Denso Australia

[www.densoaustralia.com.au](http://www.densoaustralia.com.au)



### Stand Number: 38 & 39

#### Preventing the spread of corrosion

Denso Australia is an industry leader in corrosion prevention and sealing technology and has been manufacturing and supplying corrosion prevention solutions to the Australian market since 1961.

The Denso range of brands are globally recognised which include:

- Protal
- SeaShield
- Denso
- Archo Rigidon
- DensoStrip
- Sylglas

Denso's extensive product range is suitable for use in a wide range of highly corrosive environments with operating temperatures ranging from sub-zero to 250 degrees Celsius, across the pipeline, marine, tanking and structural markets.

Denso will be showcasing a selection of anti-corrosion and abrasive resistant overcoat pipeline products for above and below ground works.

Our products and systems are tailor made for individual anti-corrosion and sealing problems, developed for on-site application in mind.

For more information on Denso's products and services visit [www.densoaustralia.com.au](http://www.densoaustralia.com.au)

Phone: +61 3 9356 7600

Email: [denso@densoaustralia.com.au](mailto:denso@densoaustralia.com.au)

## Direct Connections

[www.directconnections.com.au](http://www.directconnections.com.au)



### Stand Number: 47

#### Revolutionary Application of Technology

Direct Connections is an innovative R&D company, designing and manufacturing equipment to support the corrosion mitigation industry.

We have engineered and produced numerous devices, although our main focus has been on Dataloggers for monitoring CP Systems.

Our new range of BLE Loggers allows unsurpassed flexibility with wireless control, using Smartphones, Tablets, Laptops, or even remote monitoring from anywhere in the world.

Minimising maintenance costs and down-time, the dataloggers are totally field-serviceable and field-calibratable. Their IP67 rated enclosure permits effortless access to the standard AA alkaline batteries, which power the datalogger's continual use for 2 – 4 years.

Contact: Nick Papas

Phone: +61 3 5974 8464

Email: [nick.p@directconnections.com.au](mailto:nick.p@directconnections.com.au)

## Dulux Protective Coatings

[www.duluxprotectivecoatings.com.au](http://www.duluxprotectivecoatings.com.au)



### Stand Number: 42

Formulated specifically for Australasia's uniquely harsh and diverse climatic conditions, Dulux Protective Coatings' products protect against corrosion, UV exposure, chemical attack, abrasion and impact damage. Our heavy duty



inorganic zinc silicate and zinc-rich epoxy primers, high build epoxies, chlorinated rubbers, epoxy-acrylic and polyurethane topcoats, micaceous iron oxide coatings, polyurea and heat resisting product lines are available from over 230 outlets across Australasia.

Dulux Protective Coatings' experienced technical consultants provide tailor made solutions for whatever your project demands, even for the most exposed, corrosive and difficult conditions.

Call your local Dulux Protective Coatings Representative or Dulux Customer Service on 13 23 77.  
Contact us today at [www.duluxprotectivecoatings.com.au](http://www.duluxprotectivecoatings.com.au)

### DuoGuard Australia

[www.duoguard.com.au](http://www.duoguard.com.au)



**Stand Number: 52**

DuoGuard is an innovative and powerful anode system applied to the whole structure or targeted areas. It is a cost effective Hybrid Treatment which uses the same embedded anode in both Impressed Current and Galvanic Current role to stop ongoing corrosion within a structure thus offering our clients substantial cost savings both on installation and ongoing whole of life running costs.

Enquire about our "PatchGuard Range" for combatting the incipient anode effect in savings.

#### BENEFITS

- Innovative Solution to Concrete corrosion
- Rapid simple installation
- Targeted application /cost effective solution
- Long life > 30 + years
- No running costs
- No ongoing power supply costs
- Performance can be monitored

#### STRUCTURES

- Concrete Dams/Silos
- Wharves/Fenders/ Dolphins/Piles/Pylons
- Buildings/Bridges/Retaining Seawalls/Marine structures
- Government Assets

Duoguard - the answer to Complete Concrete Corrosion Protection

Contact: David Hadley - General Manager  
Phone: +61 419 632 241  
Email: [david.hadley@duoguard.com.au](mailto:david.hadley@duoguard.com.au)

### Freyssinet Australia

[www.freyssinet.com.au](http://www.freyssinet.com.au)



**FREYSSINET**

**Stand Number: 61**

Freyssinet in Australia & New Zealand are subsidiaries of the Soletanche Freyssinet Group which operates in over 100 countries spanning 5 continents. Freyssinet provide solutions for specialised civil and remedial engineering and structure post tensioning. Through its commitment to Sustainable Technology, we deliver effective and durable results using local expertise, teamed with proven solutions and innovative technologies.

Contact: Tom Wenzel, National Remedial Team  
Phone: +61 2 9491 7177  
Email: [twenzel@freyssinet.com.au](mailto:twenzel@freyssinet.com.au)

### Galvanizers Association of Australia

[www.gaa.com.au](http://www.gaa.com.au)

**galvanizers**  
ASSOCIATION OF AUSTRALIA

**Stand Number: 50**

Galvanizers Association of Australia (GAA), established in 1963, is a not for profit industry association comprising the leading hot dip galvanizing companies throughout Australia.

The GAA conducts research and compiles case studies in various areas dealing with corrosion protection and hot dip galvanizing. We also stand on various Australian Standards' committees for galvanizing and related industries.

We provide free technical publications and information on all aspects of hot dip galvanizing; including the process, application, durability, design and painting of hot dip galvanized steel. We also conduct informative seminars for architects, engineers and many universities around Australia.

Contact: Peter Golding, CEO  
Phone: +61 3 9654 1266  
Email: [peter@gaa.com.au](mailto:peter@gaa.com.au)

### HEMPEL

[www.hempel.com](http://www.hempel.com)



**Stand Number: 66**

Hempel is a world-leading supplier of protective coatings for the marine, protective, container, yacht and decorative segments. Our goal is to increase the long-term value of our customers'

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assets by providing them with coatings that help extend product lifetimes and reduce maintenance costs.

At Hempel, 'quality' is a promise we deliver every day, and have been for 100 years. This means not only satisfying our customers' market needs with dependable and innovative solutions, but also maintaining their commitment to international standards of excellence.

Contact: Michael O'Malley  
Phone: 1800 HEMPEL or +61 3 8369 4900  
Email: [miom@hempel.com](mailto:miom@hempel.com)

### Hychem International

[www.hychem.com.au](http://www.hychem.com.au)



**HYCHEM**  
EPOXY SYSTEMS

**Stand Number: 32**

For nearly 30 years, Hychem international has been formulating and manufacturing polymer systems for the protection of concrete and steel. Our range offers Australian manufactured flooring solutions, epoxy grouts, marine pile encapsulation, and ultra high build spray applied coatings for the water/chemical industry. Our expertise in design and innovation is backed up by technical staff available in each state. We have completed projects in a huge diverse market incorporating industrial, commercial, utilities/mining and residential.

Contact: Colin Murphy  
Phone: +61 410 319 557  
Email: [colin@hychem.com.au](mailto:colin@hychem.com.au)

### Incospec

[www.incospec.com.au](http://www.incospec.com.au)

**INCOSPEC**   
CORROSION ENGINEERS

**Stand Number: 46**

Incospec has been providing independent and authoritative corrosion consultancy to the Australian market since our inception in 1981.

We specialise in Protective Coatings, Welding, Metallurgical and Materials Analysis & Asset Maintenance Management.

As a result of our technical services capacities and industry experience, Incospec can provide excellent and consistent levels of support to all projects, thus ensuring that when a project requires specialised corrosion engineering advice or highly experienced personnel - Incospec can deliver.

Contact: Alex Shepherd, General Manager  
Phone: 1300 721 029  
Email: [mail@incospec.com.au](mailto:mail@incospec.com.au)

### Jotun Australia

[www.jotun.com](http://www.jotun.com)



**Stand Number: 22, 23, 24 & 25**

Jotun is one of the world's leading manufacturers of paints, coatings and powder coatings with over 9600 employees with 68 companies and 33 production facilities on all continents. Jotun has agents, branch offices and distributors in more than 90 countries.

Jotun Australia Pty Ltd supplies Protective, Marine and Powder Coatings nationally, providing a high level of local service, manufacturing locally while supported by Jotun's global strength to provide corrosion control solutions.

Concepts supported include Offshore Oil & Gas Production, Hydrocarbon Processing Industries (HPI), Energy, Mining, Infrastructure, Pipelines and maintenance. Marine Dry Dockings, New Builds, Tank Coatings, etc.

Contact: Ted Riding, Technical Manager.  
Phone: + 61 3 9314 0722  
Email: [ted.riding@jotun.com.au](mailto:ted.riding@jotun.com.au)

### Metz Specialty Materials

[www.metz.net.au](http://www.metz.net.au)



**Stand Number: 40**

Metz areas of expertise are Acid Proofing for protection of concrete and steel against strong chemical attack and Industrial Flooring to provide hard wearing, chemical resistant and hygienic floors for all types of industries.

