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FEATURE:
INNOVATION IN CORROSION CONTROL

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BOARD CHAIR'S REPORT

Dear ACA Members,

The ACA Board have been considering the best model of governance structure for the ACA. The Board has been liaising with Council on how to progress our future structure.

We have now developed a PAGS (Project to Align Governance to Structure) briefing which is being run through the Governance Committee to develop the model and to ensure Members and Council are consulted throughout the project, so we update our organisation to be suited to our current and future operations.

The next step is to discuss with Council the future of the Council. We are meeting in October to discuss this.

The Council play an important role in representing the interests of breadth and depth of the ACA Membership – especially the interests of our branch locations and branch representatives. The question then becomes one of what should Council do?

Should they continue to be the Electoral College of the ACA Board – or should members all vote for the directors of their choice via a confidential ballot? Should the Council act as the Nominating Committee for Board Directors, so they can review and ensure that any candidates meet the minimum requirements for anyone looking to become a Board Director (as set out by ASIC).

These are the items we look forward to discussing with the current Council members and also hearing your views.

If you would like more detail about the ACA structure, please check out the documents and information we have on our website at: https://www.corrosion.com.au/about/pags/

I'm looking forward to seeing many of our members and colleagues at the Corrosion & Prevention Conference in Cairns between 10-14 November. Please book your ticket and make the most of our big annual get together and discuss all things corrosion. One new initiative this year is our Confidential Asset Owners Session on Tuesday. I have been assisting our CEO to ensure we have a robust program and maximise the attendance of our asset owners whilst they are in Cairns.

During the past month I spent a few days at the ACA office in Preston to catch up with the ACA team. I gained a good understanding of our operational opportunities and challenges. It was great to meet the young team that are committed to making a difference for members at the ACA. I wanted to ensure I understand what we need to do next to improve our member experience, and I feel confident we are well on the way to addressing many of the concerns that have been raised over the past couple of years.

Whilst I was there, our CEO Maree, advised that we hit another positive month of surpluses to ensure we meet our goals of financial surplus for 2024. The team have made a huge effort managing costs to ensure we are on target to meet this goal.

Please feel free to contact me if you have any issues or views you would like to share at: kingsley.brown@corrosion.com.au

Kingsley Brown

ACA Board Chair

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Innovation in Corrosion Control

Dear ACA Members,

As we explore this latest edition of our Corrosion and Materials Journal, I want to take this opportunity to highlight the importance of Innovation in Corrosion Control and the tremendous impact it can have across industries. Corrosion continues to be one of the largest hidden costs we face globally, and it is up to us engineers, asset owners, and industry leaders to stay ahead of the curve by embracing cutting-edge technologies.

A study by AMPP (previously known as NACE) estimates that corrosion costs the global economy approximately $2.5 trillion annually, about 3 - 4% of global GDP. In Australia and New Zealand, it's no different, with corrosion adding up to an estimated AUD 100 billion per year—between 3.5% - 5.2% of our GDP. This figure includes everything from direct costs like repairs and maintenance to indirect expenses such as downtime, reduced productivity, and environmental impacts.

Now, here's the good news: By implementing effective corrosion control technologies, we have the potential to reduce these costs by approximately 15-35%. That's billions of dollars saved annually and less stress on asset integrity. Whether you are in oil and gas, mining, infrastructure, water supply, or transportation, there are innovations out there right now that can significantly reduce your exposure to corrosion-related expenses.

Innovation is moving fast, and I would like to invite all of you whether you're an asset owner, supplier, or engineer to get familiar with these technologies. It's not just about staying up to date, but about ensuring the longevity and integrity of the assets under your care.

At the ACA, we're committed to helping you navigate these advancements. Our Conferences, Webinars, and the wealth of information in this journal are here to keep you informed and connected to the latest in corrosion management. Don't miss the opportunity to learn more at our upcoming Corrosion and Prevention 2024 Conference in Cairns, from November 10-14, where many of these cutting-edge solutions will be showcased. It's a fantastic chance to explore how these technologies can help reduce costs, prevent asset failures, and ensure your infrastructure holds up through its design life.

Let's continue to work together to stay ahead. By adopting these innovations, we can cut billions in unnecessary costs, protect our environment, and ensure our assets maintain their integrity over time.

I look forward to seeing you in Cairns and at future ACA events. Let's position corrosion control as not only a priority but also a strategic advantage.

Kind regards,

Isaac Isakovich Castillo

ACA President.

Dear ACA Members

I took undertook a very successful trip to New Zealand, catching up with ACA NZ Branch Committee Members and other members wherever possible.

I visited Auckland and met with all the Executive Team at Metspray, including a visit to their new blast and paint facility at Drury, which is nearly completed, and is an amazing facility that will include a robotic arm for blasting.

I also met with long term Auckland based NZ Branch members, Matt Vercoe and Philip La Trobe. Matt is also a CIP instructor now, which is great for the NZ-based industry and our future courses NZ based courses. In fact, we are working on CIP 1 and CIP2 being held in July 2025 in both the North and the South Island. Thanks to Matt for his help in facilitation these courses!

In Taranaki (New Plymouth) we had an enjoyable lunch with a group of long-term members and corrosion enthusiasts. Thanks to Mark Sigley and Ry Collier for your support and pulling together a fun bunch of people.

In Wellington, Willie provided me the Wellington overview and we met with Engineers NZ. I also met up with Dr Trish Shaw, visited BRANZ and Quest Integrity. Thanks to Willie and Trish for the transport organization and meetings.

Finally in Christchurch, I met with Lumen (Aaron Lines and Declan Cruikshank), John Notley of GAANZ. And the highlight was meeting with our Branch executives Grant Chamberlain (President), Raed El Sarraf and Rene Hill. Thank you all for your welcome!

I am pleased to advise that the ACA is continuing to sort out our member experience via our member portal. The renewal process will soon be seamless and involve no other paperwork. Thank you to members that have passed on your frustrations so we can keep up the improvements.

Finally, our financial performance is achieving positive surpluses over the past three months, and we are on track to at least break even for the 2024 year.

If you have any queries or feedback let me know at maree.tetlow@corrosion.com.au

Maree Tetlow

ACA CEO

Digital Twin Technology: Revolutionizing Corrosion Management for Pipeline Integrity

The pipeline industry has long relied on overline surveys and In-line Inspection (ILI) tools to monitor and maintain pipeline integrity. Overline surveys are required for compliancy testing based on pipe-to-soil potential measurements while ILI tools are essential for identifying corrosion and other forms of pipeline degradation. However, in recent years, the application of Digital Twin technology has transformed the way operators manage and extend the benefits of survey and ILI data, enhancing both efficiency and accuracy in corrosion control.

What is a Digital Twin?

A Digital Twin is a virtual replica of a physical asset, process, or system. In the context of pipeline operations, this means creating a dynamic, real-time digital model of the pipeline, incorporating data from various sources, including surveys, sensors, ILI tools, and historical maintenance records. The digital twin evolves with the pipeline, updating continuously with new information to accurately reflect its current state.

With the advancements in computer power and data gathering, digital twins had become an attractive method for computing the behavior of real-world assets and make predictions of eventual future risks.

The expansion and dynamic behavior of the energy (renewable wind and solar energy, long-distance high-voltage direct current (HVDC) systems) and public transportation sector (high-speed AC trains and DC transit systems), presents pipeline operators with a complex set of challenges to ensure the integrity and safety of their infrastructure.

While these third-party systems can lead to various operational risks on a pipeline, most of them are not announced in advance, requiring operators to be ready to cope with unknown scenarios and situations never met before.

The Role of Physics-Based Models in a Data-Driven World

Physics-based modeling (also known as mechanistic modelling) is a predictive computational approach that solves the physical equations driving a given phenomenon. Elsyca's solutions physics-based models rely on finite and boundary elements technologies, two robust and trusted approaches used in many industries to evaluate the performance, reliability and safety of new products before committing to physical prototypes. Applied to corrosion and cathodic protection predictions, these methods enable pipeline operators to anticipate and address corrosion threats in time, supporting a proactive approach essential for effective corrosion integrity management.

With increased data availability, integrating physics-based models with AI and machine learning (ML) has gained interest across industries. While AI/ML can analyze large datasets and identify patterns that human operators might miss, they struggle with data falling outside their training set. Physics-based models fill this gap allowing prediction beyond AI's scope.

They help identify corrosion causes with high time and space resolution, offering full pipeline coverage and immediate insights. By linking remote sensors and physics-based models, operators can obtain ON and IR-free potential levels and corrosion rates across the entire pipeline system, without time or spatial constraints.

Digital Twin Approach

Digital Twins in ILI Extension

Traditionally, ILI tools are deployed at predetermined intervals, often dictated by regulations, which require operators to conduct inspections at specific time-based intervals. While this ensures a baseline level of safety, these inspection schedules are not always aligned with the actual risk profile of individual pipeline segments. For example, some pipeline sections may experience minimal corrosion and do not require frequent inspections, while others might need closer monitoring or adapted protection systems.

This one-size-fits-all regulatory approach can result in unnecessary inspections or delayed interventions for higher-risk segments. The use of the Digital Twin approach does provide a more tailored, risk-based approach to corrosion management. By continuously updating with real-time data from field data (surveys and sensors) and previous ILI runs, the digital twin allows operators to predict the future condition of the pipeline with greater accuracy and granularity, optimizing inspection schedules based on actual pipeline behaviour rather than rigid time intervals. This flexibility not only reduces unnecessary costs but also ensures that maintenance and inspections are conducted only when truly needed, improving operational efficiency.

Optimizing remedial actions

When critical pipeline sections are identified, often comes the question on how to better protect and manage those specific areas. Here again, the use of the digital twin approach can support the operator in adopting the most cost-effective remedial actions.

In a recent study [1], a large pipeline operator conducted an optimization analysis based on the physics-based digital twin model of a 565-mile-long dual pipeline corridor. The objective of the study was to identify possible cathodic protection remedial actions to decrease external corrosion growth rates (CGR) with the final goal of extending the ILI inspection interval.

Relying on the physics-based numerical model approach, various remediation scenarios of cathodic protection designs and their impact on the corrosion rate were analysed. The outcomes of the different what-if simulations were assessed from a cost-benefit perspective, in other words, to what extent the remediations can reduce maintenance and repair costs while maintaining asset integrity. The outcomes of the study show that a significant reduction in digs can be achieved with a minimal of cost by optimizing a combination of different countermeasures. The remaining life is more than doubled, the ILI interval is increased from 3 to 5 years with an annual benefit-cost ratio of 13 and payback period of 1 month.

Conclusion

The integration of Digital Twin technology is a significant leap forward in corrosion management for the pipeline industry. By extending the value of ILI data, enabling real-time monitoring, and supporting predictive maintenance, digital twins are helping operators move from reactive to proactive corrosion control strategies. Physics-based numerical models provide a unique high spatial and time resolution with the capability to simulate actual and future corrosion conditions on pipelines. Combined with complementary technologies such as internet-of-things (IoT) and artificial intelligence, digital twins will play a central role in the future of pipeline integrity management.

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References

1. K. Parker; Y. Li; C. Baete; V. Chum; T. Johnston, Digital Twin as a Tool for Extending In-Line Inspection Intervals, AMPP 2024, New Orleans, March 2024

Artificial Intelligence Machine Learning, and Big Data for Corrosion Control – Quo Vadis?

By Prof. David Winkler

The paper explores the application of advanced computational techniques such as artificial intelligence (AI), machine learning (ML), high throughput corrosion testing, and big data to corrosion control. Despite the potential of these technologies, the corrosion science community has been slow to adopt them compared to other scientific fields. The paper discusses the need for adoption, highlighting the potential of these advanced methods to accelerate the development of organic corrosion inhibitors, and summarizes the current advancements and challenges.

THE PROMISE OF AI AND MACHINE LEARNING

AI and ML algorithms have been successfully applied to diverse fields, such as medicine, finance, and manufacturing, due to their ability to model complex systems and make quantitative and qualitative predictions of properties. In corrosion science, these techniques can significantly accelerate the discovery of novel corrosion inhibitors by predicting their performance while minimizing the need for extensive physical testing. ML algorithms create models that link molecular properties to their effectiveness as corrosion inhibitors. They are particularly useful for predicting the performance of materials not yest synthesized, allowing testing to focus on the most promising possibilities.

CHALLENGES IN CORROSION SCIENCE

Corrosion protection costs exceed US$1 trillion annually, yet the industry has been a late adopter of high-throughput technologies. Currently, few high throughput testing systems exist, limiting the size of datasets suitable for training models. Since data-driven machine learning models require large datasets for training, this lack of data hampers the development of accurate and generalizable models. As a result, even the best ML models have limited domains of applicability, which restricts their use in discovering effective corrosion inhibitors.

HIGH-THROUGHPUT TESTING AND DATA GENERATION

Efforts to generate larger datasets have been initiated by multiple research groups. For example, the development of high-throughput electrochemical robots and optical methods allows the testing of many more compounds in shorter timescales. Despite these advances, the scale of testing remains insufficient to fully leverage ML methods. High-throughput testing is essential to generate the data needed for machine learning models that can predict real-world performance accurately.

MACHINE LEARNING FOR CORROSION INHIBITORS

The paper exemplified the use of ML to develop organic corrosion inhibitors for metals like aluminium and magnesium alloys. For example, models developed using ML methods like random forests and neural networks have achieved high prediction accuracies for corrosion inhibition performance. These models were trained using molecular features such as dimerization enthalpies, Gibbs energies, and other structural and physicochemical properties of the small molecule corrosion inhibitors.