Metz materials are manufactured (quality accredited ISO9001:2008) in Melbourne with three Australian branches and distributors across Asia and the Middle East.

Our focus on the corrosive effect of harsh chemicals in industry and the protection of flooring in the most difficult physical and chemical environments gives us an expertise that is unmatched by other Australian companies.

Contact: Peter Johns  
Phone: +61 2 9671 1311  
Email: [info@metz.net.au](mailto:info@metz.net.au)



**MRJ Industrial**

[www.mrjindustrial.com.au](http://www.mrjindustrial.com.au)

**Stand Number: 14**

MRJ Industrial Services provide services and products in the construction industry and are a company built on over 25 year's industry experience.

MRJ have partnered with leaders in the industry bringing the latest technologies to the Australian market from many corners of the globe.

MRJ offer supply, supply and install, training (on or offsite) and full specification services to architects, engineers, asset owners and end users with service based integrity, leaning on the vast experience of our international product partners.

MRJ's technologies are spread over a wide variety of market sectors including but not limited to mining, construction, marine, civil, commercial and residential.

Contact: Mark Jones

Phone: +61 409 477 422

Email: [admin@mrjindustrial.com.au](mailto:admin@mrjindustrial.com.au)

**Munters**

[www.munters.com](http://www.munters.com)

**Stand Number: 51**

Munters is a global leader in energy efficient air treatment solutions based on expertise in humidity and climate control technologies. We can deliver state of the art dehumidification equipment for short-term or long-term climate control to any location.

For over 60 years, Munters has engineered and manufactured equipment to solve humidity and climate control problems. Our technicians will install, set and monitor equipment throughout the duration of your project. Our technical expertise enables us to advise you on your optimal requirements, giving you reassurance that the job will be completed efficiently and cost-effectively.

We provide:

- Corrosion Control
- Surface Preparation & Protective Coating
- Utilities (Oil & Gas, Power Stations)

Contact: Khalid Shaikh

Phone: +61 2 8843 1588

Email: [Khalid.Shaikh@munters.com.au](mailto:Khalid.Shaikh@munters.com.au)

**NACE International**

[www.nace.org](http://www.nace.org)

**Stand Number: 30**

NACE International, The Worldwide Corrosion Authority, serves more than 36,000 members in 130 countries and is recognized as the premier authority for corrosion control solutions. NACE International's global membership includes engineers, inspectors, technicians, scientists, business owners, CEOs, researchers, educators, students, and other corrosion professionals. Located in Houston, Texas, with offices in the U.S., China, Malaysia, Saudi Arabia, and Brazil, the organization serves all industries impacted by corrosion. NACE International is the key resource for corrosion prevention and mitigation, technical knowledge and information, conferences and exhibitions, industry standards, reports, publications, and the most specified technical training and certification programs worldwide.

Contact: FirstService

Phone: +1 281 228 6200

Email: [firstservice@nace.org](mailto:firstservice@nace.org)

**NDT EQUIPMENT SALES**

[www.ndt.com.au](http://www.ndt.com.au)

**Stand Number: 48**

NDT Equipment Sales has been trading since 1992 and is a leading supplier of equipment and consumables to the non-destructive testing industry. Our customer base includes companies from the Corrosion, Aviation, Defence, Mining and Manufacturing industries both nationally and internationally. Products include gamma and x-ray equipment, radioactive sources, ultrasonic equipment, hardness testers, eddy current systems, magnetic particle equipment and consumables.

NDT Equipment Sales are also distributors for a range of specialist C.U.I. equipment manufacturers. These include Lixi, Inc. (The Profiler™), Sentinel NDT: (OpenVision™) and Vidisco (Digital Radiography).

Contact: David Morphett,

Business Development/Sales

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### NMT Electrodes

[www.nmtelectrodes.com](http://www.nmtelectrodes.com)



#### Stand Number: 28

NMT® Electrodes is a well-established name in providing high quality, cost effective solutions and products in the field of Cathodic Protection. NMT® Electrodes' Mixed Metal Oxide (MMO) and Platinised titanium Anodes are the products of choice and are used and specified worldwide for use in concrete, underground storage tanks, pipelines, offshore and marine installations among numerous other applications. NMT® Electrodes' full range of tubular, wire, ribbon, rod, mesh, mesh ribbon and plate anodes are available from its Australian and South African facilities.

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### Oil & Gas Australia

[www.energy-pubs.com.au](http://www.energy-pubs.com.au)



#### Stand Number: 33

For over three decades Energy Publications, through its flagship Oil & Gas Australia journal and other titles, PNG Resources and Oil & Gas Asia, has established itself as the world acknowledged authority on the oil and gas sector in the region.

Oil & Gas Australia magazine first flowed off the presses in 1981 on a journey that has inspired everyone at Energy Publications to raise the bar ever higher to enhanced levels of excellence.

Our PNG Resources magazine is the bible of publications in Papua New Guinea, delivering a unique, accurate and up-to-date coverage of mining and petroleum activities in that lively Asia Pacific country.

Our mission statement is to keep covering the oil and gas sector in a lively, informative style consistent with a standard of excellence that will do justice to our readers, advertisers and associates.

Contact: Troy Douglas, Business Manager  
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Email: [troy@energy-pubs.com.au](mailto:troy@energy-pubs.com.au)

### Oliver Technologies

[www.olivertechnologies.com.au](http://www.olivertechnologies.com.au)



*Providing Solutions, Supporting Innovation*

#### Stand Number: 49

- At Oliver Technologies we provide products and solutions for abrasive blasting, spray painting & powder coating applications and dust & fume control issues.
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- We understand the Regulations, Codes of Practice and Australian Standards relevant to these applications.
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- We are happy to put you in contact with these customer or where possible arrange a visit to their facilities so you can see and hear how our products are providing benefit to their business.

Contact: Mick Muirhead  
Phone: 1300 538 948 or +61 412 046 141  
Email: [info@olivertechnologies.com.au](mailto:info@olivertechnologies.com.au)

### Omniflex

[www.omniflex.com](http://www.omniflex.com)



#### Stand Number: 63

OMNIFLEX have been manufacturing electronic power products for 50 years of operation worldwide and now are one of the leading Impressed Current Cathodic Protection System suppliers in Australia.

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Contact: Rod White, Sales and Marketing  
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Email: [aussales@omniflex.com](mailto:aussales@omniflex.com)



## Parchem Construction Supplies

[www.parchem.com.au](http://www.parchem.com.au)



**Stand Number: 43**

Parchem Construction Supplies specialises in the supply and manufacture of concrete construction products, with a specific focus on the durability and corrosion protection of reinforced concrete infrastructure.

With trusted brands such as Fosroc, Galvashield & SewperCoat, Parchem has a corrosion solution for all civil, commercial and industrial projects. Our range includes:

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- Protective Concrete Coatings – Silanes, anti-carbonation and epoxy coatings
- Calcium aluminate mortars for sewer rehabilitation – **SewperCoat**
- Range of high performance epoxy coatings and lining systems – **Nitocote/Nitomortar** range

Contact: Hamid Khan, Brand Manager - Concrete Durability

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## Phillro Industries

[www.phillro.com.au](http://www.phillro.com.au)



**Stand Number: 15**

Founded in 1971, Phillro Industries have grown to be a respected specialised supplier of high quality products and equipment including:

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- Spray Booth Filtration
- Associated Safety products
- Solvent Recovery
- Food and Pharmaceutical Fluid Transfer
- Coatings Inspection
- Concrete Inspection
- Metal Detection

They are also trained and authorised service and repairers of Major Brands such as Graco & Ciemme. As the Principal Australasian/Oceania Importer Distributor for Elcometer Ltd, Phillro are the only Elcometer authorised Service centre in the region.

Phillro's activities include Focussed Product Training, Sales, Service and Hire of Equipment manufactured by the world's most respected Brands.

Contact: Paul Jenkins

Phone: 1300 503 610

Email: [paulj@phillro.com.au](mailto:paulj@phillro.com.au)

## Phoenix Australasia

[www.phoenixlimited.com.au](http://www.phoenixlimited.com.au)



**Stand Number: 57**

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Contact: Adam Castro, Chief Executive Officer

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## PPG Industries

[www.ppgpmc.com](http://www.ppgpmc.com)



**PPG Protective & Marine Coatings**

Bringing innovation to the surface.™

**Stand Number: 20 & 21**

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Contact: Graeme Gunston  
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Email: gunston@ppg.com

### ProDigitek

www.prodigitek.com



#### Stand Number: 3

ProDigitek – IDN Australia leads on from ProDigital as the exclusive representative for BioLogic Science Instruments with local staff members that have attended every Corrosion Conference since 1988.

Specialising in research grade Potentiostats, SECM's and Material's Analysers, ProDigitek and together with BioLogic, offers more than 30 years of experience in customer service, sales, training and on-going application support assisting the researcher from the laboratory to publications. BioLogic continues to develop new software and hardware that span from the single channel handheld potentiostat to research grade laboratory models and multichannel systems with a price/performance value second to none.