For aluminium alloys, random forest models achieved balanced prediction accuracies of 82-85%. However, earlier models using small datasets (less than 10 compounds) were limited in scope and often inaccurate, highlighting the need for larger and more diverse datasets to produce reliable ML models. Similar progress has been made in the discovery of organic inhibitors for magnesium alloys, where neural networks demonstrated good predictive capabilities for corrosion inhibition.

ADDRESSING DATA PAUCITY

A major challenge in using machine learning for discovery of new, green corrosion inhibitors is the lack of large, chemically diverse datasets. The scale of high-throughput testing needs to be expanded to generate the large datasets required for ML training. Some promising efforts include electrochemical robots and optical methods, but further scale-up is needed to begin addressing the data gap. Experiments need to capture all relevant data relating for experimental systems that are closer to 'real world' corrosion scenarios than is currently the case.

QUANTUM MACHINE LEARNING AND FUTURE DIRECTIONS

So-called quantum machine learning methods use deep learning algorithms to model data from accurate but very expensive quantum chemical calculations, providing up to 1-million-fold speed up calculations and improved accuracy of molecular property predictions. These new methods, together with other advanced deep learning methods such as generative AI, offer exciting opportunities for the discovery and design of organic corrosion inhibitors. Other AI-driven methods such as evolutionary algorithms, can "evolve" molecules toward an improved set of properties, such as higher inhibition, low toxicity, and compatibility with coatings.

CONCLUSION

The paper posits that machine learning and AI hold enormous potential to accelerate the discovery of more benign organic corrosion inhibitors necessary to replace toxic materials like chromates. However, to fully benefit from these technologies, there needs to be a concentrated research effort on high-throughput data generation. Once the data gap is addressed, machine learning methods are poised to create a paradigm shift in the design and discovery of new, effective corrosion inhibitors.

AUTHOR DETAILS

David Winkler is a highly awarded Professor of Biochemistry & Chemistry at La Trobe University, a Professor of Medicinal Chemistry at Monash University, and a visiting Professor in Pharmacy at the University of Nottingham after a lengthy career at CSIRO. His research involves the application of computational chemistry, AI, and machine learning methods to materials-biology interactions and design of drugs, nanomaterials, and biomaterials.

How Low Can You Go – Developing Low VOC Coatings for a Brave New World

By Dan Savage
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Keywords:

Success, challenges, story, example VOC

Preface::

While Australia is not fully active on this front yet, there are forces at work in our industry to reduce the level of volatile organic compounds (VOC) in our coatings and to actively remove chemicals of concern (CoC) out of our formulas. Rightly so, as it is good for the environment and for humankind.

This article was originally written by me from a US experience vantage point, but it gives some good insights into what is involved to evolve from a high VOC solvent-based coating company to a coatings company that when I left it after 15 years of service had transformed itself into a company which had a full array of low VOC to no VOC options to replace just about every generic technology in their historical product line.

As someone who worked in that company's Technical Services department and as a Product Development Manager, working closely with my R&D counterparts over this period of time, I had a front row seat to watching this evolution occur. What follows are my insights from those experiences with maybe a thing or two to ponder as we all consider what is next in the evolution of product creation within the Australia marketplace.

CHALLENGES TO BE OVERCOME

To achieve the desired coating properties as well as meet other formulation goals, coating manufacturers must overcome many challenges. Some of these challenge include:

- **Product Reformulation Expectation –** When updating a formula it is rarely as simple as "just add more solids and use less solvent", or, "just use a different solvent," A great deal of work typically goes into properly balancing out a coating formula – especially if there is already an expectation by the contractor that the new version of an established product will work as well or in the same manner as the current version they have applied for years.

- **Solvent Packages –** Developing a solvent package for a coating formulation that meets regional VOC regulations, federal hazardous air pollutant (HAP) requirements, "clean building" VOC emission requirements, and/or VOC extractable level requirements for water or food storage tanks, while still facilitating proper solvation of the resin, and allowing for needed flow properties, cure rates, proper cross linking, etc. to occur as intended is a very important component in the proper formulation of a product.
- **Thinning Agents –** Similar to formulating effective solvent packages, thinning agents many times need to be created in such a way that they allow the product to not only meet the targeted regulations, but also perform their intended function in an acceptable manner. Creating thinner combinations to optimize the application of new products is crucial to the product's success.
- **Additives –** Although many times additives are used in small quantities within a formulation, these constituents and/or the combination of such constituents can have a big impact on coating properties such as flow, levelling, wetting, adhesion, and sag resistance. These kinds of enhanced or refined coating properties

SUCCESS STORY EXAMPLE 1

Creating new products or reformulating existing ones can be challenging, but the result can be both rewarding and beautiful. Take for instance the University of Albany (NY) 320K standpipe water tank. Inside this iconic water storage tank is a zinc rich prime coat that has a VOC content of less than 100 gram per liter (g/l) and a 100% solids thick film epoxy finish coat that has a VOC content of less than 5 g/l.

When solvents leach out of the coating into water storage tanks or reservoirs, they are referred to as "extractables". Extractables which are detectable in laboratory testing equipment are typically enumerated in parts per million (ppm) and parts per billion (ppb). New York has a low tolerance for VOCs in drinking water relative to the majority of the country.

In New York, the Maximum Contaminant Levels (MCLs) is 5 ppb for a single xylene extractable in drinking water and 10 ppb for combined xylene (ortho, meta and para) extractables. The state health department regularly tests drinking water for VOCs and when they find the city's water to be in excess of established MCLs, it creates a huge headache for everyone involved with the coating application.

Photo: Courtesy of Tnemec Company, Inc

Having products such as these can be very helpful when trying to meet strict VOC extractable regulations for the state of New York.

The outside of the water tank used the same zinc rich primer and utilized a less than 100 g/l VOC fluoropolymer finish coat that will allow for many years of stable colour and gloss retention and provide the owner with many years of corrosion protection as well.

SUCCESS STORY EXAMPLE 2

As part of a $1 billion airport expansion project, the owner, San Diego International Airport, wanted to obtain a Leadership in Energy and Environmental Design (LEED) status of Platinum. Through the use of environmentally friendly zincs, epoxies, acrylics, hybrid urethanes, and fluoropolymer urethanes that are all less than 100 g/l VOC, they were able to make that successfully happen.

Photo: Courtesy of Themec Company, Inc

are critical to the success of a product. Small changes in the formula or even supposed "like" substitutions can at times make a huge impact in the performance of the product.

- **Chemical Resistance –** When reformulating a product, it is important to make sure the chemical resistance of the updated material is comparable to the existing product. When creating a new product, it is just as important to verify that what is believed in theory to work well is vetted out through proper testing to in fact be the case. In either instance, this process requires testing in various exposures over an extended period of time. Depending upon the severity of service exposure desired for the coating to resist, the vetting process can take several years.
- **Application Properties/Equipment Requirements –** Many times when products are reformulated or new products are created to meet new environmental regulations, the application method(s) previously utilized to apply these materials – or generically similar materials need to be updated. This may result in different application methods needing to be employed, such as using plural-component equipment vs. "single-leg" airless equipment or having to increase the material pressure requirements to properly apply the product, requiring the contractor to buy a larger pump to apply a certain material.

METRICS TO GAUGE SUCCESS

Quite a lot of work and refinement goes into a successful coating formulation. Some of what dictates the success of a coating in the marketplace include items such as:

- **Product Performance Expectations –** Will this new or reformulated product meet the performance expectations of not only the coating manufacturer, but of the engineer/architect, contractor, and owner? Will the coating have the level of durability, colour, and gloss retention values, etc. properties desired by the client? All these items need to be vetted out both in the laboratory and in the field before moving forward with the commercial release of a product.
- **Environmental Capabilities - T**he ability of the coating to cure properly under a wide range of environmental conditions such as low surface temperature, high surface temperature and/or varying levels of humidity.
- **Specialized Coating Properties –** Coating properties needed/desired by a client for specific scenarios such as surface tolerance, elongation/flexibility, moisture tolerance, or dry-fall capabilities need to be considered depending upon the market focus(es) of the product.
- **Aesthetic Value -** How well does the product

flow over the surface to be coated and how well does it blend back into itself at transition zones. In other words, what is the overall finished appearance of the dried coating film?

- **Adhesion Value –** How well the product adheres to both the substrate and to other layers of coating is a critical element in its ability to properly protect the structure and perform as intended by the coating manufacturer.
- **Corrosion Protective Properties -** Asset protection is a critical factor to consider when developing a protective coating. A new formulation may meet a new VOC emission regulation, but if it cannot protect the substrate at the desired level of protection, it will have very little value to the industry.
- **Application Equipment Needed -** The application equipment required to successfully apply a product can at times influence a contractor on how often they may desire to use a particular product. As an example, can the coating be successfully applied with a typical "single-leg" piece of airless equipment, or is specialized plural component equipment required to apply the material? There is always an argument that could be made for or against using one piece of equipment over another piece of equipment. Many times, though, it may come down to something as simple as what equipment the contractor has in their inventory and what investments they are willing to make to apply a certain material.

SUCCESS STORY EXAMPLE 3

The Albert Ellis Airport Fuel Storage Tanks stand as examples of where a heavy-duty industrial grade waterborne epoxy primer containing less than 1 g/l VOC was successfully used in conjunction with a hybrid low VOC (<100 g/l) modified polycarbamide finish coat to provide the client an environmentally friendly, long-term solution for the exteriors of their fuel storage tanks.

Photo: Courtesy of Themec Company, Inc

HONOURABLE MENTIONS

Alternative Coating Technologies – The coating industry is currently awash with many interesting and innovative technologies such as

- Nanotechnology additives that allow for many characteristics which may not have been possible in the past.
- More environmentally friendly technologies, such as newer waterborne resins. While waterborne coatings are not a new concept, as the technology has evolved, so has its capability to perform well in many heavy-duty industrial environments. Many of the alternative technologies being developed today have been found to be as robust as the traditionally used solvent-borne coating materials and have shown to perform in a similar manner to many of the "old school" coatings.
- It should also be noted as drone application technology comes more into mainline use in the industry, reformulations of coatings and new coating formulations will need to be created to facilitate use of this emerging equipment technology.

CONCLUSIONS

Successfully filling a need with a new or reformulated product in this ever-changing marketplace is the goal of every good coating manufacturer. It is this kind of forward-thinking proactive approach which helps create unique and innovative products to meet the needs of industry with a greener world in the forefront of their collective minds. As the coating industry becomes more and more attuned to both the individual and to the earth as a whole, the industry will continue to evolve – leaving behind traditional products used in the past – and enter a brave new world of coating technologies for the betterment of us all.

REFERENCES

1. Project examples & photos referenced are courtesy of Tnemec Company, Inc., 123 West 23 Avenue, North Kansas City, MO 64116, USA

[1]Tnemec Company Case Histories

ABOUT THE AUTHOR

Dan Savage is the author of this paper. He is the Technical Services Manager for DuluxGroup Protective Coatings Division, a position he has held since 2019. He is responsible for the day-to-day national operations of Technical Services that include functions such as colour support services, field specific testing requests, failure analysis/ product complaints, external/internal training, sample creation, application demos, start-ups, new & existing material application evaluation works, product industry certification works, and general technical reviews on subject matter as needed for the business.

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Challenges and Future Perspectives of Corrosion Engineering in the Emerging Renewable Energy Age

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Although significant progresses in corrosion engineering have been made over the past century, leading to the development of various anti-corrosion methods and materials, corrosion remains a tenacious threat to the integrity and safety of the huge network of civil and industrial infrastructure assets. It is evident by many publicly reported catastrophic engineering structure failures and an enormous amount of unreported infrastructure incidents discussed in reference [1-4].

Corrosion is expected to be an even more serious problem in the emerging renewable energy age because corrosion and materials degradation are expected to significantly affect the safety, durability, and sustainability of essential infrastructure required for the production, delivery, storage and utilisation of renewable energy such as wind, solar, hydrogen, geothermal, hydropower, ocean and bioenergy. To decarbonise our economy, a huge network of energy infrastructure will need to be built both onshore and offshore, often at remote locations. Corrosion, hydrogen embrittlement and other forms of materials degradation will pose major challenges to critical components of energy infrastructure that often operate in extreme and complex environmental conditions. Currently solar and wind farms are designed for 20-30 years due to the degradation of solar panels and wind turbines. Such short design life is unsustainable, not only from a lifecycle assessment point of view, but also for generating significant materials wastage that is often difficult to recycle. The life of batteries, electrolysers and fuel cells are also affected by corrosion and materials degradation. Addressing these issues is critical for the feasibility and sustainability of a future renewable energy-based economy. Corrosion engineering will need to contribute to overcoming these challenges.