Contact: Vincent Stafrace  
Phone: +61 2 9674 4222  
Email: sales@prodigitek.com

### Russell Fraser Sales

www.rfsales.com.au



#### Stand Number: 27

Russell Fraser Sales Pty Ltd (RFS) has been serving Australia and New Zealand's Non-Destructive Testing and Inspection community since 1993. RFS supplies equipment to the Corrosion, Aviation, Mining, Oil & Gas, Defence, Forensic and Diving industries. For the Corrosion industry, RFS supplies 3D Scanners,

Ultrasonic Thickness Gauges, Holiday Detectors, Thermal Imagers, Field Microscopes, Surface Replication products and much, much more. We know how important it is to provide timely solutions to inspection problems, so we aim to keep most items in stock for immediate dispatch. As a Supporting Sponsor RFS invites you to visit the "Toy Shop" on stand 27 to play with the equipment on display.

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### Rust-Oleum Australia

www.rustoleum.com.au



#### Stand Number: 19

For over 90 years, Rust-Oleum Corporation has been producing the highest quality labor saving coatings for both industry and home. Rust-Oleum is the trusted name for superior solutions which reduce preparation time, reduce application time, reduce downtime, and lengthen the lifetime of your assets. Our portfolio of brands includes Sierra®, Mathys Noxyde®, Rust-Oleum High Performance, Industrial Choice®, Concrete Saver®, Stops Rust® and more. Rust-Oleum Australia Pty, Ltd. is based outside of Sydney, New South Wales. Rust-Oleum Corporation global headquarters are based outside of Chicago, in Vernon Hills, Illinois. For more information visit

Contact: Rust-Oleum Sales  
Phone: +61 2 8808 0600  
Email: sales@rustoleum.com.au

### Savcor Products Australia

www.savcorproducts.com.au



#### Stand Number: 69

Savcor Products Australia (SPA) is one of the leading distributors of brand name corrosion products in Australia. The company provides expert technical support for a wide range of corrosion products including materials for Cathodic Protection systems. SPA also focuses on fast responses to enquiries, and can often deliver various products directly from stockpiles, which substantially reduces the waiting time for customers.

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Email: vinay.swaroop@savcor.com.au



**Sika Australia**

aus.sika.com

**BUILDING TRUST****Stand Number: 56**

Sika is the global leading producer of specialty chemicals for the construction, industrial, automotive, mining and home improvement market.

Priding itself on being technically driven and project motivated, Sika provides a wide range of construction solutions including high quality concrete admixtures, specialty repair mortars, sealants, adhesives, damping and reinforcing material, structural strengthening systems, industrial flooring as well as roofing, waterproofing and concrete protection systems.

Sika has cultivated a stand-out team of more than a hundred staff nationally including onsite product engineers, well trained customer service, other technical services team, well-equipped and knowledgeable sales force that have years of on-site and application experience.

Contact: Grant Dowling  
Phone: +61 2 9725 1145  
Email: dowling.grant@au.sika.com

**Specialist Repair and Construction Products (SRCP)**

www.srnp.com.au

**Stand Number: 17**

Free "Guide for Concrete Repair" on SRCP's stand gives background to repair selection procedures and describes anode and control systems available.

SRCP provide a wide range of sacrificial and impressed current anodes and a control and monitoring systems for the smallest to largest ICCP installations. Many are specific to concrete but others are for use on steel structures.

SRCP are the distributors for:

- corrPRE's range of sacrificial anode including Zinc Layer Anode (ZLA), Roll Anodes, and GSC Super Anodes.
- CPI's durAnode 4 small diameter impressed current discrete anodes and range of control systems.
- Protector's surface mounted ribbon anode (Cassette) and conductive paint (Zebra) anode.

- Chemical Newtech's mixed metal oxide mesh, ribbons, discrete and tube anodes.

SRCP are seeking a national manager.

Contact: Frank Papworth  
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Email: f.papworth@srnp.com.au

**Svenic**

www.svenic.com.au

**Stand Number: 41**

Svenic will be exhibiting its Coating and Foam (CAF) Spray System. This portable and lightweight system sprays paints, coatings, sealants, adhesives, foams, polyurethanes, and polyureas using 2 part cartridges and static mixers. It is excellent for use in confined spaces, repair jobs, and smaller applications. Material wastage is significantly reduced. CAF requires minimal set up time, training, clean up and machinery maintenance. More expensive 2 part pumps are not required

Svenic also provides filling, labelling, and assembly of two part cartridges, syringes, and other containers filled with sealants, adhesives, coatings and foams.

We also supply:

- Crack Injection Components and Accessories
- Manual, Air and Battery Operated Dispensers
- Advice, testing and package suitability
- 2 part cartridges and static mixers

Contact: Peter Coundouris  
Phone: +61 7 5539 2255  
Email: peter@svenic.com.au

**Swart and Sons**

www.swartandsons.com.au

**SWART & SONS****Stand Number: 5**

Swart and Sons is highly diversified contractor based in South Australia. Founded in 1954, Swart and Sons is a wholly owned private South Australian company.

Swart and Sons hold PCCP for Class 3, 4, 5a and 5b and Class 6.

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### Areas of expertise:

- Red Lead/ lead paint removal from any structure and recoating
- Repairs to waste water industry
- Oil and gas pipelines, tanks and associated structures.
- Concrete Repairs to any structure.
- Heritage Plaster works.
- Passive fire protection to petrochemical and general industry.
- Access/scaffolding
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### Approved applicators for the following products:

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- Polibrid 705-E
- Nullfire Intumescent range of products.
- Ceilcote range of coatings
- Chartek range of hydrocarbon intumescent paints form International

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Phone: +61 8 8262 6226 or Mobile: +61 418 814 538

Email: mark@swartandsons.com.au

### Tcorr Inspection

www.tcorr.com.au



**Stand Number: 26**

Tcorr Inspection offers the following services: corrosion engineering, protective coating inspection and QA/QC, and welding, pressure vessel, pipeline inspections.

Lead paint and environmental management in accordance with AS4361 and PCCP.

Tcorr Inspection is a NATA accredited inspection body (19230) able to undertake coating and hot dip galvanizing inspections in accordance with AS/NZS ISO/IEC 17020:2012.

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Email: andrew.twining@tcorr.com.au

### Technic

www.technic.com.au



**Stand Number: 64**

Technic provides the sales and support for COMSOL Multiphysics throughout Australia and New Zealand. COMSOL Multiphysics is a finite element based software environment for modelling any physics phenomenon that can be described using Ordinary or Partial Differential Equations.

Comsol Multiphysics is a complete modelling suite and has become the industry standard for multiphysics modelling, research, design and development. Multiphysics simulation provides a single unified simulation environment that replicates the complex behaviour of natural systems.

COMSOL Multiphysics has a wide array of applications across engineering disciplines, including structural mechanics, fluid flow, electromagnetics, chemical engineering, heat transfer and acoustics.

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Email: shane@technic.com.au

### Universal Corrosion Coatings

www.unicc.com.au



**Stand Number: 45**

UCC are leading solution providers for corrosion and degradation problems across Oil and Gas, Ports and Harbour, Water, Energy, Mining, Refining and Chemical Industries.

UCC are the exclusive Australasian distributor for CANUSA-CPS Heat Shrinkable Pipeline Sleeves and High Build Pipeline Epoxies.

Additionally UCC are the exclusive Sth East Asia Distributors for the DEKOTEC range of Self Amalgamating PE-Butyl Pipeline Tapes manufactured by Denso GmbH, Leverkusen, Germany.

More recently UCC have taken on the exclusive Sth East Distributorship for FIBERTEC Ultimate Directional Drill Coating, the Fibertec System is designed to be site applied offering huge savings against shop applied HDD coating.

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### Wattyl Industrial Coatings

www.wattylindustrial.com.au



**Stand Number: 54 & 55**

Wattyl Industrial Coatings is a leader in corrosion protection. Our high performance protective and marine coating solutions are designed to optimize the life of our customers' assets,



deliver brilliant aesthetics and reduce maintenance costs. As a leading manufacturer and supplier of high performance coating solutions, we are located across over 112 stores in Australia and New Zealand. Wattyl covers a full spectrum of exposure environments including offshore, buried, coastal and tropical, specialising in the Oil & Gas, Mining, Infrastructure and Water & Waste markets. Wattyl's Epinamel® high performance epoxies, Poly U® & Paracryl® polyurethanes, Galvit® zinc primers and, Seapro® anti-fouling range are well known brands that have

been protecting major assets for over 100 years, a testament to the enduring performance of Wattyl's product capabilities. Valspar acquired the Wattyl Group in 2010, further strengthening the Wattyl brand by bringing expertise and experience from one of the largest global coatings companies.

Contact: Jasmine Moey

Phone: 132 101

Email: [wattylindustrial@valspar.com](mailto:wattylindustrial@valspar.com)

For more program details and to register go to [www.acaconference.com.au](http://www.acaconference.com.au)

# ASSET MANAGEMENT FORUM



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## MONDAY 16 NOVEMBER 2015

**Adelaide Convention Centre | 2pm**

In conjunction with the ACA's annual conference, Corrosion & Prevention 2015, we invite local industry to attend a half day corrosion forum to discuss the impact corrosion has on some of our most vital infrastructure.