Since corrosion is a thermodynamically spontaneous process that is not completely preventable, the practical goal of corrosion engineering should be to prevent the pre-mature failure of engineering materials with an aim to extend the economical and safe operational life of engineering structures. If we examine cases of practical engineering structural failure, pre-mature failure of engineering materials is frequently due to localised corrosion that causes very localised and severe penetration of metal structures, with maximum corrosion damage being most likely the sites of local stress concentration and for unnoticed cracking initiation and loss of containment. For instance, offshore steel pipelines are known to be prone to localised corrosion including pitting corrosion at welds along and between segments of pipes, crevice corrosion at bolts (heads, nuts, washers) on flanges between spools as well as crevice corrosion between flanges bolted together and at end plates on parked pipelines [5]. Localised corrosion is often the 'worst case scenario' and the most significant challenge to realising optimal operational lives of engineering structures such as underground steel pipelines where corrosion under disbonded coatings is responsible for almost 90% of corrosion induced damages to underground pipelines [6]. Unfortunately, currently there is a lack of effective methods and materials for localised corrosion control and management [3,4], and therefore corrosion engineering needs to address the localised corrosion control issue.

Corrosion, especially localised forms of corrosion, is expected to be an even more serious problem in the emerging renewable energy age. Corrosion, hydrogen embrittlement and various types of materials degradation are expected to pose major challenges to the safety, durability, and sustainability of essential infrastructure required for the production, delivery, storage and utilisation of renewable energy. The control and management of localised forms of corrosion will be critical for maintaining the safety and integrity of renewable energy infrastructures that are often exposed to more complex environments and located at remote offshore and underground sites. One example is localised corrosion of buried gas and hydrogen pipelines that are affected not only by seasonal changes in soil moisture and oxygen levels, inhomogeneous coating defects and coating disbondment, but also by fluctuating stray currents and oscillating mechanical stresses. Another example

is localised corrosion on offshore structures such as wind turbines and green hydrogen production infrastructure that are affected by multi-zone and dynamically changing marine environmental conditions. Variable and complex environmental conditions can not only lead to changes in corrosion rates, but also in corrosion patterns and mechanisms. Unexpected changes in environment and mechanism could also cause suddenly accelerated localised corrosion damage that is not predictable and controllable by conventional corrosion management methods and tools.

Despite of difficulties in localised corrosion control, there are perspectives on overcoming these difficulties through innovation in corrosion control methods and materials. As discussed in the reference [7], this can be considered as an analogue with the management of human health and the life extension of human life through innovation in medical technologies. Methods and materials that can detect, monitor, prevent, repair localised corrosion and local coating damages will be critical for achieving this purpose. An 'ideal' corrosion monitoring and control system is one that not only provides in-situ and site-specific corrosion data required to visualise localised corrosion in variable corrosion environments, but also to use such data to inform corrosion predictive modelling, and mitigation and management actions that may need to be adjusted smartly and dynamically based on the prevailing corrosion condition and mechanism. For instance, corrosion data is needed to guide local coating repair and to regulate local cathodic protection potential and corrosion inhibitors injection. In this manner, the threat of localised corrosion to the integrity and safety of engineering structures would be minimised and the safe operational life of infrastructure would be maximised.

One approach to achieving this is a closed-loop control cathodic protection (CP) technology that has been developed recently for localised corrosion control. This technology employs an electrode array based localised corrosion probe to perform in-situ monitoring of localised corrosion and uses corrosion monitoring data to automatically adjust and closed-loop control CP potential/current (for details see pending patent [8]. This technology offers several unique capabilities: It uses corrosion monitoring data to automatically adjusts CP potential/current to appropriate levels to count against undesirable environmental condition variations and effects such as stray currents; It applies more CP currents, when necessary, to generate a high pH environment to control complex forms of localised corrosion such as corrosion under disbonded coatings on underground pipelines; It avoids overprotection that can cause hydrogen generation and hydrogen embrittlement, and coating damages such as cathodic disbondment of coatings on pipelines. Figure 1 shows field installation and testing of a prototype of the

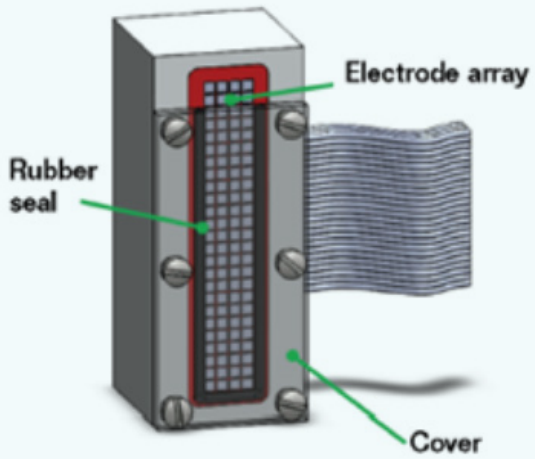
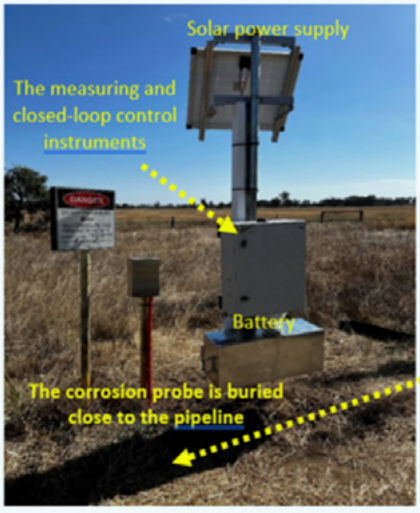


Illustration of the electrode array localised corrosion probe



The corrosion probe (view before being buried with the piepline)

technology on a gas pipeline affected by coating disbondment in Victoria Australia, confirming that the technology can effectively reduce localised corrosion. This technology has also been preliminarily tested in a marine environment. Currently the commercialization of the technology is supported by an Australia's Economic Accelerator Ignite 2024 grant (Grants - Australia's Economic Accelerator, Australian Government (aea.gov.au).

Figure 1. Field installation and testing of a prototype of the closed-loop CP technology on a gas pipeline in northern Victoria, Australia, for monitoring and mitigating corrosion under disbonded coatings since 2021 (This work is funded by the Future Fuels Cooperative Research Centre Australia).

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Oilfield Microorganisms Management

Abdullah Hussein

Microorganisms are known to cause various types of damages to oil and gas production systems, such as Microbiologically influenced corrosion (MIC), Biofouling, Reservoir souring, Interfering with phase separation operations and Chemicals degradation.

Microorganisms can be indigenous to the petroleum reservoirs, or may be introduced to production system through fluids injected during various operations, such as drilling, chemical squeeze jobs, acidizing, and water injection.

Various types of bacteria and archaea have been reported in oil and gas fields. Some examples include sulfate reducing bacteria (SRB), sulfate reducing archaea (SRA), iron oxidizing bacteria (IOB), iron reducing bacteria (IRB), sulfur oxidizing bacteria (SOB), acid producing bacteria (APB), methanogens, and others.

The management of these bacteria can be very challenging since they function through different mechanisms, and they might resist or adapt to certain treatments. Moreover, different bacteria types can coexist in a syntrophic relationship, which can

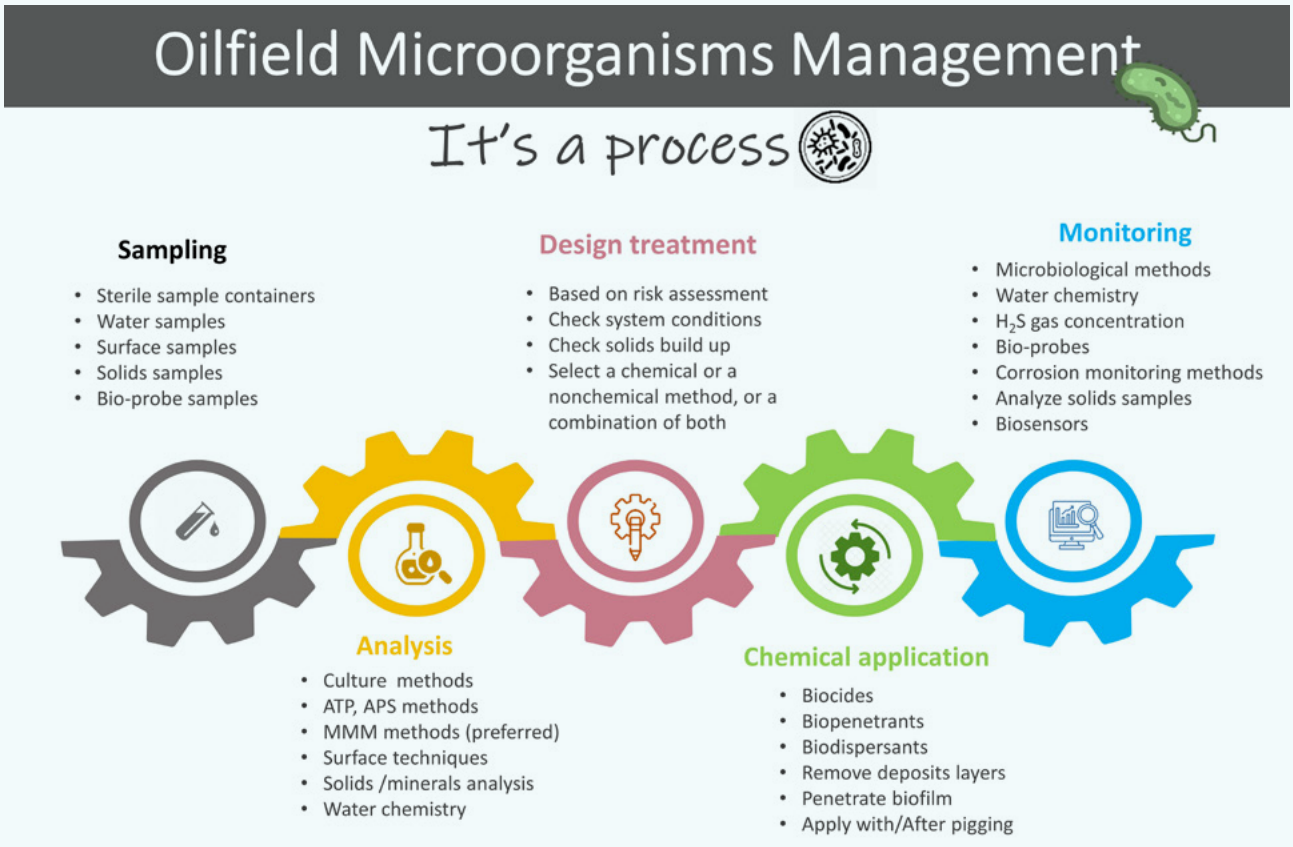

Fig.1: microorganisms management strategy

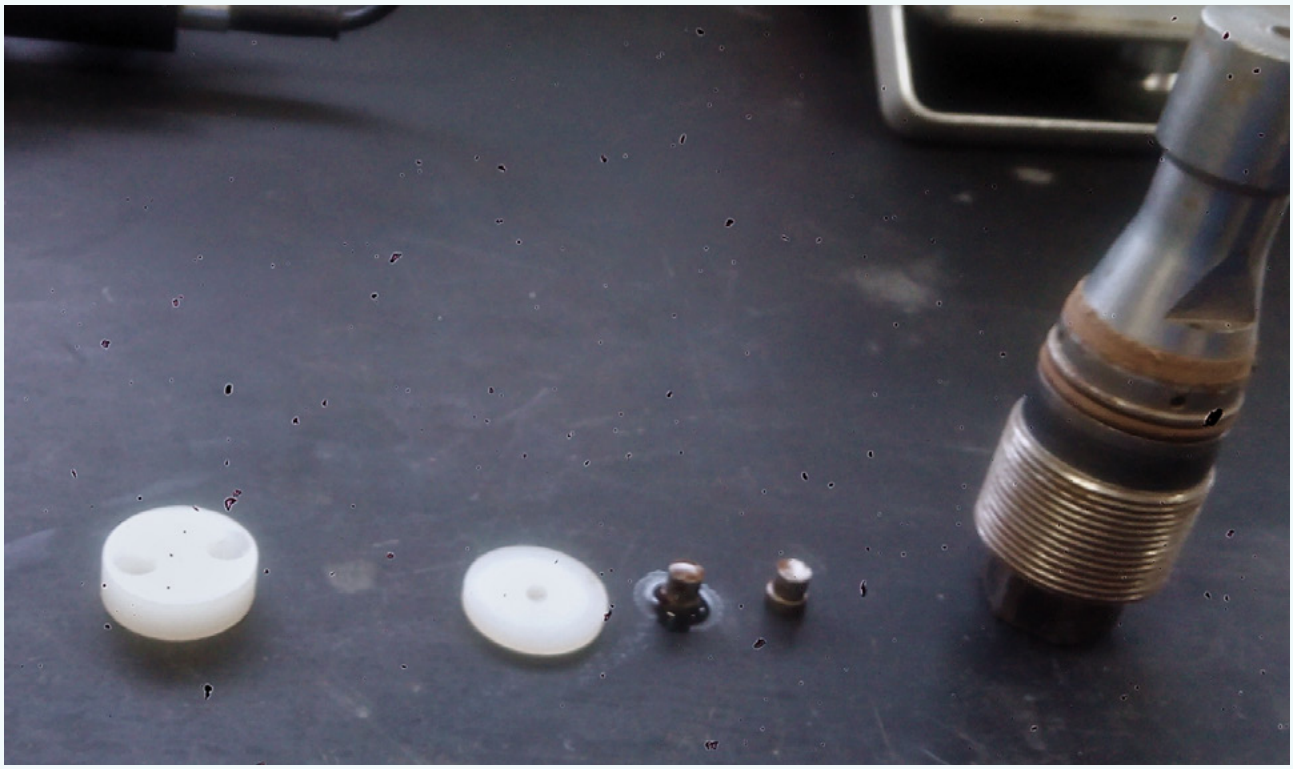

Fig.2: Dismantled bioprobe with the studs

exacerbate the damage they do to the system. As a result, strict protocols should be always followed to effectively manage these microorganisms. A few of these steps are illustrated in Fig. 1 and further explained in the sections that follow.