This forum will provide access to three technical papers from the conference program. There is also the opportunity to engage with a range of key industry personnel in a panel to discussion about corrosion mitigation challenges facing large assets. The panel will include a range of asset owners and consultants.

# Introductory Corrosion Seminar Protective Coatings & Cathodic Protection

Proudly presented by:



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## TUESDAY 17 NOVEMBER 2015

**Adelaide Convention Centre | 10am**

The ACA is holding this one day seminar to discuss the basic concepts of both protective coatings and cathodic protection. This seminar is aimed at people starting off in the corrosion industry or those wanting a refresher.



# Corrosion Research at UNSW



**UNSW**  
AUSTRALIA

The High Temperature Group at the School of Materials Science and Engineering, UNSW, is internationally recognised for its mixed gas corrosion research, and is the only group in Australia carrying out this nationally significant work. Research on high temperature alloy corrosion has been conducted at UNSW for many decades. The group has graduated over 60 PhD and Masters students in the last 30 years. It has successful collaborations with international research institutes, universities and industries. e.g. Oak Ridge National Lab, USA; CIRIMAT-ENSIACET, France; Haynes International, USA; Max-Planck-Institute for Iron Research, Germany; Karl-Winnacker-Institut der DECHEMA, Germany; Juelich Research Centre, Germany, State Key Lab for Corrosion and Protection, Institute of Metal Research (IMR), China. The group is under the leadership of Professor David Young and Dr Jianqiang Zhang. Currently, there are one postdoc fellow and five PhD students in the group.

## Research Projects

The current principal research projects carried out at the High Temperature Group include 3 ARC Discovery Projects and 1 ARC Linkage Project: i) Controlling high temperature corrosion of steel by CO<sub>2</sub>-rich gases; ii) development of nickel-base alloys to resist high temperature corrosion by CO<sub>2</sub>-rich gases; iii) heat-resisting iron-nickel base alloy design; and iv) steel oxidation in hot rolling processes.

## High temperature corrosion of steel by CO<sub>2</sub>-rich gases

This research addresses an important phenomenon in the handling of hot CO<sub>2</sub>-rich gas corrosion in coal combustion for power generation. The oxyfuel process, where coal is burnt in O<sub>2</sub> rather than air, has been developed, making CO<sub>2</sub> capture feasible. Unfortunately, the flue gas, rich in CO<sub>2</sub> and H<sub>2</sub>O is very corrosive to steels used for the boiler construction. Steels were able to survive in oxygen or air at high temperatures by forming a slow-growing oxide scale, usually Cr<sub>2</sub>O<sub>3</sub>, which protects the underlying metal, but not in CO<sub>2</sub> as it can interact with scales in damaging ways, resulting in a transition from slow "protective" scale growth to rapid "breakaway" corrosion. This project is to define corrosion kinetics in CO<sub>2</sub>-H<sub>2</sub>O gases, identify the mechanisms, and investigate ways of preventing attack by controlling gas composition and appropriate alloying. The carburisation observed under low carbon activity CO<sub>2</sub>/H<sub>2</sub>O gas has been successfully described by a local equilibrium model at the scale/alloy interface. Direct observation of enriched carbon at oxide grain boundaries has been achieved by using TEM and atom probe tomography, for understanding of how carbon penetrates via grain boundaries in the external oxide scale in CO<sub>2</sub> (Figure 1 [1]). This finding makes a possible approach to blocking carbon access by selective adsorption of sulphur on oxide grain boundaries. Minority alloy components of Si and Mn on

CO<sub>2</sub>-rich gas corrosion have also been investigated, showing strong effects on improving corrosion resistance of steels.

## Development of nickel-base alloys to resist high temperature corrosion by CO<sub>2</sub>-rich gases for advanced power generation

This project deals with nickel-base alloys for the advance ultra-supercritical power generation where traditional ferritic/martensitic and austenitic iron-base steels no longer meet the requirement, and nickel-base alloys should be used due to their high creep strength and corrosion resistance. As described above, the oxyfuel process limits CO<sub>2</sub> emission but produces CO<sub>2</sub> and H<sub>2</sub>O gas mixture which are very corrosive. The mechanisms and kinetics of nickel-base alloy corrosion in CO<sub>2</sub>-H<sub>2</sub>O gases have not been investigated.

The aims of this project are to determine the kinetics and mechanisms of nickel-base alloy oxidation and carburisation under CO<sub>2</sub>-H<sub>2</sub>O gases at high temperatures, and investigate ways of preventing attack by controlling gas composition and appropriate alloying. This fundamental research will establish a scientific basis for development of corrosion resistant nickel-base alloys and assessing the feasibility of their use in next generation coal-fired power generation plants.

## Determination of oxygen solubility and diffusivity for heat-resisting iron-nickel alloy design

Heat-resisting alloy design is based on forming a slow-growing protective oxide scale, usually Cr<sub>2</sub>O<sub>3</sub> or Al<sub>2</sub>O<sub>3</sub>, which protects the underlying metal. To design (or select) such materials needs fundamental data of oxygen solubilities and diffusivities in these alloys, which are unknown. Also, it has been discovered recently that rates of internal oxidation in heat resisting alloys are accelerated in the presence of CO<sub>2</sub> and H<sub>2</sub>O, a phenomenon not yet understood, but of critical importance to alloy design. This work used Rhines packs and gas mixtures of CO/CO<sub>2</sub> and H<sub>2</sub>/H<sub>2</sub>O with the same oxygen potential to measure oxygen solubility of Fe-Ni alloys at high temperatures. Oxygen permeability was also determined by carrying out internal oxidation experiments for Fe-Ni alloys doped with

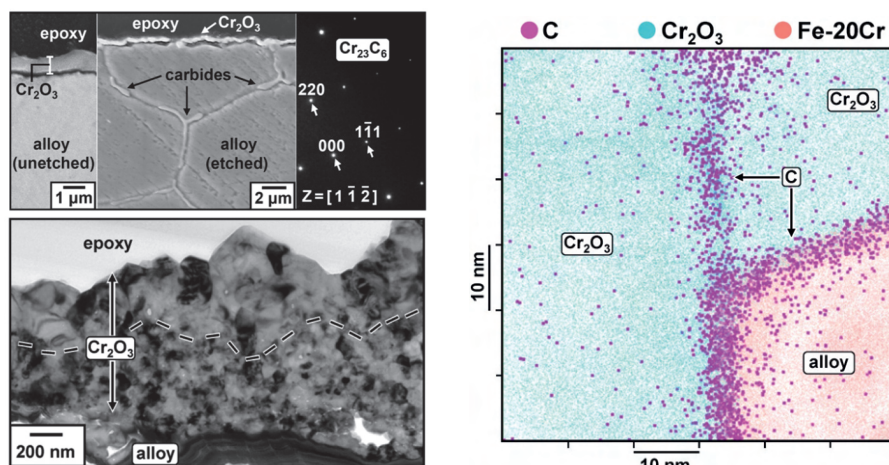


Figure 1. Left – SEM and TEM analyses of Cr<sub>2</sub>O<sub>3</sub> and internal Cr<sub>23</sub>C<sub>6</sub> in Fe-20Cr exposed at 650 °C to Ar-200<sub>2</sub> for 24 h, and then to Ar-20CO<sub>2</sub> for 70 h; Right – Atom probe analysis of Fe-20Cr reacted with Ar-20CO<sub>2</sub> for 120 h at 650 °C, showing 10 nm thick slice from reconstructed atom distribution [1].



Cr. The effects of interstitial solutes (hydrogen and carbon), Fe/Ni ratio and temperature will all be investigated to provide the understanding necessary to design oxidation resistant alloys for gas atmospheres relevant to new power generating technologies.

**Steel oxidation in hot strip rolling using water based lubricants with nanoparticles**

During the hot rolling of steel, the formation of oxide scales occurs in reheating, roughing and finishing rolling processes. Oxide scale plays an important role in determining the final surface quality of steels. The development of nanoparticle water

based lubricants for steel hot rolling is a new technology for improving the quality of rolled strips and reducing roll wear and energy consumption. The involvement of nano-particles in hot rolling may affect the oxide formation in hot rolling processes. In this project, the effects of newly developed lubricants on the oxide scale formation in different temperatures will be studied by comparing with and without the existence of nano-particles. The possible inter-reaction of nano-particles with iron oxides/steel will be evaluated. The oxide forming kinetics will be determined by measuring weight gain and/or oxide scale thickness. The reaction products will be identified by

X-ray diffraction, scanning electron microscopy together with energy-dispersive x-ray spectroscopy.

**Contact Details**

For more information on research opportunities, collaboration, and consulting with the High Temperature Group in the School of Materials Science and Engineering, UNSW, please contact Dr Zhang on [j.q.zhang@unsw.edu.au](mailto:j.q.zhang@unsw.edu.au).