Like other production chemistry issues, managing microorganisms entails risk assessment, appropriate treatment application, and continuous monitoring to assess the treatment efficacy. However, with the microorganism problem, a deeper investigation is necessary due to the multifaceted challenges associated with them. For example, in the case of the MIC problem, a thorough corrosion risk assessment is required in addition to investigating the existence of microorganisms and their contribution to the corrosion problem.

SAMPLING

Samples can be fluids, solid deposits, and steel surfaces/pipe cut-offs. A representative sample is key to accurate microorganisms' investigation. A few tips for proper sampling are listed below:

- Use proper sample containers; make sure they are sterile.
- sample size should be sufficient for microbiological tests and other chemical or physical examinations.
- Solids and surface samples are preferred since they contain the sessile bacteria that are more damaging and resistant to treatments vs. planktonic bacteria, which are normally tested in water samples.
- Sample preservation and storage are critical.
- Sampling after pigging: multiple samples from the pig body, in addition to a composite sample, are recommended.
- Bio-probe (Fig. 2), corrosion coupon, or scale coupon samples are good representations of the production system and can be used to capture the damaging sessile bacteria.

ANALYSIS

As mentioned above, microorganisms are a multifaceted issue. Thus, a variety of examinations might be required, including water chemistry, deposits composition, surface morphology, and most importantly, an accurate microbiological analysis. Here are a few tips for the key examinations:

Fig.3: microorganisms mitigation methods

- Water chemistry analysis is necessary to assess the risks of corrosion, scaling, and microorganisms.
- Culture based techniques (such as serial dilution or most probable number MPN) are common in use for microbiological analysis. However, these techniques only account for < 5% of the actual bacteria counts in the sample, and they are time consuming. Culture methods are detailed in standards API RP 38 and NACE TM-0194.
- Techniques such as Rapid Check and ATP give fast results about the existing microorganisms, which can be crucial, especially when treatment is ongoing.
- Microbiological methods (MMM) such as PCR, DGGE, and others are preferred. These methods are superior to the culture and rapid techniques in accuracy and recommended in complex cases. Some of these techniques are mentioned in NACE standard TM0212.
- Solids analysis, including both mineralogy and microbiological analysis, is necessary. Certain minerals are metabolic byproducts of bacterial activity, and this can be used as a marker for such bacterial activity. Microbiological tests of solid sample are conducted to determine the presence of sessile bacteria.
- Surface methods such as microscopy are used to determine surface properties, the extent of damage, and biofilm properties.

TREATMENT

The operator should gather field data, historical data, and similar case studies in addition to the data gathered from the above testing and analysis. These should all be combined to create a risk assessment matrix that illustrates the extent of the issue. Based on this, a mitigation plan is designed and applied. In general, there are numerous ways to treat microorganisms, including chemical, nonchemical, and operational approaches, as illustrated in Fig. 3.

Here are a few tips to keep in mind during mitigation:

- Study the system design, conditions, and accessibility of the treatment method.
- Check solids buildup: solid layers must be removed to assure that treatment makes contact with the microorganisms.
- For chemical methods, routine treatments include the injection of biocide chemicals into water

systems for specific contact times at specific time intervals. Switching between two different biocide chemicals is necessary to avoid bacterial adaptation to the chemical. Select and use a chemical biocide that can penetrate the biofilm and kill the bacteria. If biofilm is hard to penetrate, try using biopenetrants or biodispersants with biocide treatment. Biocides are also preferred to be applied during or after pigging (considering this will not cause any further damage to the pipeline), specifically if there is solids buildup on the pipe wall, to make sure that the solids layer is removed, and biofilm and bacterial cells are exposed to the chemical slug (Fig. 4).

MONITORING

Continuous monitoring is crucial to assess the effectiveness of the treatment strategy and identify any microbiological problems as soon as they arise, ideally before they become serious challenge. There are several ways to accomplish this:

- Frequent microbiological testing.
- Solids analysis, from pig returns and well gauging.
- Water chemistry.
- Corrosion monitoring methods.
- Bioprobes
- Sensors
- ILI and smart pigs

BIOGRAPHY

Abdullah Hussein is the CEO of CHEMDUSTRY, based in Canada. He has more than 16 years of experience in oil and gas production chemistry as a field chemist, trainer, and advisor. His experience spans lab activities, solids deposition, phase separation, production chemicals, corrosion, and oilfield microbiology. He authored journal papers, and an all-in-one flow assurance book published by Elsevier.

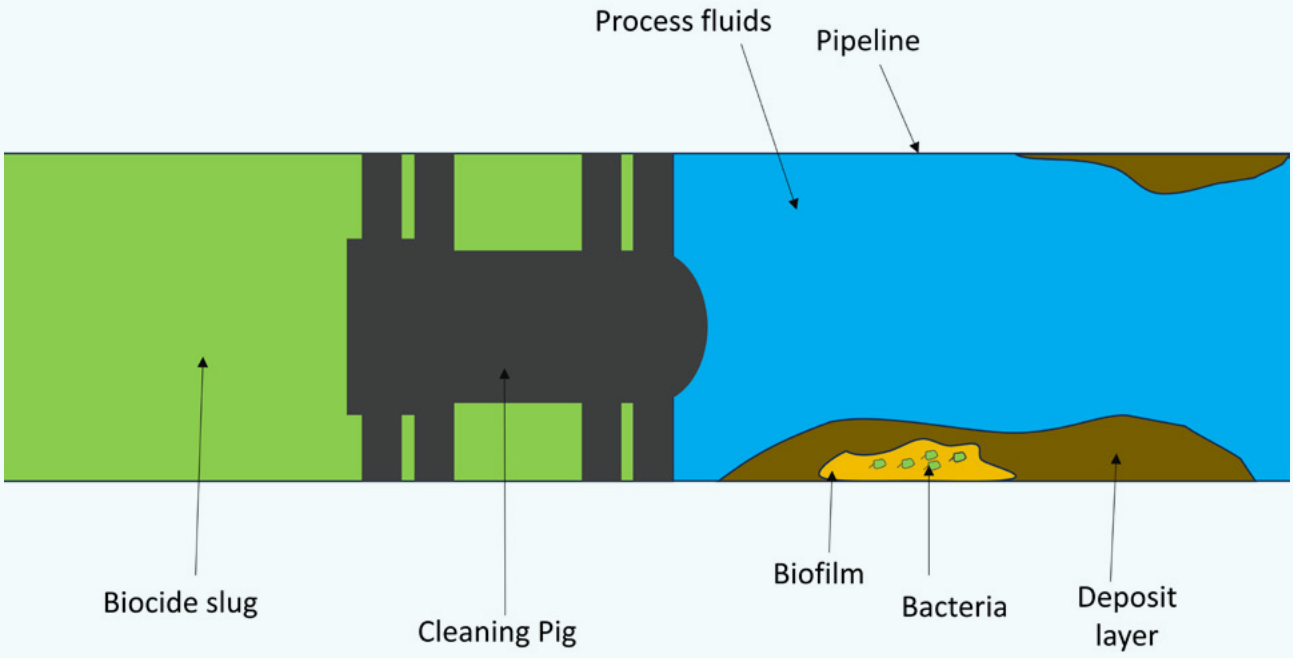

Fig.4: Applying biocide during pigging

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DAVID HARVEY PPG INDUSTRIES

Marine Manager ANZ, Fiji and PNG for PPG

Presentation Title: Evolution of Foul Release Coatings

BLANE MCGUINESS ENGINEERING AT MARINE & CIVIL MAINTENANCE (MCM)

Executive Manager

Presentation Title: Sustainably led asset management: A Pacific Case-Study | Queens Wharf, Lautoka FIJI

CHRISTINE CRAWSHAW INFRASTRUCTURE ADVISORY GROUP

Director

Presentation Title: Ports – Anchors of the Energy Transition

JOYCE WRIGHT NEWPORT NEWS SHIPBUILDING / WOMEN OF AMPP

Presentation Title: The fight against corrosion in our vital marine ecosystems.

WAYNE NEIL & KATE DYLEJKO DSTG

Presentation Title: Cathodic protection and its implications for vessels in the royal Australian navy

LEARNING CENTRE

CORROSION & PREVENTION
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Located in the Exhibition Hall, the Learning Centre provides companies with an opportunity to provide case study presentations or live practical demonstrations to delegates. The Learning Centre is an opportunity to showcase how equipment and products work, introduce delegates to new technologies and innovations, as well as demonstrate best practice in corrosion related skills.

A Learning Centre timeslot is 15 or 30 minutes per session. The Centre has a stage that is equipped with a laptop, projector and audio to support product demonstration.

The Learning Centre Schedule will appear in the Conference Program, Conference Website, Signage in the Exhibition.
We will announce the start of each session via the PA system.

Would you like the opportunity to present on the learning centre? Submit your idea on the link below:

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- MBS
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- ACA
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In 2023, we made significant advances in our approach to developing products that are both commercially viable and sustainably advantaged. Sustainably advantaged products are identified using PPG's internal methodology that validates product attributes and their contribution towards the UN Sustainable Development Goals.

We are on track to meet our 2030 goal, with 44% of sales coming from sustainably advantaged products in 2023. The increase in sales was driven by a combination of customer interest in more sustainable solutions, adding TIKKURILA® products into our scoring process, and a more thorough review of existing product data. Our sustainability team has now evaluated 180,000 PPG products against our sustainably advantaged product methodology.

Learn more about our approach, including our sustainably advantaged product methodology, on PPG.com

One of our most impactful changes in 2023 was improving the way that we track sustainably advantaged products in our development pipeline. We added additional touchpoints in the R&D process, reviewing each product multiple times as it passes development milestones. Evaluating innovative, differentiated technology more frequently ensures that we are developing a sustainably advantaged product portfolio that fits our customers' needs and helps us invest resources in developing the right products. We also continually monitor to ensure that a percentage of our R&D pipeline meets our sustainably advantaged product methodology. This helps our researchers focus their efforts on products that align with our enterprise growth strategy and meet our customers' sustainability needs.

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EXHIBITORS 2024

Burgers & Bowls

What do you get when you mix juicy burgers, thrilling lawn bowls, and a dash of educational coatings talk? A recipe for an unforgettable evening! Our AkzoNobel Brisbane event hosted on 13th Sep in collaboration with The Young Corrosion Group (YCG), the youth arm of ACA (Australasian Corrosion Association) was a fantastic blend of flavors and fun, where attendees not only sharpened their bowling skills but also indulged in mouthwatering burgers. Who knew that rolling a ball could work up such an appetite?

A huge shoutout to Matthew Brown for his enlightening coatings sharing and discussion. We learned that coatings are like the secret sauce of the materials world - protecting and beautifying surfaces while keeping things interesting! While some folks tried to perfect their bowl techniques, others took notes on how coatings can save the day. Thanks to everyone who joined us for this unique fusion of sport and learning - let's just say, we bowled over expectations and left with full bellies and even fuller minds!

Abrasives

HOW TO BLAST FASTER, CLEANER AND SAFER WITH LESS

Sponsored by GMA

The Newcastle Branch of the Australasian Corrosion Association (ACA) is excited to present another local unique opportunity to hear from our guest speaker Peter Gunness who will provide a short presentation on. This event is a great way to gain a new understanding of surface preparation and network with industry colleagues.

Thursday 10th October | 5pm to 7:30pm

The Blind Monk
76 Beaumont Street, Hamilton Newcastle 2303

CLICK HERE TO REGISTER

Site Tour

NEWCASTLE PORT MARINE STRUCTURES

Sponsored by
Watt Asset Advisory

The Newcastle Branch of the Australasian Corrosion Association (ACA) is excited to present another local unique opportunity to host a joint event with Ports Newcastle for a boat cruise and hear from 3 experienced speakers. An event proudly sponsored by Watt Asset Advisory.

Port of Newcastle (PON) is the regions international trade gateway. PON have the responsibility of maintaining and operating more than 12 critical wharf facilities. PON will share insights into their approach to maintenance of their marine structures in the corrosive port environment, by providing narrative around ageing structures, types of structures and the choice of remediation and preventative measures to keep these important facilities in operation. PON use a combination of cathodic protection, both galvanic and impressed current, protective coatings, pile jacket systems and conventional concrete repairs along with a rigorous inspection regime and early input into detailed design.

Thursday 24th October | 2:45pm to 5pm

NOVA Cruises - Harbour Square Boat Dock (Behind Rydges Hotel), Newcastle 2300.

Followed by networking drinks and light refreshments at a nearby venue (TBC)

CLICK HERE TO REGISTER

Upcoming Events

9 October	NSW	Sustainability in Corrosion Protection	BOOK NOW
10 October	NSW YCG	Introduction to Industry Associations webinar	BOOK NOW

Upcoming Technical Presentation
(Lunch & Learn)

22 October	ASBC Seminar	Sydney
23 October	TTW	Sydney
24 October	ACA Guest Lecture	UTS Sydney

Panel Participation
CONVR 2024 5th November

Completed Technical Presentations
(Lunch and Learn) July - Sept

Thanks for your time today. Great presentation!

- 3rd July, Mott MacDonald, Sydney

I just wanted to pass on, there was a lot of positive feedback from everyone who attended the presentation yesterday, which has brought up some great discussion points and learnings for future projects. We really appreciate you making the time to come down to Wollongong for the presentation, and please let us know if any similar opportunities come up.

19th September Wollongong City Council

Introduction to Industry Associations

The New South Wales Young Corrosion Group (YCG) on behalf of the Australasian Corrosion Association (ACA) invites all members to join us for an online Zoom webinar on an Introduction to Industry Associations. Are you an early-career professional or student eager to boost your professional development and contribute to the future of your industry? Join us for an insightful one-hour webinar designed to introduce you to the role and work of industry associations. Discover how these organizations support professional growth and skill-building of their members, while also providing platforms to shape and influence the industry at large.

Thursday
15th October
4pm to 5pm
AEST

Online Webinar
via Zoom

CLICK HERE TO REGISTER

Round Table Conference

The Round Table Conference is a Victorian Branch annual tradition spanning decades. It celebrates experienced practitioners in the corrosion field, who are invited to provide an engaging, entertaining and non-technical presentation over a meal and drinks. Presenters spin tales about their journey in corrosion, unique projects they have worked on, and wild stories. Presenters in the previous five years have included Maria Forsyth, Ian McCloud, Ted Riding, Peter Wade and Sergio Mattioli.

This year, we welcomed Tracey Gramlick, from Standards Australia, who has a Masters in Technology Management and Administration and a background in Mechanical Engineering. She has extensive experience in the industrial metals, building products and infrastructure sectors.

She also has had diverse experience in several manufacturing, R&D, advocacy, executive management, training and marketing roles in private, not for profit and government enterprises. Tracey recently retired from the role of Deputy Director for Growth and Strategy, Science Connect. She is the chair of the board of Standards Australia, chair of the Industry Advisory Board for Macquarie University's Faculty of Science and Engineering, and remains the liaison between the National Building Products Coalition and CSIRO.

Tracey delivered a tale of her career and how she wove in and out of corrosion, constantly drawn back by an early career passion built in the field when working with Alcan International.

Couldn't make it this year? The Round Table Conference typically takes place in/around August. Keep an eye out!

Brian Cherry Awards

The first round of the Brian cherry awards is taking place online at 5 pm AEST on Wednesday 9th October. It isn't too late to register for free, click here!

The Brian Cherry Awards has been running for over 10 years. Originally only open to Victorian post graduate students, it has expanded to include any final year or postgraduate student studying corrosion at an Australasian university.

In the first round, eight students will present a three-minute thesis (3MT). Originally developed by the University of Queensland, the 3MT challenges students to present a compelling story on their research and its significance in just three minutes, in language appropriate to a non-specialist audience. They get just one slide, no props, no animations and no questions.

Prizes this year include:

1st Place
$1,000 + 1 year Student Membership

2nd Place
$750 + 1 year Student Membership

3rd Place
$500 + 1 year Student Membership

4th Place
$250 + 1 year Student Membership

3MT Runner-Ups
(1 year) Annual Student Membership

This year's presentations include:

- Joelle Chia (RMIT University) on Predicting Airframe Corrosion Under Varying Environmental and Operational Conditions
- Bishwjeet Binwal (University of Sydney) on Addressing Sewer Corrosion: Enhancing Sewer Pipe Durability and Sustainability Through Mine Waste Utilisation
- Marc Peters (Monash University) on Understanding the Repassivation Behaviour of Tungsten in Ni-Cr Based Alloys
- Zhi Wang (Deakin University) on Inhibiting Hydrogen Permeation of Pipeline Steel by Chemical Inhibitors
- Nithin Joseph Vattappara (Deakin University) on Evaluating Barrier Property Degradation In Two-Part Epoxy Pipeline Coatings
- Ran He (RMIT University) on Improved Corrosion Behaviour of PBF Fabricated Ti-6Al-4V In 3.5wt% NaCl Solution Using Heated Substrate
- Kinjal Patel (RMIT University) on What's That Smell? Volatile Components from Garlic & Onion for Thin Film Coating Protection of Metallic Surfaces
- Taj Kuchel (Curtin University) on Exploring Resorcinarene-Based of CO2 Corrosion

A panel of three judges from industry and/or academia rate the presentations and the top four progress to the final round on the 23rd of October. While judges deliberate, the audience fight it out in their own competition for bragging rights in the corrosion themed quiz! There may even be a bad corrosion joke or two.

Currently involved in corrosion research or know someone who is? Keep an eye out for next year, call for abstracts to enter the competition come out in June/July.

WA & Vertech Event

On the 18th of September 2024, the Western Australia branch of the Australasian Corrosion Association (ACA) along with our host Vertech held a technical event with well-informed speakers who presented on the theme of: Corrosion of subsea equipment and appropriate NDT to identify them.

We would like to thank you Vertech for hosting the well reception and commend the speakers and their presentations which offered a full understanding of the advanced technologies and expertise in subsea and underwater inspection and corrosion mapping. Guests advised it was a great pleasure to attend the event, assuring that the presentation and discussion followed have added values to the audience.

Andrew McGregor
Integrity Team Manager
Sonomatic Australia
Presented: Inspection Data Processing and Review in SIMS.

Jon Millen
Sonomatic Australia Operations Manager
Sonomatic Australia
Presented: Subsea Inspection Tooling

Nick Veitch
Managing Director
Geo Oceans
Presented: Deployment of Subsea Inspection Tooling

Rust Never Sleeps:

STRATEGIES FOR SUBSEA CORROSION CONTROL WITH FLOW ASSURANCE.

The Western Australia Branch of the Australasian Corrosion Association (ACA) invites all our members and those interested to attend another unique local Technical Event with guest speaker Raymond Bosman presenting a piece on Rust Never Sleeps: Strategies for Subsea Corrosion Control with Flow Assurance.

Thursday 17 October
5:30pm to 7:30pm AWST
The Grosvenor Hotel
339 Hay St, Perth WA 6000

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Our CEO recently visited New Zealand, engaging with key ACA members and industry professionals. Here's a brief overview:

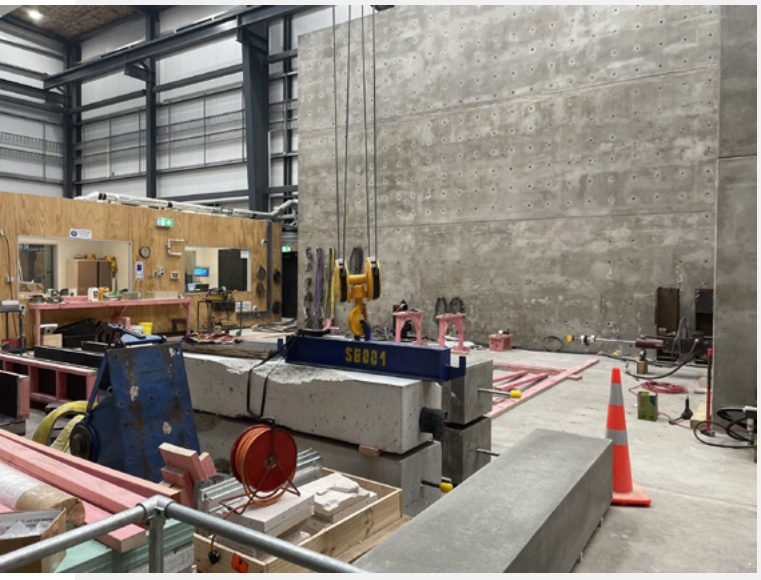
Auckland Highlights:

Metspray Visit: The CEO met with the Metspray executive who have a commitment to training and quality. This was followed by a tour of their fabulous new facility in Drury, that is due to open in November. It will be state of the art and include a robotic arm for abrasive cleaning! Thanks to Chris and Kim Shult-Merrick and your team for the investment of your time!

Corrosion Specialists Meeting: It was great to meet with other members in Auckland and discuss the potential for more training opportunities, and events including Matt Vercoe of Metal Spray, Philip Latrobe, and Zac MacDonald of Gold Seal.

Taranaki Insights:

Industry Lunch: We had a good catch-up with most of our Taranaki based members over lunch. The CEO enjoyed hearing about the area and how corrosion is dealt with. It was big news on the day that Methanex, a longtime member of the ACA, has moved into maintenance mode as they redirect dwindling gas supplies for use by the community and energy security. Great community mindedness! Thanks to Ry Collier and Mark Sigley for your contacts and support.



Wellington Collaborations:

Engineers NZ Meeting: Explored collaboration on advocacy, especially around the need for infrastructure investment. We also received a briefing on the big focus on the condition and repair of the Wellington Water infrastructure. Thanks to Willie Mandeno for this meeting and general transport logistics. What a host!

BRANZ Visit: The CEO had a good briefing on what BRANZ does and how it levees the construction sector to invest in research including corrosion research such as detailed corrosivity maps and structural testing. Thanks to Trish Shaw for organising this meeting and meeting with Quest Integrity – and amazing member based in Wellington with great asset integrity testing facilities.

Christchurch Connections:

Christchurch Meeting: Thanks to Council SVP, Raed El Saraff, Rene Hill, and NZ President, Grant Chamberlain for spending their Friday afternoon and evening discussing our plans for NZ, including increasing young members, and the potential for a conference in NZ in 2026. It was also great to meet Aaron Lines from Lumen and new keen YCG member, Declan Cruickshank, and John Notley of GANZ.

Overall Observations:

New Zealand is facing significant challenges, including energy supply issues and economic shifts, which are impacting confidence and employment.

This trip reinforced ACA's commitment to supporting our New Zealand members during these times.

ACA's Corrosion Technologist

AND TECHNICIAN CERTIFICATION SCHEME

The Australasian Corrosion Association (ACA) invites all members and those interested to join us for an online Zoom webinar on the ACA Certification Scheme Revisited – All you need to know about ACA's Corrosion Technologist and Technician Certification Scheme.

Please find in the following documents in the 'Content' tab: Certification Guide, FAQ's and CPD Policy.

Tuesday 22th October
1pm to 2pm AEST
Online Webinar via Zoom

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Applicators & Coatings 2025 ROADSHOW

Auckland | Christchurch | Sydney | Perth

Presented by:

The Applicators and Coatings Roadshow is a joint event delivered by our Applicators and Coatings Technical Groups. This will be a fantastic opportunity to bring the industry together, raise awareness of new technologies, maintain and develop new Standards, support training opportunities and more!

WE NEED SPONSORS, SPEAKERS & CONTRIBUTORS!
Interested in contributing to the 2025 Applicator & Coatings Roadshow?

Next meeting: 14th October 2024

Please contact frances.marshpaaki@corrosion.com.au for a meeting invite.

WHAT'S ON:

Equipment Demonstrations

Industry leading companies are joining us to share the latest industry machinery updates and how they operate on-site. Equipment Demonstrations are a performance masterclass not to be missed.

Professional and Skills Development

Roadshow attendees have a unique chance to be amongst top industry leaders and learn from their knowledge and experience.

PROPOSED ROADSHOW DATES FOR 2025

SYDNEY Tuesday 6th May 2025
PERTH Tuesday 13th May 2025
AUCKLAND Monday 21st July 2025
CHRISTCHURCH Thursday 24th July 2025

History & Evolution of the Oil Gas & Energy Technical Group

Phil Fleming

The origins of the Technical Group go back to 2010 when ACA project manager, Caitlin Granowski was tasked with reinvigorating the then dormant Refining and Process Technical Group.

The focus of that group was the downstream petroleum refining industry in Australia and New Zealand. Refining was a substantial industry in those days with 8 refineries ranging from WA, through to Victoria, NSW, Queensland and across the Tasman to NZ. The Refining and Process Technical Group had a strong following with 418 registered members concentrated in the Australian states with oil refineries as well as 40 members in NZ.

The first meeting of the newly reformed Refining and Process Technical Group steering committee was held by telecon on 8th April 2011 with Dr Fikry Barouky (Chair), Phil Fleming (Secretary), Arthur Austin and Caitlin Granowski in attendance. Despite the small size of the meeting the program proposed by Fikry was ambitious. The group realized that the refining industry had a limited future in ANZ and wasted no time changing its name in order to embrace additional industries. The focus was expanded to include upstream petroleum exploration and processing, coal seam gas (which was very new) and petrochemicals as well as oil refining. The new name was the Petroleum & Chemical Process Industries Technical Group. The meeting also established working groups covering the areas of cost of corrosion, standards, risk based inspection and research. A date and theme was set for a mid year one day symposium and planning commenced for a petroleum and chemical process industries forum to be held as part of the 18th International Corrosion Conference to be hosted in Perth by ACA in November 2011.

(Lto R) Margarita Vargas, Fikry Barouky, and Arthur Kokolekos

The technical group steering committee resolved to meet by teleconference for one hour every two months and to record and issue detailed minutes covering the business and actions from each meeting.

It was realized early on that in addition to providing an avenue for technical communication between oil & gas corrosion practitioners it was important that the group provide an opportunity for social networking. The group symposia and ACA conferences have been an opportunity for Technical Group members to socialise and despite the busy schedule of those events we invariably manage to

get together for a drinks function or a dinner. No member of the technical group attending an ACA conference has ever felt lonely.