**Reference**

[1] T.D. Nguyen, J. Zhang, D.J. Young, Microstructures of chromia scales grown in CO<sub>2</sub>, Materials at High Temperature, 32 (2015) 16-21

# Corrosion Control Directory



If you are seeking a Cathodic Protection Consultant, a Coatings Inspector or Applicator – search an extensive list of service providers in the corrosion prevention industry at [www.corrosion.com.au](http://www.corrosion.com.au) under Directories.

**The Australasian Corrosion Association** is a not-for-profit, membership Association which disseminates information on corrosion and its prevention or control by providing training, seminars, conferences, publications and other activities.



# Bridge Mired in Troubled Water

**“The successful engineer is the one who knows not only what has worked in the past but also what has failed and why.”**

*(Henry Petroski, To Forgive Design: Understanding Failure)*

Problems with bridges and similar infrastructure in the USA have largely concerned degradation due to old age. However, one new bridge has been the subject of much discussion because of expensive and high profile failures during construction. A number of critical anchor rods in California's \$US6.5 billion replacement San Francisco–Oakland Bay Bridge, built to last 150 years, fractured in March 2013. As a result, the California Department of Transport (Caltrans) had to install a steel saddle retrofit to provide the required strength at a cost of \$US25 million. In addition, the department has suffered bad press and spent significant sums of money on investigations and strategies to prevent further failures.

This failure provides a good case study showing some of the technical issues and problems that can arise in modern steel and concrete structures. The fact that the failure has been played out in public, with most of the documentation freely available on the internet, has made it easy to identify the problems and follow the discussion and arguments by various parties. However, it should be noted that investigations are ongoing, and it is possible that new findings will change some conclusions and recommendations.

The bridge uses shear keys between the deck and supporting pier to minimise bridge damage in the event of an earthquake. Large steel rods anchor these blocks to the pier. In March 2013, soon after workers tensioned these rods, a number of them fractured in two. As the roadway had been installed above the shear keys and the rods had been dead-ended, they could not be removed. The anchor rods were 75 mm in diameter of two lengths, approximately 3 or 5.5 metres long, with both ends threaded. They were manufactured in 2008 from 4140 low alloy steel to meet

the requirements of ASTM A354 Grade BD and hot dip galvanized (HDG) for corrosion protection. They were installed in the anchor holes but left to sit due to delays in the project. They were finally tensioned five years later to 75% of the ultimate tensile strength and over the following two weeks, 32 of the 96 rods (5 of the 3 metre, 27 of the 5.5 metre) fractured. The tension on the unbroken rods was reduced to prevent further failures and none have fractured since. A metallurgical investigation was immediately carried out which concluded that failure was due to hydrogen embrittlement, although the source of the hydrogen was not identified. A subsequent investigation which reported in September 2014 found the hydrogen was environmentally induced as the rods had been sitting in water that had entered the pipe sleeve assemblies enclosing the rods because of the delay before grouting and tensioning. Corrosion of the zinc generated the hydrogen causing the embrittlement.

The following discussion looks at the rod material, galvanizing, grouting and other factors that have contributed to the failure and some suggestions to minimise the risk of such occurrences in the future.

## Rod Material

The high tensile steel rods were manufactured, heat treated and delivered in 2008. Specification requirements, along with the results of quality control tests and tests carried out during failure analysis on the rods are given in Table 1 which show that the material easily exceeded these requirements, although some samples showed elongation at or slightly below the ductility requirements.

ASTM A354 Grade BD requires hardness readings at the mid radius, whereas it is the hardness at the steel surface (or just

below) which is critical for development of hydrogen embrittlement. QC reports by the heat treater showed many of the rods had a surface hardness of Rockwell C 39. Considering the relationship of this parameter to hydrogen embrittlement, this should have been investigated further.

The likelihood of failure due to hydrogen embrittlement depends on a combination of three factors: a susceptible material, a source of hydrogen and a tensile stress (applied or residual). High strength steel was essential given the loads and is a susceptible material. Caltrans disallowed pickling before galvanizing (see below) so were aware of the risk of internal hydrogen embrittlement if not embrittlement from cathodic corrosion reactions. The risk of embrittlement increases as steel strength increases. Maximum strength or hardness limits to avoid hydrogen embrittlement have been provided in numerous sources and standards, with a typical hardness quoted of Rockwell C 35, but some sources have figures as low as Rockwell C 31. There is no definite figure as the likelihood of embrittlement depends on hydrogen content as well as strength for a susceptible steel, so a steel exposed to high levels of hydrogen will have a lower strength or hardness limit than one exposed to low hydrogen levels. The maximum Rockwell C hardness of 39 given by ASTM A354 would be considered as excessive by most sources where there is a risk of hydrogen embrittlement such as for HDG product. A more conservative upper limit on the steel hardness should have been applied. This would have not caused problems as a slightly higher tempering temperature would have reduced hardness, and the risk of hydrogen embrittlement while still meeting minimum strength requirements. As a bonus, it would have made the elongation less marginal and improved impact properties although

**Table 1: Standard requirements, QC inspection and failure examination mechanical test results for the anchor rods.**

	Yield strength (MPa)	Tensile strength (MPa)	Elongation in 50mm (%)	Reduction of Area (%)	Hardness at mid radius (Rockwell C)
ASTM A354 BD standard	793 minimum	965 minimum	14 minimum	40 minimum	31 – 39 range
QC Test results (Max/ min)	875 - 1089	1048 - 1193	12.5 – 16.2	40 – 50	33 - 37
Failed rods	1027, 1007, 938	1172, 1158, 1096	15.5, 14, 15	46, 48, 48.4	32.5 – 36.2





these are not directly related to hydrogen embrittlement.

### Hot Dip Galvanizing

Hot dip galvanizing is problematic with high strength steels because of the known risk of hydrogen embrittlement. It is the pickling stage rather than the galvanizing that can introduce hydrogen. ASTM A354 does not forbid HDG for grade BD, but does note that "Research conducted on bolts of similar material and manufacture indicates that hydrogen-stress cracking or stress cracking corrosion may occur on hot-dip galvanized Grade BD bolts." However, standards for similar strength fasteners such as ASTM A490, along with proprietary post-tensioning bar "Macalloy 1030", forbid HDG whether pickled or not. Other standards or guidelines put a limit, such as HDG is only permitted for tensile strengths below 1100 MPa or below Rockwell C hardness of 33.

Caltrans were aware of the issue of hydrogen embrittlement from HDG and specifically required rods to be abrasively blasted rather than pickled. However, this only avoids the problem of hydrogen ingress during the fabrication (sometimes called internal hydrogen embrittlement or IHE). Zinc coated items can generate hydrogen during service when exposed to corrosive environments (environmental hydrogen embrittlement or EHE) which in fact is more likely to cause embrittlement, as was the case here.

Given the potential and actual problems with galvanizing, zinc metal coating applied by any method should be avoided if possible for fasteners of such high strength in such environments. The galvanizing is designed to protect against corrosion from salt, oxygen and water which may penetrate to the bar surface although the risk is low. However, there is a very real of risk of hydrogen gas and resulting embrittlement as a result of reaction of zinc with water leaching alkali from cementitious material encapsulating the bars, especially given the planned 150 years life. This risk would be much greater than the risk of loss of section from corrosion. Uncoated steel passivates in an alkaline cementitious environment with a very low corrosion rate. Moreover, there are organic and other coatings available which would not generate hydrogen in the cementitious environment.



### Grouting of the Rods

Problems with the anchor rods were further compounded when they were installed in the anchor holes. Water from rain and washing activities had entered the anchor holes and built up around the lower nut and thread. This water was analysed and found to have a pH of 13. Clearly, the water reacted with the cement to produce a highly alkaline solution. Such conditions lead to rapid zinc corrosion, with hydrogen gas being formed as the cathodic reaction. Once the zinc corroded to the steel substrate or at any uncoated areas, the steel would be protected but act as a cathode with hydrogen gas formation leading to embrittlement. Furthermore, investigations after rod breakages showed that the grouting was missing or incomplete in a number of the holes. The grouting is an essential part of the corrosion protection system. If moisture can build up in the grout ducts, then both general corrosion and hydrogen damage are likely. Proper quality control and inspection to ensure this crucial stage is carried out is absolutely essential.

### Quality Assurance, Quality Control and Records

The ability to analyse the various issues which have arisen on this project is in part due to the records, along with the compliance and traceability requirements of Caltrans. Caltrans required their own inspection or auditing as well as quality control and detailed documentation by the relevant contractor. However, it appears from the problems noted above that some important inspection stages were missed and that critical problems were overlooked by both the quality control and Caltrans inspectors. This would appear to be due to lack of knowledge of the various processes that were being monitored. The best QA system is pointless if the actual QC technicians and inspectors do not understand the processes and key inspection stages.

### Terminology

The investigations have highlighted a problem with terminology for failures involving hydrogen. Historically, it was thought that embrittlement and failures due to hydrogen would arise during steel making and fabrication and terms such as hydrogen embrittlement and hydrogen induced cracking were reserved for such failures. Similar failures arising due to the hydrogen produced by corrosion reactions were



believed to result from a different failure mechanism and considered as a form of "stress corrosion cracking". Subsequent research has shown that the mechanism in both cases is the same, namely the presence of hydrogen embrittling high strength steel causing it to fail at a stress lower than it is designed to withstand. Now, the generally accepted term used to distinguish between the two forms (if necessary) is Internal and Environmental hydrogen embrittlement (IHE and EHE). The term stress corrosion cracking should be restricted to failure where active path metal corrosion assists in the formation of cracks, such as failure of certain stainless steels in chloride environments at above ambient temperatures. Stress corrosion cracking is rare in structural and fastener steels, even at these strength levels, at ambient temperatures. However, the term "stress corrosion cracking" is still used for the EHE, even by experts in the field. This confusion does not assist designers who may believe they have to consider hydrogen as an issue only during fabrication.

### Lessons

- When using high strength fasteners under significant loads, hydrogen embrittlement is a real possibility and all steps should be taken to minimise the risk.
- An upper limit on surface hardness of around Rockwell C 35 should be specified and QC and inspection of steel mechanical properties are critical.
- If possible, zinc coating, especially hot dip galvanizing, should be avoided for such fasteners and alternative methods of corrosion control used. This is to minimise the risk of environmental hydrogen embrittlement, especially in concrete environments.
- The grouting of such fasteners is critical and all steps must be taken to ensure that such fasteners are 100 per cent encapsulated in protective grout.

There will usually be a risk of hydrogen embrittlement using high strength fasteners so it is imperative that designers, contractors and inspectors are aware of all aspects of the material properties, heat treatment requirements, fabrication issues, corrosion protection and installation of such items.

**Rob Francis**

# Minimisation of water treatment plant degradation and chemical spills

For more than half a century, municipal councils, as well as industrial and mining companies throughout Australia and New Zealand have invested billions of dollars into equipment and infrastructure to process waste water and sewage. Corrosion of this infrastructure, and in some cases the subsequent leakage, costs industry in excess of \$1B each year. Assets that are impacted by corrosion in waste water treatment plants (WWTP) include the pipelines, storage tanks, clarifier ponds and sewage channels.

As much of the WWTPs infrastructure is ageing, it is starting to require refurbishment or replacement. One method of refurbishment of these assets is to carry out surface repairs and then apply protective coatings. These coatings must be strong, flexible and resistant to chemical attack.

## WWTP and H<sub>2</sub>S

Corrosion particularly affects WWTP structures that are in continually changing liquid levels, leaving damp surfaces that are exposed to oxygen. "Special consideration has to be given when coating structures in sewage treatment plants," stated Dennis Baker, Special Projects Engineer at Gold Coast-based Rhino Linings Australasia (RLA), the only manufacturer of spray applied coatings in Australia developed specifically for sewage treatment systems. "One of the more corrosive by-products of sewage is hydrogen sulphide gas."

Hydrogen sulphide by-products attack the cement, copper and iron which gradually degrades the structure. In the case of a pipeline, this may ultimately result in the collapse of the pipe wall. The modern requirement for capping storage systems in order to control

excessive odours has the drawback of also increasing gas concentrations.

In addition to hydrogen sulphide being corrosive to structures and pipes at WWTPs, the flammable, colourless gas also poses a health risk to workers. The typical rotten egg smell can be detected by people at concentrations ranging from 0.0005 to 0.3 parts per million (ppm). However, at high concentrations, a person can lose their ability to smell the gas and might falsely think that H<sub>2</sub>S is no longer present. Continued exposure to higher levels of hydrogen sulphide can result in death. The Australian National Occupational Health and Safety Commission (NOHSC) has classified hydrogen sulphide as a hazardous chemical substance since 1995 and has set limits for anyone working around sewer pipes and treatment plants. The Occupational Exposure Limit (OEL) values for H<sub>2</sub>S are between 10ppm and 15ppm.

*[Editorial Note: Hydrogen sulphide reacts with moisture and dissolved oxygen on surfaces in a waste water plant and is oxidised from the (-II) to the (-VI) state in the form of sulphuric acid. The acid which is also formed by bacteria, reacts aggressively with the cement in concrete.]*

## Benefits of Polyurea

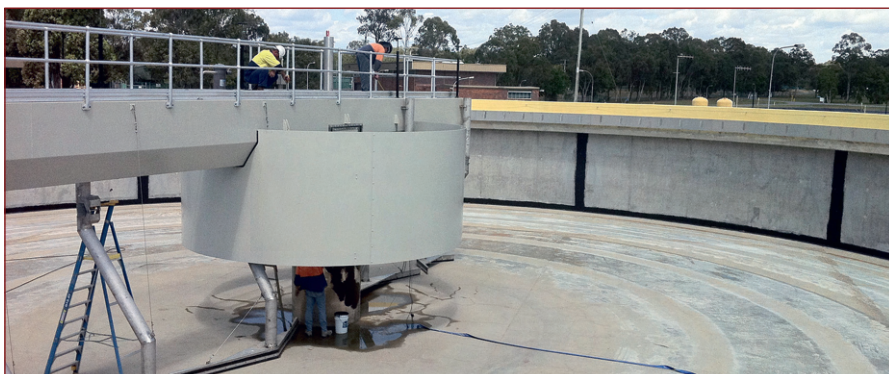
One type of coating that is ideally suited for waste water treatment is spray applied Pure Polyurea which is a relatively modern material that has been developing rapidly during the past 10 – 15 years. "Polyurea and particularly the catalyst free Pure Polyurea came to the forefront in 1980 when the entire outer surface of the Alaskan oil pipeline was coated in polyurea," Baker said.

Pure Polyurea are formed when a liquid isocyanate is mixed with an amine based resin solution. Isocyanates are reactive because the double covalent bond attaching the carbon atom to nitrogen and oxygen atoms is easily broken to form single bonds in the more stable tetrahedral configuration around the carbon atom.

Pure Polyurea comes as a two-part solution that is mixed under high temperature and pressure (3000 psi at 65°C) in a specially designed spray apparatus. When applied, the significant extent of cross linking produces a dense but flexible surface. The high density makes the coating almost impervious to abrasion, water and most chemicals.



A Rhino Linings high-pressure, plural-component spray machine on a travel pallet.



A waste water treatment plant settlement tank being prepared for protection by a sprayed Pure Polyurea coating.



"Many people do not know that spray applied Pure Polyurea are a very good method of protecting most structures," Baker added. "We need to educate the engineering market place about the benefits and cost effectiveness of this versatile and adaptable material."

One company that is keenly aware of the benefits of Polyurea is Queensland-based Satintouch. The chemicals utilised in the Polyurea and Pure Polyurea coatings means that most of their work is defined as an Environmentally Relevant Activity (ERA) under government legislation. The main activities undertaken fall under ERA 17, 38 and 57. These regulations require a licence for the abrasive cleaning and spray coating work to be conducted as well as special constraints on the subsequent cleanup in order to minimise the impact on the natural environment around the work site.

"We have great support from Rhino Linings where the technical staff have extensive knowledge of their products," said Scott Blair, owner and Managing Director of Satintouch. "They are a great resource for us especially for advice as to what can or should be done on a project."

"We also get better results because the product is made fresh here in Australia," added Blair. "We know what it contains and when it was made which is rarely the case with imported products."

Pure Polyurea coatings 'snap cure' to form a solid surface in a few seconds and can be walked on without damage in less than a minute. Another advantage is the ability for it to be sprayed at very high thickness (6000 microns and greater) on a sloping or vertical surface without sagging or running. The surface is easy to maintain, clean and recoat if necessary.

Whereas epoxies and other paints form a solid rigid shell, the greater flexibility of Polyurea coatings allow them to move with the expansion and contraction of the underlying structure as temperatures change.

Spray coating enables quicker application and less disruption to a client's operations. The rapid cure time of Polyurea means that a facility can be back on line much quicker. "Unlike all other coatings, we can spray Pure Polyurea on and they gel in 3 - 6 seconds," stated Baker. "They are not affected by ambient moisture or temperature so we can return a facility to service in four hours with a full cure in 24 hours."

### Polyurea Case History

One unusual project Blair's company was involved with was at a cyanide production plant in Queensland. The company cleaned existing tanks and concrete structures to remove the original coatings before priming them and applying the new Pure Polyurea covering. "It was a major challenge to recoat surfaces at an operating cyanide plant," Blair said. "There were very strict health and safety guidelines we had to comply with, both in terms of the team preparing for the work each day and the actual operation of our equipment."

"The majority of our work is onsite at a client's facility, with about 40 per cent done in one of our yards in Mt Isa, Dalby or suburban Brisbane," Blair stated. For one mining project, the larger tanks were cleaned and coated onsite, but transportable structures such as smaller tanks were trucked to one of the company's yards where the blasting systems are in buildings that are designed to limit the spread of the abrasive material and debris.

Satintouch's teams usually consist of three technicians and a supervisor working on-site along with an

independent QA/QC inspector who oversees projects and ensures all procedures are followed and documentation prepared according to requirements and specifications. This includes the Rhino Linings procedures as well as the rules and guidelines of the ERA legislation.