Meanwhile the Australian and NZ refining industry was rapidly changing. Oil refineries started closing and whilst refining was shrinking, massive investment poured into upstream gas with the construction of major LNG projects in Queensland, WA and NT. In October 2015 the technical group again switched its focus and the name was formally changed to the Oil & Gas Technical Group to reflect the increasing importance of the upstream industry.

The technical group under the auspices of the ACA conducted nine annual one day symposia between 2011 and 2019 . In addition the group has conducted an oil & gas forum at every ACA conference since 2011. Technical group members also supported the NZ Branch of ACA with their petroleum symposia held in New Plymouth, hub of the NZ upstream oil and gas sector. The themes of the symposia evolved over time to reflect the changing focus of the technical group. Early on attention was on corrosion in oil refineries and aging assets. Corrosion under insulation (CUI) became a key interest of the Oil & Gas Technical and lot of effort went into the scoping of a CUI best practice document which remains a work in progress. By 2019 the Oil & Gas Technical Group symposium covered topics such as remote corrosion sensing, drone thermography, non-destructive testing, coal seam gas erosion mitigation as well as pipe wraps and coatings.

Oil & gas professionals are a highly mobile workforce, often working on a fly-in fly out basis so the global COVID-19 pandemic in 2020-22 presented a challenging period for the industry. With the price of oil collapsing due to demand shortfalls and a manpower shortage in the industry resulting from pandemic restrictions many projects were parked and non-essential work curtailed. This was a difficult time for the oil & gas industry as well as for the ACA centre which as well as suffering its own manpower problems saw its income stream from training courses severely restricted. But the Oil & Gas Technical Group operations didn't miss a beat. Internet conferencing had become available through convenient platforms such as Zoom and Teams and in early 2020 the bi-monthly group steering committee meeting went on-line. The Oil & Gas symposium we had been planning for mid 2020 was transferred to webinar format with a presentation in June 2020 on the subject of "Evaluation of coatings for CUI protection". This was followed by a further webinar in August on the topic of "Real time radiography for CUI detection" and in December 2020 the group held the first of a series of webinars on "microbially influenced corrosion (MIC)" in the oil & gas industry. The online format made it very convenient for overseas speakers and delegates to participate. The online MIC webinar in December 2021 included 2 overseas presenters and set an attendance record for the Oil & Gas Technical Group with over 90 people from 17 countries in attendance.

June 2022 saw a return to face to face meetings with an Oil & Gas Forum held as part of the ACA Corrosion and Prevention conference held in Newcastle, NSW. Whilst the conference attendance was smaller than usual, coming on the back of the pandemic, the forum was well attended with presentations from Santos, Deakin University and Curtin University initiating a lively forum discussion covering a broad range of topics around pipeline corrosion including effectiveness of biocides, coatings and cathodic protection for pipeline corrosion management.

The Oil & Gas Technical Group has always welcome participation from major asset owners and our current steering committee includes representatives from Santos, Qenos, Viva Energy Refining and Methanex.

In addition, since its inception the group has enjoyed strong support from the research and university sector, especially Curtin and Deakin Universities. The Curtin Corrosion Centre has been active in the establishment of joint industrial projects covering the areas of microbiologically influenced corrosion (MIC) and corrosion under insulation (CUI), projects which the technical group and its asset owner members have taken a keen interest in. Deakin University's leadership in the Energy Pipelines CRC and research into pipeline corrosion and coatings

disbondment have provided a focus for the technical group in this key area of oil & gas operations.

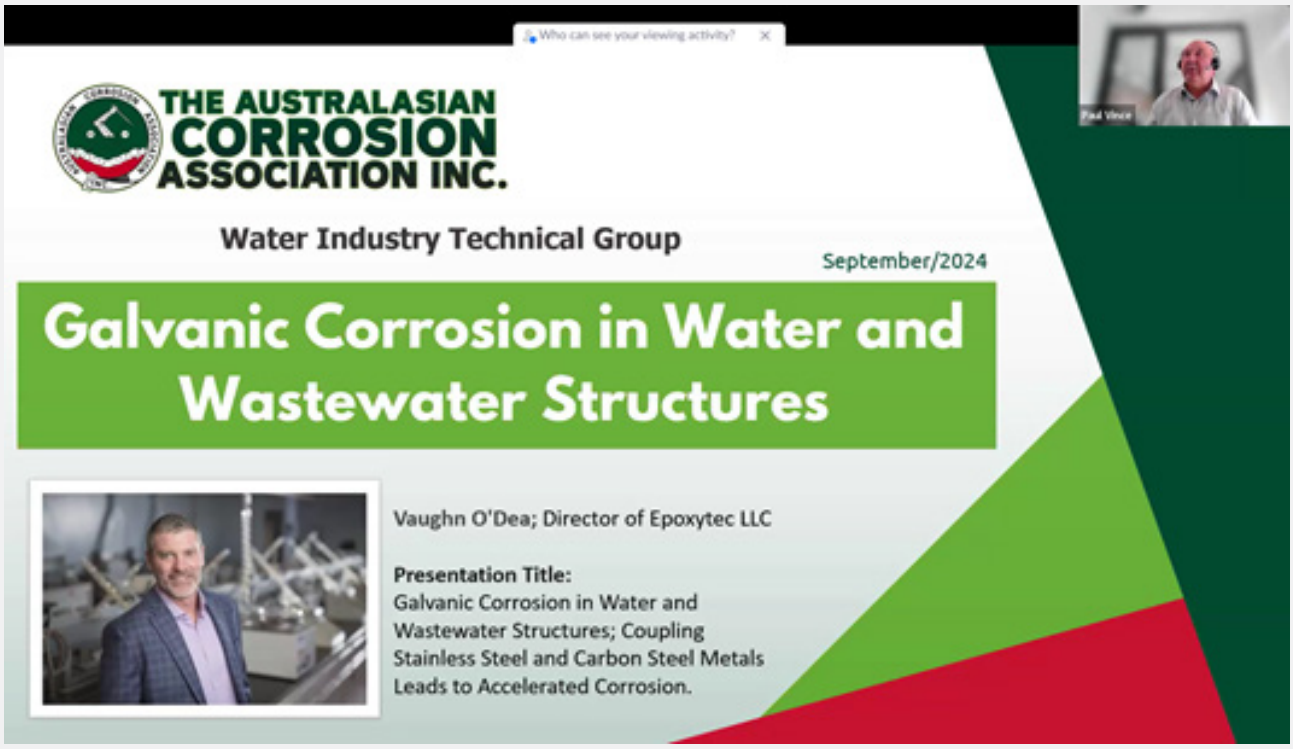
The November 2023 ACA Corrosion & Prevention Conference in Perth saw the Technical Group once again conduct a highly successful Oil & Gas Forum. A significant highlight of the conference was the award of Life Membership of the ACA at C&P 2023 to Dr Fikry Barouky and Mr Philip Fleming for service to the Oil & Gas Technical Group.

In 2024 the Group's steering committee noted that whilst oil and gas would remain the principal focus for the technical group the increasing importance of renewables in the energy mix, especially hydrogen meant that a further pivot was required if the group was to continue to remain relevant into the future. The decision was made to re-brand as the **ACA Oil, Gas & Energy Technical Group** and the group charter expanded to include material engineering and corrosion control activities associated with renewable energy sources especially solar, wind and hydrogen.

(L to R) Ripan Kapoor and Phil Flemming

The Oil Gas & Energy Group steering committee now numbers 29 members based in five Australian states and New Zealand. Membership includes asset owners, researchers, contractors, consultants and suppliers. ACA members interested in joining the committee should contact the secretary, Dr Margarita Vargas, Margarita@anticorrosiontechnology.com

Water Industry Technical Group



On the 10th of September, our Water Industry Technical Group hosting an online zoom webinar where Vaughn O'Dea (Director of Epoxytec LLC) gave our attendees and guests a presentation on Galvanic Corrosion in Water and Wastewater Structures; Coupling Stainless Steel and Carbon Steel Metals Leads to Accelerated Corrosion. With around guests tuning in Vaughn provided insight to guests on corrosion issues facing municipal wastewater engineers and facility owners and high-performance coatings technology that can prevent corrosion damage to wastewater infrastructure.

Concrete And Structures Technical Group

On the 4th September, members of our Concrete & Structures Technical Group Troy Palmer; Senior Technical Engineer (Marine and Civil Maintenance) & Andrew Dickinson; Business Development Manager - Oceania Region (Vector Corrosion Technologies) provided presentations on Corrosion protection case studies at different stages of an assets life.

Troy presented: Case Studies for Condition Assessments and Repairs Using Mixed Corrosion Protection Solutions. The presentation covered case studies where mixed corrosion protection solutions were used to suit individual project requirements. It covered strengths and limitations of various systems and how the solutions were chosen.

Andrew presented: Corrosion Protection Options during an Assets Life Cycle. Andrew's presentation covered some of the corrosion protection strategies that can be used during the life of a reinforced concrete asset from when the structure is first built through to its end of design life period. The presentation showed examples of these options through case studies of projects that are in a marine environment.

Bruce Ackland

I have broad training in chemistry, physics, chemical engineering, and radioastronomy. I am a Professor of Biochemistry & Chemistry at La Trobe University, a Professor of Medicinal Chemistry at Monash University, and a visiting Professor in Pharmacy at the University of Nottingham after a lengthy career at CSIRO. My research involves the application of computational chemistry, AI, and machine learning methods to materials-biology interactions and design of drugs, nanomaterials, and biomaterials. I'm ranked 157th out of 95,000 medicinal chemists, have published >250 journal articles and book chapters, have an H index of 60, and I'm an inventor on 25 filed patents. My awards include the CSIRO Medal for Business Excellence, RACI's Adrien Albert award for medicinal chemistry and a Distinguished Fellowship, the ACS Herman Skolnik award for excellence in cheminformatics, a Royal Academy of Engineering (UK) Distinguished Fellowship (bioengineering) and the AMMA Medal (molecular design).

Q1: Can you briefly describe your background and how you came to specialise in corrosion?

As an undergraduate I obtained a B.Sc. (hons) at Monash University specialising in low temperature nuclear physics (Dept. of Physics) and then received my PhD at Monash in the Department of Materials Engineering. My postgraduate supervisor was Prof Brian Cherry and the subject matter dealt with stress corrosion cracking of linepipe steel, with cathodic protection playing a pivotal role in the process. The undergraduate and postgraduate studies may seem very different, but they actually share quite a bit in common, especially the thermodynamics and kinetics aspects.

Q2: Can you tell us about your current role?

I class myself as a corrosion scientist, specialising in all aspects of cathodic protection. I am an individual consultant to industry and have operated my own business since 1985.

Q3: In your opinion, what makes corrosion a critical issue for the Cathodic Protection (CP) industry specifically?

Cathodic protection is an electrochemical method of controlling corrosion. The method has a 200 year history and is well understood and established throughout the corrosion control industry.

Q4: What are the most significant corrosion challenges facing your sector today?

Personally, I think that education remains vital for those

working in the area of CP. In this era where software programs and apps are widely used it is important for users to understand the principles involved in order to better apply the technology to real life situations. It is often too easy for an application to spit out a number but it takes an informed user to assess the validity and apply it properly in practice.

Q5: *Could you discuss any new technologies or materials that have emerged recently to combat corrosion in your area?*

The inline internal inspection tools have made significant advances in detecting corrosion related defects in pipelines and combined with software that allows analyses of features such as CP, stray currents, induced voltages from AC systems (power lines and traction) etc. a full picture of the corrosion and protection status can be gained.

Q6: *What are the key strategies for corrosion prevention and management that companies in the sector should implement?*

It is vital for any CP system to be well designed, based on sound principles and comply with all standards (Australia has an excellent set of CP standards) and regulatory requirements. The CP system must be integrated with any other corrosion mitigation system to ensure the most technically efficient and cost effective solution is provided to the end user.

Q7: *Where do you see the future of corrosion research and technology heading for the sector you work in?*

Good science involves the never ending refinement of theories and methodologies. There are exciting projects being researched in tertiary institutions around the globe, with Australian universities and institutes of technology producing world class work. The outcomes of the research not only provides us with the invaluable fundamental understanding of the principles involved, but also helps industry to continue to improve the products that help mitigate corrosion within our communities.

Q8: *What advice would you give to asset owners to better address corrosion challenges?*

If CP is assessed as a good solution, then ensure the above key strategies are followed.

Q9: *Please share a specific case where innovative corrosion management significantly improved operations, efficiency or safety?*

Rather than a specific case (because it is common to most pipelines systems), the use of CP together with modern coatings and programs to mitigate interference from HV power lines and traction systems on all modern pipelines has reduced the corrosion failures dramatically. Similarly, the combined impact of CP methodologies and concrete technology have greatly improved all sensible corrosion mitigation systems for steel reinforcement in concrete.

Q10: *How are data analytics and predictive maintenance being utilized to address corrosion-related issues in the industry?*

This is not in my direct area of expertise! However, the use of AI and mass data learning seem to be heading our way and we need to be ready to embrace it and most importantly to understand how these technologies arrive at their solutions and output information.

CORROSION

& Materials Magazine

- ***Connect*** *with the Experts*
- ***Influence*** *the Industry*
- ***Reach*** *the Heart of the Corrosion Community*

ADVERTISE IN CORROSION & MATERIALS MAGAZINE

Distributed nationally to over 3000 readers, Corrosion & Materials magazine is the mostly widely read within its market. The readership is highly targeted: senior decision makers with real purchasing power from major professional firms, universities, government, and research institutions.

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- **Targeted Audience:** Tap into a niche market of dedicated professionals. Our readers are your direct audience - engaged, informed, and influential in corrosion.
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2025 FEATURES

Maritime

The Water and Waste Water Sector

Oil & Gas

Concrete Structures

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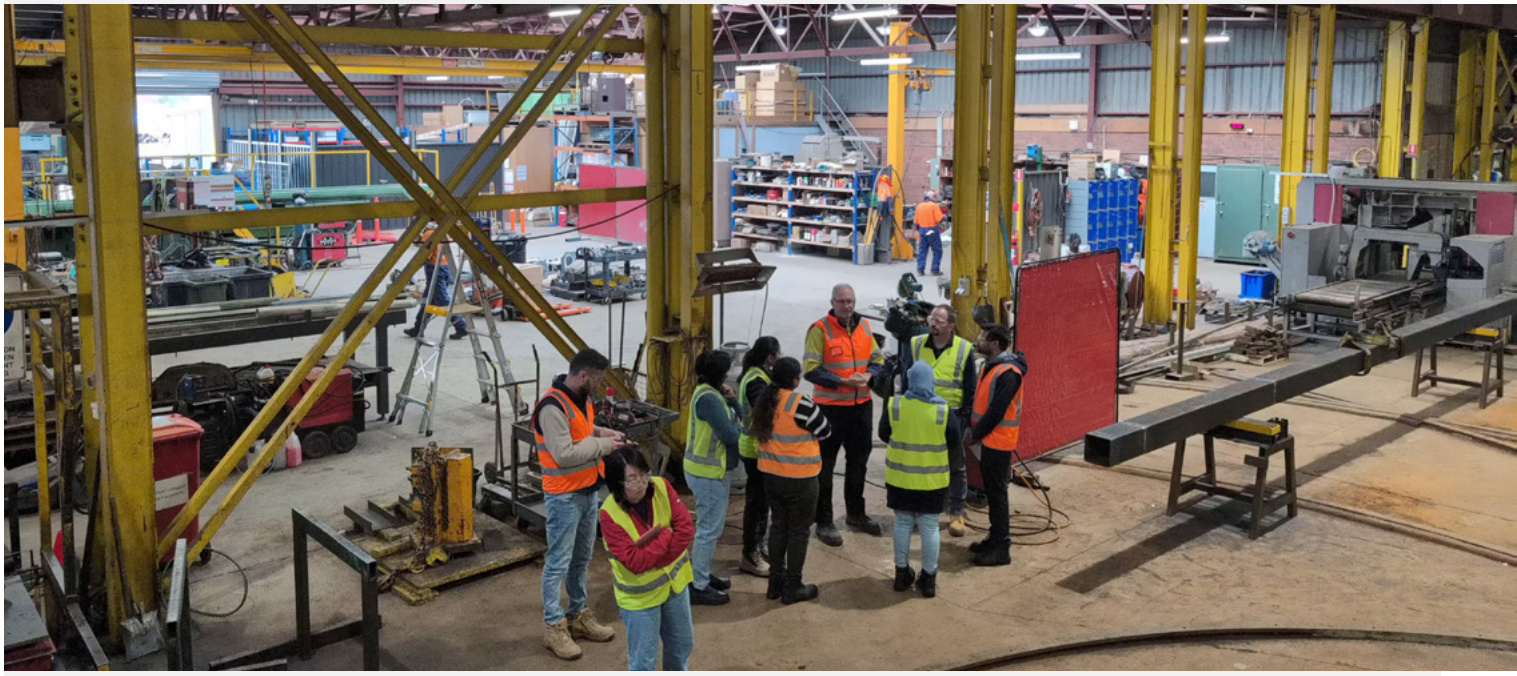
YOUNG CORROSION GROUP

On the 16th September, the Victoria Young Corrosion Group (YCG) proudly partnered with Inductabend for an informative tour of their manufacturing facility in Tottenham VIC. Inductabend has been manufacturing induction bends for the Oil & Gas, Mining and structural industries for over 30 years.

It was an excellent opportunity to gain insight into some of the key considerations for designers and constructors when sourcing induction bends and see the manufacturing process up close.'



Praveen Weerakkody

I am a doctoral candidate at the Curtin Corrosion Centre, Curtin University, and the recipient of the 2021 Ph.D. scholarship from WASM: Minerals, Energy, and Chemical Engineering, awarded by the QEERI-Curtin Corrosion Research Alliance. My research integrates fundamental electrochemical approaches with microstructural characterisation to investigate the role of nickel in surface film formation and the development of trench and crack morphologies in high-strength alloy steels exposed to sour environments. I currently serve as the Chairperson of the ACA Young Corrosion Group (YCG) Technical Steering Committee in the WA branch, where I am also a committee member of the ACA WA branch. Additionally, I am a state representative of the National ACA-YCG Steering Committee.

Q1:
What is your current ACA membership level?

I am a Corporate member

Q2:
What is the Young Corrosion Group (YCG)?

The YCG is a technical group within the ACA that offers a unique combination of professional and personal development opportunities tailored for young and emerging professionals in the corrosion industry. It provides an ideal platform for professional interaction, networking, and support, while also promoting the value of camaraderie and enjoyment. This group not only fosters professional growth and development but also creates a lively and engaging environment where members of all ages can build personal connections, making the experience both enriching and enjoyable.

Q3:
Why are you a member of the YCG?

Being part of the YCG allows me to interact with a network of like-minded individuals, participate in specialised events and workshops, and stay updated on the latest developments and breakthroughs in corrosion science. Additionally, the YCG fosters a supportive community where members can share knowledge, collaborate on projects, seek advice or support and build valuable connections. This involvement not only enhances my career development but also enables me to contribute to the advancement of the field and support the next generation of corrosion experts.

Q4:
What inspired you to pursue a career in Corrosion?

My interest in pursuing a career in corrosion

stemmed from a combination of academic curiosity and practical relevance. During my studies in engineering, I became fascinated by the complex interplay between materials and their environments, particularly how corrosion affects the longevity and performance of structures. Additionally, the severe impact of corrosion having on industries such as mining, oil and gas, and construction highlighted the importance of this field.

Q5:

What are some important corrosion-related issues facing your industry today?

We, at the Curtin Corrosion Centre (affiliated with Curtin University) are trying to help resolve some critical corrosion-related issues currently faced by the oil and gas industry, which include;

- *Internal Pipeline Corrosion: The deterioration of pipeline interiors poses significant challenges, affecting the integrity and longevity of the infrastructure.*
- *Corrosion Under Insulation: This issue remains a major concern, as corrosion can develop beneath insulation materials, often undetected until significant damage has occurred.*
- *Influence of Oxygen on Inhibitor Performance: The effectiveness of corrosion inhibitors can be compromised by the presence of oxygen, impacting their performance and requiring careful management.*
- *Hydrogen Embrittlement in Gas Transportation: This phenomenon, which also affects the renewable energy sector, leads to the weakening and cracking of materials due to their exposure to hydrogen.*
- *Reliable Techniques for Offshore Corrosion Inspection: Developing and implementing effective methods and procedures for on-site corrosion inspection in offshore environments are crucial for maintaining structural integrity.*
- *Microbial Controls for Biocides: Managing microbial growth through biocides remains essential, as microbial-induced corrosion (MIC) can significantly impact the durability of materials.*

Q6:

How does the ACA and YCG support young people in the corrosion industry?

The ACA and YCG provide comprehensive support for young professionals in the corrosion industry through various initiatives. We offer targeted presentations, workshops, and seminars designed to meet the needs of early-career individuals and recent graduates, facilitating their professional and personal development. Additionally, we promote generational exchange by organising activities where senior professionals share their knowledge and experience with younger personnel. To further support career growth and industry integration, we create opportunities for networking and social interaction, allowing young professionals to connect with peers and industry leaders.

Q7:

How can others interested in the YCG, join?

If you are an ACA member under the age of 35, you are automatically enrolled in the YCG with no additional registration required. To participate in YCG activities, you simply need to attend the events. Alternatively, you can engage with YCG by contacting the ACA head office or reaching out to the respective state Chairperson of the ACA Young Corrosion Group (YCG) Technical Group, whom for Western Australia is myself. When registering as a new member, ensure you tick the checkbox to update your contact details in the YCG database for your state. Additionally, if you are interested in a more active role, you can join the respective "State YCG Committee," where you can engage in event organising and planning.

News from the ACA Foundation Chairman

The ACA Foundation (ACAF) was established in 2000 and it has discharged its primary goal of providing scholarships & training for ACA Members and non-members. By fostering corrosion education for all applicants, we are continuing to build the body and empower the wider community with an increased capacity for making informed decisions on corrosion mitigation and amelioration.

Additional Expertise – New Director

ACAF has emerged from the COVID era as has restructured to a more streamlined team that is focused on the future. The ACAF Board is delighted to announce the recent appointment of a new director, Geoff Will. They will enhance the ACAF development opportunities. Through further recruitment actions ACAF is securing additional directors who come from outside of the mainstream industry.

Geoff Will is a well-known and established leader and lecturer in the Chemical Engineering fraternity. Geoff has an enviable reputation as an industry problem-solver who can turn his creative mind to a vast array of challenges and so provide his students with the most stimulating choice of research topics.

The success of our scholarship programs is totally reliant on the donations and support provided by corporate organisations as well as the many ACA members who generously continue to support our scholarship programs and the Centurion program.

Recent Achievements:

- ACA Foundation delivered more than 150 corrosion education cKits to secondary schools.
- **All At Sea -** we developed a TAFE-endorsed training platform for delivery of a STEM program called All At Sea in 2012, which is being utitlised by teachers of high school students across Australia and New Zealand.
- **ACAF Ltd –** A Registered Incorporated Tax-Deductible Charity In 2010, ACA Foundation Limited became a registered Charitable Organization with TAX DEDUCTABLE Status for donations. This process greatly improved the value of donations to our sponsors.
- **ACAF Centurion Program** Initiated in 2010 the Centurion program, encourgages individuals, corporations or community-based organisations, to become donors for local

and international scholarships. The program facilitates the expansion of knowledge and supports careers in Corrosion Engineering, Corrosion Management or Specialist Corrosion Integrity and Prevention Programs to blossom and flourish

The continued support of Centurion Donors ensures the viability of future scholarships.

- **ACAF Corporate Donors –** The ACAF has been very fortunate in gaining the support of corporate organisations who provide long term commitments to support ACAF Scholarship Programs.
- Scholarship History – Since its introduction of Scholarships in 2000, ACAF has now delivered more than 140 scholarships to ACA Members and community members, in the form of :
    - training scholarships
    - post graduate scholarships
    - Conference attendance International education scholarships
    - Future Leaders Forum Program
- **Updating your Centurion & Donors Support -** The ACA Foundation is proud of our members-based Centurion donor program. Members renewing or joining the Centurion program for 2024/2025 will receive a Centurion Badge plus a Centurion Certificate as acknowledgement of their support.

If you are a company or corporation you could provide a scholarship program over a 5 year term. Open this link to make contact with one of our ACAF directors to discuss the opportunity further.

- Be part of the future development of our Corrosion Prevention people's careers.
- International exchange programs are coming.
- The expertise of our young community must grow & foster future international participants in our Australasian businesses – this rests with your support.

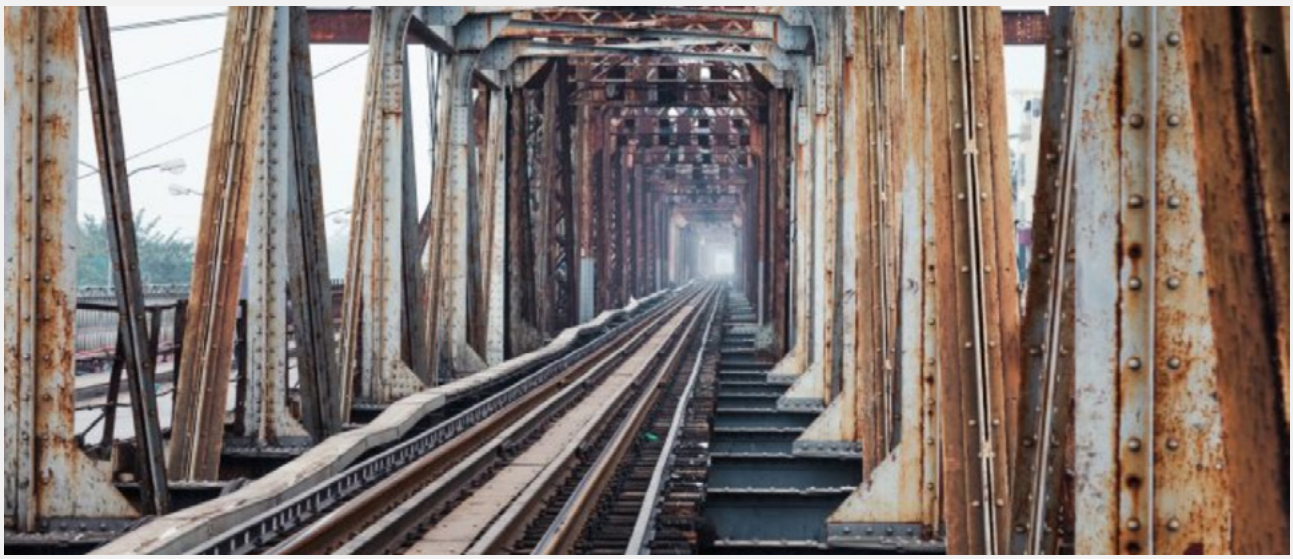
We need the financial support from Centurions, Industry & the Business Community to help grow the expertise of our future generations and to ensure continued viability of the ACA.