The durability of Pure Polyurea and Polyurea as surface protection means that money can be saved because the structure has a longer repair/replace cycle. "Polyurea coatings are also easy to repair," Baker said. "The area around a damaged surface can be re-activated using special primers and then covered with a new layer of polyurea."

For projects involving heavy traffic and wear, Blair said that Satintouch will usually install an indicator layer which is bright red before the final top coat. Once the red layer starts to show through the main coating, it is clear that the structure or surface will need re-covering soon. Recording these wear rates enables better protection planning.

Spray applied Pure Polyurea and Polyurethane offer superior solutions for liquid containment. All coatings developed by the company for the water industry are continually tested to ensure they comply with the latest standards and have been certified safe for applications such as lining potable water storage tanks, sea life enclosures, food freezers and grain silos. RLA coatings are tested for compliance with AS4020 at the Australian Water Quality Centre in Adelaide. "AS4020 is regularly updated," Baker said. "Every time the standard changes, we endeavour to have all polymer coatings quickly re-tested."

For further information, please visit the web site: [www.rhino linings.com.au](http://www.rhino linings.com.au) or contact: Michelle Gunn  
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E-Mail: [info@rhino linings.com.au](mailto:info@rhino linings.com.au)



Technicians applying a coloured Pure Polyurea coating to hardstands at a chemical processing plant.



A grit channel and clarifier tank in the process of being coated.

## 50 Year Evaluation of St Louis' Gateway Arch

Catherine M. Houska,  
TMR Consulting, Pittsburgh, USA

Stainless steel's corrosion resistance made it a natural choice to achieve the desired longevity and aesthetic requirements of the exterior of the Gateway Arch in St. Louis, USA. While it is celebrated for its elegant symbolism and amazing size, many people do not realise that it was also visionary and innovative as the world's first large structural application for stainless steel. This article summarises a metallurgical investigation, historic review and current site assessment, which had the goal of determining the structural performance and integrity of the Gateway Arch's exterior stainless steel plate and welds.

While it was not possible to locate the original plate or weld filler metal chemical certifications in the Gateway Arch archives, Type 304 was specified during design. There has been considerable industry consolidation since the 1960's and the mills that produced the plate are now part of the corporate history of ATI Allegheny Ludlum and Outokumpu. Neither firm had retained the 50-year old mill certificates but both provided information about the technology and testing capability of that time period. The archives did not identify the source of the filler metal.

The stainless steel used for this project predates the installation of the first AOD (Argon Oxygen Decarburisation) furnace in the United States in 1974. AOD furnaces very efficiently remove impurities, including carbon and sulfur, and make overall chemistry control easier. Metal produced prior to their widespread use typically had higher levels of both elements and would not meet the requirements of the 'low carbon' Type 304L austenitic stainless steels typically specified when welding sections that are 0.125 inches (3.2 mm) in thickness or greater today.

During the 1960's, the Type 304 plate specified for this project would have been ordered to ASTM A167. Type 304 and other common stainless steels were moved to ASTM A240 many years ago and A167 was recently withdrawn.

### Weld procedures

Welding procedure qualification records were found for the vertical and horizontal stainless steel butt joints in the archives dated January 7, 1964 (vertical) and May 18, 1963 (inclined horizontal). It was not clear whether either was a final procedure. Both indicated that MIG welding was to be used with different argon-CO<sub>2</sub> helium cover mixtures for each joint orientation. Weld clean up was to be with a wire brush, and there were to be two weld passes and a grooved back up root treatment. A Pittsburgh-Des Moines Steel Company letter dated December 5, 1963 mentioned removal of 'weld haloes' (heat tint) using electrolytic methods.

Electrolytic cleaning wands are commonly used to remove heat tint today. It is an old technology, which probably has not changed much during the past 50 years. Presumably it was used in combination with brushing to restore corrosion resistance. Oakite 33, a phosphoric acid based cleaner that is still sold today, was used to clean and degrease the surface prior to welding. Both AWS and ASME code Section IX were referenced in the weld procedures.

### Weld sample collection and analysis

Five approximately 0.75 inches (19 mm) diameter weld samples were obtained from the North leg of the Arch after examination of the welds using a lift. Larger weld beads, obvious weld repair or the other areas with visual cues that might indicate a possible imperfection were selected. All of the samples came from the lower sections of the North leg and a mixture of 'field' and 'shop' welds were selected.

During the second site visit, the architect's daily reports were found in the archives. A report dated September 4, 1963 indicated that the carbon and stainless steel shop welds had not been X-rayed properly prior to shipment. Extensive lack of weld penetration at these joints was found during field X-ray. Problems with the field welding equipment were also identified around that time period. Subsequent reports included approvals for 100% X-ray inspection of all of the welds below levels N63 and S63.

These records implied that most if not all of the carbon and stainless steel below these levels was re-welded and some areas needed further repair after re-inspection. Therefore, all of the sample welds were probably welded at least twice with the second of those welds being a field weld. This explains the large weld beads relative to the thickness of the plate. The metallographic weld cross-sections were mounted and polished and examined using optical light microscopy. Some of the samples were also examined using SEM/EDS to confirm findings.

Even with today's low-carbon levels, the high levels of heat input associated with repeated welding of plate could cause sensitisation (precipitation of carbides at grain boundaries), which decreases the corrosion resistance of the stainless steel plate adjoining the weld. Sensitisation was found in the microstructures of all the samples, but neither they nor any area that was inspected exhibited the characteristic corrosion pattern associated with sensitisation-related corrosion. Given the high carbon levels typical of stainless steel produced prior to the introduction of the AOD, the sensitisation observed during weld cross sectioning is not surprising. Since the samples were from an area known to have been repeatedly re-welded, we cannot be certain that welds higher on the structure were also sensitised. After 50 years of service, the lack of the characteristic pattern associated with sensitisation related corrosion indicates that Type 304 is suitable for the environment.

SEM/EDS confirmed the presence of manganese sulfides in the base metal. Sulfides were seen in all the samples and can make the stainless steel more susceptible to pitting corrosion if the surface is not chemically passivated. The post-fabrication cleaning procedures indicated that passivation was to be done although we did not find confirmation of it. This would have removed surface sulfides and improved corrosion resistance.

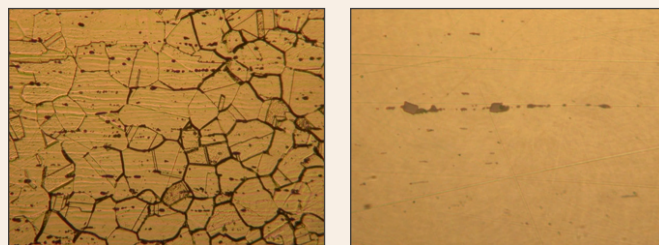


Figure 1(left) Micrograph of W1 in the etched condition showing sensitised grains (right) and grains that are not sensitised (left). (256x).  
Figure 2 (right): Micrograph of a plate inclusion, W1, as-polished condition. (517x) (Photos taken by TMR in 2014).



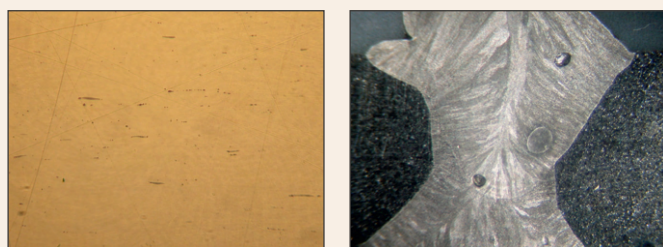


Figure 3: Micrograph of manganese sulfide stringers in the plate, W1, as-polished condition. (256x). Figure 4 (right): Macrograph, W4, etched condition, showing the most significant weld porosity found in any sample. The largest void near mid thickness has an approximate diameter of 0.04". (Photos taken by TMR in 2014)

All of the sample welds appeared to be full penetration. Numerous weld imperfections were documented during visual examination and microscopic evaluation of the weld samples, including small areas of porosity, weld spatter, weld slag and a shallow weld undercut. No cracking or significant corrosion was found at these imperfections after 50 years of service so they were not considered a concern. Figures 1 through 5 provide representative images of these imperfections, the inclusions and the sensitisation.

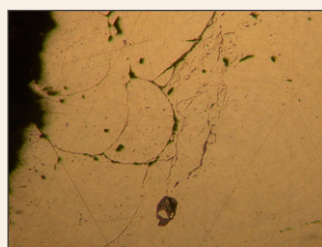


Figure 5: Micrograph W5 at the weld crown shown in the as-polished condition showing the sub surface weld slag. (256x) (Photo taken by TMR in 2014).

Table 1. SEM/EDS Chemistry Evaluation

Sample	Description	SEM/EDS Data for Primary Elements (Mass %)				
		Si	Cr	Mn	Fe	Ni
ASTM A167-1963	Type 304	1.00	18.00-20.00	2.00	Rem	8.00-12.00
A240/A240M-2015	Type 304	0.75	17.5-19.5	2.00	Rem	8.0-10.5
W1	Stainless plate	0.4	17.2	1.8	65.7	8.8
W1	Weld	0.4	17.6	1.8	61.9	8.4
W2	Stainless plate	0.4	17.8	2.0	65.3	8.4
W2	Weld	0.5	17.8	2.0	62.9	8.3
W3	Stainless plate	0.6	18.1	2.3	64.5	8.5
W3	Weld	0.4	17.2	2.1	59.8	8.0
W4	Stainless plate	0.4	17.8	1.7	65.1	8.7
W4	Weld #1	0.4	16.8	1.5	56.5	7.6
W4	Weld #2	0.4	16.6	1.5	55.7	7.6
W4	Weld #3	0.4	17.4	1.5	60.7	8.0
W5	Stainless plate	0.4	17.5	1.6	65.8	8.5
W5	Weld	0.4	17.8	1.7	61.3	8.3

Note: ASTM values are maximums unless a range is listed.

### Plate and weld chemistry

The weld samples made it possible to determine the approximate chemistry using SEM/EDS. The small size of the plate in the weld samples and need to retain them made it impossible to do a full laboratory chemistry evaluation. Additionally, the weld area was not large enough for a full chemical analysis. SEM/EDS chemistry is not exact and is only permissible for general alloy verification. Neither carbon nor sulfur levels can be accurately measured so neither element was included in Table 1 where the samples are identified based on weld sample number. Carbon levels measurements done with SEM/EDS are typically much higher than what is physically possible due to surface contamination. Unless carbon is specifically excluded from the analysis calculations, which was not done by either lab, the concentrations of deliberate alloying element additions will appear lower than they actually are.

The plate appears to be the specified Type 304 with an appropriate matching chemistry filler metal. If the carbon had been eliminated from the analysis, they should meet 1963 requirements. Even if some plates or filler metal were outside of the required chemistry range, there has been no significant corrosion problem after 50 years of service and remedial action, such as plate identification and replacement, is not reasonable.

### Surface deposits and site corrosion assessment

Samples were collected between September 29 and October 1, 2014 from the lower areas of the North leg, which were reachable by foot or lift and by the inspectors climbing down the North leg between October 14 and 21, 2014. Gunshot residue kits, which were developed for law enforcement use, are specialised SEM/EDS sample collection tapes that can pull fine particles from the surface for analysis. Data analysis identified specific compounds associated with different types of industry.

Very minor amounts of deicing salts (chlorides) were found at all heights on the surface along with industrial particulates (i.e. fly ash, ferrochrome oxide, iron and steel slag, iron, copper, copper zinc, lead, and titanium), and soil constituents. Soil consists of carbon rich material (i.e. spores, pollens), clay materials, silica (sand), dolomite, mineral wool, paint particles, and calcite and magnesia alumina silicates. With the exception of normal surface "dust", the other accumulations can be explained by current and past heavy industrial activities in the area and nearby highways. The industrial pollutants could have been from plant emissions, dust generated as buildings were torn down or brown field site soil disturbed during reclamation or redevelopment. The iron particles that were not obviously from steel mills (i.e. iron without other elements) are typical of carbon steel particulate from construction sites.

Various sources were reviewed to determine the industrial pollution sources that have been in the area since the construction of the Gateway Arch. Many possible industrial plant sources of the surface deposits have shut down or changed what they are producing during the past 50 years. The industries in the area, which could have contributed to the surface deposits, included several steel mills; companies that may have had steel foundries or manufacturing steps could put metallic particles in the air; St. Louis Army Ammunition Plant; Carondelet Coke Plant; three coal fired power plants Cahokia, Union Electric, and Venice; Sauget Industrial and Big River Zinc (zinc refinery); Cerro Copper (copper alloys); and chemical plants.

Fly ash ( $\text{SiO}_2$ , and  $\text{CaO}$ ) is also known as flue-ash, and is one of the residues generated in combustion. Fly ash most commonly refers to ash produced during combustion of coal (coal fired power plants, coke plants, steel mills and other coal burning industry). It used to be released into the environment and would have been present for much of the Gateway Arch's service life. In recent decades, scrubber systems have been mandated and fly ash is no longer released into the environment.

The iron rich particles were mainly ferrochrome or iron and steel slag. Ferrochrome (FeCr) is an alloy of chromium and iron containing between 50% and 70% chromium. Steel production is the largest consumer of ferrochrome, especially stainless steel. The particles contained iron and chromium but no nickel; and therefore did not appear to be Type 304 stainless steel from the Gateway Arch. Iron and steel blast furnace slag is similar to fly ash in composition but it contains iron. There were also iron particles found on the surface, which could have been from manufacturing operations or nearby construction.



Figure 6. Superficial corrosion staining at the base caused by deicing salt exposure. [Photo taken by author in 2014].

Chlorides from deicing salt were found on the surface in very small concentrations at all sample heights. Highways surround the site and they are within the documented distance that deicing salt can travel. The high winds documented at elevated levels indicate that most of the structure is probably well rain-washed. It is not possible to determine how high deicing salt concentrations are in the winter and early spring but studies conducted by Argonne National Laboratory and by other researchers indicate that concentrations would be relatively low.

Other than very small, localized areas, the only corrosion staining observed on the surface was at the base, which would not be as effectively rain-washed as elevated areas. This light superficial staining was caused by microscopic deicing salt related pitting and could easily be removed. The environment is not corrosive enough for any of these deposits to have caused more than superficial discoloration after 50 years, so their presence is a purely aesthetic issue. Figure 6 shows superficial corrosion staining at the base.

## Embedded iron contamination

There were scratches on Arch's base, which contain embedded iron particles from carbon or alloy steel. The largest of these extends along the base, are relatively deep and may have been from a snowplow. This surface contamination should be removed because the deposit creates a crevice and corrosion does not stop when the iron has corroded away. The exposure to deicing salt increases the corrosion rate. This contamination should be removed from the deep scratches with either a handheld electro-polishing wand or stainless steel pickling paste painted on to these localized areas with a small brush in accordance with ASTM A380 followed by chemical passivation to improve the corrosion resistance.

## Alloy selection

Overall the Gateway Arch is in very good condition. The service environment is less corrosive now than it has been historically due to the dramatic reduction in pollutants from heavy industry. Deicing salt has been added to the environment since the Arch's construction but surface concentrations were very low and only identifiable through SEM/EDS. The high winds combined with rain washing and a mechanically polished surface finish that is finer than most No. 4 polished plate today have made rain-washing effective for most of the surface. Type 304 appears to have been an appropriate alloy for this project. Cleaning could remove the existing discoloration.

Based on the assumption that corrosion staining is undesirable and there will be little or no maintenance cleaning, the stainless steels that would be most commonly specified today for low to moderate salt exposure or heavily polluted environments with little or no cleaning would be Type 316/316L or the duplex alloys UNS S32101 or S32304, because typically rougher finishes than a relatively smooth No. 4 are specified for monuments and sculptures. Duplex UNS S32205 provides substantially more corrosion resistance and is suitable for higher levels of industrial pollution and salt exposure, when rougher finishes are specified, or where natural heavy rain cleaning is less frequent.

## Memorial and sculpture use

The first large structural stainless steel non-industrial projects to use this research were the 1964 Unisphere sculpture (World's Fair, New York City) and the following year's Gateway Arch, which were both Type 304. Because it is in a coastal environment, cleaning of the Unisphere has been necessary to maintain its appearance, and it would have been constructed from Type 316L if it had been designed today. The 266 ft (81 m) sculptural flagstaff on the Australian Parliament building is also Type 304L. Canberra is an inland location with low pollution levels.

The 1986 restoration of the Statue of Liberty used Type 316L and the high strength proprietary super-duplex stainless steel UNS 32550 to replace much of the original iron support framing. It was the world's first known large non-industrial duplex structural application. There are many other examples of stainless steel's use in sculpture, memorial and building restoration throughout the world. Restoration of the Atomium in Brussels, which was built for the 1958 World's Fair and originally clad in aluminum, began in 2001, and Type 316L stainless steel was chosen to replace the poorly performing aluminum.



More recent examples of duplex stainless steel use include the large moving flag sculpture inside the entrance of the Smithsonian National Museum of American History in Washington, DC where its' high strength permitted structural section and weight reduction. A proprietary cast duplex stainless steel was used for the Pentagon 9/11 Memorial because added corrosion resistance was needed due to deicing salt exposure. By far, the largest construction-related structural application for duplex alloys (not including industrial buildings) has been pedestrian bridges.

Type 316L has been the most commonly used stainless steel for exposed structural sculpture and memorial section applications because it provides better resistance to corrosive coastal and deicing salts and pollution than Type 304/304L. Examples in the US include the US Air Force Memorial, Chicago's Cloud Gate, and the New Jersey, New York and Connecticut 9/11 Memorials. Stainless steel concrete reinforcement is used in restoration projects as well including the replacement of failing carbon steel in the seawalls around the Sydney Opera House (316L) and the Hassan II Mosque in Morocco (2205 duplex).



*Inspectors used gunshot residue kits with specialised SEM/EDS sample collection tapes to gather samples from the surface of the Arch.*

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**Content deadlines December Issue:**

Professional Practice / Research – 2 October
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