We thank everyone for taking the time to read to our message. We look forward to your continued support of our scholarship program. As a Centurion Donor or as a Corporate Scholarship donor for longer-term you can make a difference for the community at all levels.

Thank You,

Wayne Burns

Chair – ACA Foundation Limited
https://www.corrosion.com.au/foundation/



ACA Has a Win for Steel Fabricators and Paint Suppliers with the Support of Steel Sustainability Australia and Australian Steel Institute.

The ACA is happy to announce a major advocacy win with the support of Steel Sustainability Australia (SSA) and the Australian Steel Institute (ASI). The final new SSA Credit 3.1 was approved by the Green Building Council of Australia and published on 5 August 2024.

See: Credit 3.1 Paints and Coatings.

This was a great collaborative effort. It is a great win for steel fabricators/ suppliers, whilst also retaining a benchmark for sustainability in buildings. Essentially the credit specifies that any paint applied to steel must be applied in accordance with paint manufacturers specifications (including WHS and paint dry times) – applicants must show evidence of a procedure in place that aligns with paint specs. And, any paint applied to steel at a building site,

and in an area that is regularly occupied, it must meet GBCA VOC limits. All other paint applicants are exempt from the VOC limit (as GBCA's intent is to protect the health of building occupants).

Thank you to Melinda Coles of SSA and Phil Casey of ASI, for being such great listeners and problem-solvers to get the balance between Green Building certification and protecting steel from corrosion – whilst being practical and achievable. Also thank you to Adam Hockey and the ACA Sydney Branch for your leadership and raising this issue for us all to address.

Please find below the SSA and ASI full announcement on this development.

Industry collaboration achieves benchmark for sustainability in paint for steel suppliers

In an industry-first collaboration, the Australian Steel Institute (ASI) coordinated a working group to establish a realistic standard for sustainability in paint within the steel industry.

The working group comprised paint manufacturers, building industry representatives and members of the Australasian Corrosion Association.

Working group members had lengthy discussions over a period of four months. Topics included the sustainability and circularity of steel, the importance of anti-corrosion paint to the longevity and durability of steel, the volatile organic compound (VOC) levels in solvent based paint and the decay times of VOCs associated with the drying time of paint.

An important step was acknowledging where the paint industry is at in terms of measuring and reporting of VOC levels and understanding the complexities of measuring VOC decay times. Dulux and AkzoNobel provided technical input, which was invaluable in gaining intelligence in paint chemistry and determining what's possible for steel fabricators. Built Australia provided input into the site practicalities of what is achievable in measuring VOCs on building sites and providing assurance to project teams that VOC limits are met.

The challenge was to find a solution whereby fabricators could demonstrate paint was applied to steel products in a safe manner to reduce impact to their health and wellbeing and retain compliance with VOC limits set by the Green Building Council of Australia (GBCA) within the construction of a building.

The working group ran various scenarios to determine what was achievable for fabricators, what is in their zone of responsibility and what could be auditable by the ASI's Steel Sustainability Australia (SSA) scheme. A final new SSA Credit 3.1 Paints and Coatings was endorsed by the GBCA, who also published an associated FAQ F-00332 *What can be excluded from the scope of Minimum Expectations in the Exposure to Toxins credit from Green Star Buildings.*

Bringing together representatives from each of

these industries led to a successful outcome and offered valuable insights for the GBCA's Responsible Products Framework. Launched in 2020 the Green Star Buildings rating tool relies on initiatives such as SSA to assess and certify best practice sustainable businesses and products. Developed closely with GBCA and key stakeholders in the steel supply chain, the SSA scheme was launched in 2023. It serves as a leading platform for downstream Australian steel suppliers - including fabricators, roll formers and reinforcing businesses - to showcase their commitment to sustainability within the building industry. Whilst SSA is a stand-alone program, certification also results in Responsible Product Values which translate to Green Star credits under the GBCA rating tools.

ASI's ability to unite key stakeholders for positive outcomes is one of the benefits of ASI membership and the collaborate approach of this working group is a testament of effective teamwork in action for the benefit of the steel industry. For more information on ASI's SSA scheme, visit the website or email ssa@steel.org.au.

Australia/New Zealand Standards Update

The ACA is represented on 11 different Standards Australia Committees. They are Committee names and ACA representatives are as follows:

Committee	Sector	ACA Rep/s	Description
EL-024 (Protection Against Lightening)	Electricity and Gas	John Grapiglia	Protection of structures and buildings against lightning and overvoltages, as well as for persons, installations, services and contents.
CH-003 (Paints and Related Materials)	Manufacturing	Rob Francis	Standardization in the field of paint and related materials Included: • Architectural paints; Industrial coatings; Roadmarking paints; Laboratory testing; Field testing; Lead paint management; Painting of buildings and steel structures.
ME-038 (High Pressure Pipelines)	Electricity and Gas	Geoff Cope (a new rep is required)	Standardisation in the field of high pressure gas, liquid and multiphase pipelines. Included: Submarine pipelines. Excluded: Low pressure gas distribution and liquid pipelines.
MT-014 (Corrosion of Metals)	Manufacturing	Peter Dove, Rob Francis, Willie Mandeno	Standardization in the field of the corrosion of metals and alloys, including corrosion test methods and corrosion prevention methods.
WD-003 (Welding of Structures)	Manufacturing	Paul Hilton	To prepare Standards that specify requirements for the welding of structures. To prepare Standards that specify safety precautions that minimise hazards from welding processes and brazing processes
EL-057 (Boating & Boating Marinas Installations)	Electricity and Gas	Wayne Burns	Standardisation in the field of electrical installations on marinas, and boats up to 50 m
ME-001 (Pressure Equipment)	Manufacturing	Christiane Schulz	Standardization in the field of boilers, pressure vessels, pressure piping and associated equipment.
MT-009 (Metal Finishing)	Manufacturing	Rob Francis	Standardization in the general field of metal finishing.
CE-030 (Maritime Structures)	Construction	Peter Dove	Standardisation in the area of marina and maritime structure design. Included: Design of structures built over water, up to the top of the sea-deck level Structures in maritime environments up to the high water mark.
BD-023 (Structural Steel)	Construction	ACA Needs a rep on this standard	Standardization in the fields of production and supply of structural steel products for general structural and engineering purposes
MT-003 (Aluminium & Aluminium Alloys)	Manufacturing	Paul Vince	Standardization in the field of aluminium and aluminium alloys for general engineering purposes

MT-009 Metal Finishing

AS 4506:2024 (Metal finishing - Thermoset powder coatings) was published in June 2024. It specifies relevant test procedures and performance requirements for thermoset powder coatings applied to metal substrates other than architectural aluminium for atmospheric exposure. This has undergone a major re-write.

AS 1627.6 (Metal finishing — Preparation and pretreatment of surfaces, Part 6: Chemical conversion treatment of metals) has been to public comment and subcommittee review. This has had only minor editorial changes. It is now being edited for final approval and release.

AS 3715 (Metal finishing—Thermoset powder coatings for architectural applications of aluminium and aluminium alloys) has been to public comment and subcommittee review. This has undergone a major re-write. It is now being edited for final approval and release.

AS 8501.3:2022 (Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness, Part 3: Treatment grades of welds, edges and other areas with surface imperfections (ISO 8501-3:2006, MOD) Identically adopts and modifies ISO 8501-3:2006, which outlines treatment grades of welds, edges and other areas on steel surfaces with imperfections. Such imperfections can become visible before and/or after an abrasive blast-cleaning process. Treatment grades given in this document are to make steel surfaces with imperfections, including welded and fabricated surfaces, suitable for the application of paints and related products.

CH-003 Paints and Related Materials

Currently looking at 149 aged standards to determine whether they should be reconfirmed, reviewed or withdrawn.

AS 3894.1 (Site testing of protective coatings Method 1: Non-conductive coatings—Continuity testing—High voltage (brush) method) is about to commence review.

MT-014 Corrosion of Metals

AS/NZS 2312.3:202X (Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings, Part 3: Thermal spray coatings) is being edited for public review.

AS 2312.1:2014 (Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings, Part 1: Paint coatings) and

AS/NZS 2312.2 (Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings, Part 2: Hot dip galvanizing) are next to be reviewed which will probably commence in 2025.

Mirror Committee: **ISO 12944** (Paints and varnishes — Corrosion protection of steel structures by protective paint systems, Part 5: Protective paint systems and Part 6: Laboratory performance test methods) are currently being reviewed by ISO TC35/SC14/WG12 incorporating the existing Part 9 (Protective paint systems and laboratory performance test methods for offshore and related structures). This is proving a major review and unlikely to be ready for public comment until well into next year.

MT- 003 Aluminium & Aluminium Alloys

AS 1866 – Drafting of Aluminium and aluminium alloys extruded rod, bar, solid and hollow shapes is currently underway.

CE – 030 Maritime Structures

AS 4997 – Drafting of Maritime Structures is currently active.

The objective of this Standard is to provide designers, manufacturers and operators of marina and vessel berthing facilities with requirements for recreational marinas and small commercial vessels up to 50 m in length. Requirements are also given for on-shore facilities such as dry boat storage, boatlifts, boat ramps and associated parking facilities.

ME-001 Pressure Equipment

AS 4343 – Pressure equipment – Hazard levels are currently being drafted.

AS 3788:2024 – Pressure Equipment – In Service Inspection (published June 2024) Specifies the minimum requirements for in-service inspection and fitness for service of pressure and associated equipment. This includes repairs, modifications, alterations and re rating of new and used equipment, manufactured anywhere, to any recognized standard, for all stages of pressure equipment life from commissioning until disposal.

AS 1796.2022 - Pressure equipment - Qualification of welders, welding supervisors and welding inspectors (Published June 2022) Specifies requirements for the qualification of welders, welding supervisors and welding inspectors engaged in welding processes used in the manufacture of pressure equipment, such as boilers, pressure vessels and associated piping, as well as other applications requiring a prescribed standard in the theory and practice of welding.

EL-057 Boating and Boating Marinas Installations

AS/NZS 3004.1 Electrical installations – Marinas and boats, Part 1 Marinas is currently being drafted.

AS/NZS 3004.2 - Electrical installations – Marinas and boats, Part 2 Boat Installations is currently being drafted.

This standard relates to electrical safety for marinas and small craft(boats). The review of this series of standards has been extensive as it is intended to address the upgrade of the standard to address the future charging facilities that may also be initiated for charging battery banks for future electric boats, ferries and marine craft. These drafted standards are due for final review and will be released soon for public comment.

WD-003 Welding Of Structures

AS 1554.2:2021 - Structural steel welding, Part 2: Stud welding (steel studs to steel) is currently at ballot for voting (since 2021)

AS 2205.8.2-2003 - Methods for destructive testing of welds in metal, Method 8.2: Transverse fillet shear test is currently being drafted.

AS 2214.1 - Structural steelwork — Qualification of personnel, Part 1: Welding supervisors and inspectors is currently at the ballot (closed end of August 2024)

AS 2214.2 - Structural steelwork — Qualification of personnel, Part 2: Bolting supervisors and inspectors (closed end of August 2024)

AS/NZS 2205.3.1 Amd 1 - Amendment 1 - Methods for destructive testing of welds in metal, Part 3.1: Guided bend tests (went to ballot in 2020 – not finalised).

ME-038 High Pressure Pipelines

AS 4822 - External field joint coatings for steel pipelines is at the ballot (finalised end of August 2024).

SA HB 216 - Submarine Pipes Decommissioning Handbook is currently being drafted.

EL-024 Protection Against Lightning

Nothing active.

Standards Report for ME-038 High Pressure Pipelines

by Geoff Cope

The revised ME-038 standard on subsea pipelines – AS 2885.4 Pipelines-Gas and liquid petroleum, Part 4: Submarine pipeline systems, was published just back in June.

Work on AS/NZS 2885.1 Pipelines-Gas and liquid petroleum, Part 1: Design and Construction is much in progress, mainly still undergoing consideration of its scoping. Full revision and publication is not considered likely for at least another couple of years.

Another item of interest with ME-038 is that a project proposal has been raised with Standards Australia to revise the title of the AS2885 series. Currently it is "Pipelines - gas and liquid petroleum". The proposal is to change to "Pipeline systems - high pressure".

This is to address the widening scope of potential fluids in pipelines in the future.

Work that had been being undertaken for several years by ME-038-08 was virtually finished earlier this year - revision of AS 4822 External Field Joint Coatings for Steel Pipelines has been completed. Approval has finally been gained from the Standards Australia editor, and the ME-038 committee ballot has finally given approval also. Publication is expected somewhere towards the end of October this year.

AS 2832.1 Cathodic protection of metals, Part 1: Pipes and Cables is approaching the end of its 10 year revision timetable, and very considerable work has been progressing for most of the 10 year period. Much of this work has been research supported through the APGA Research and Standards Committee, with research being carried out, mainly under MT-014 personnel direction, at Deakin University. The research work has been looking at causes and protection criteria for stray current corrosion – due principally to DC powered traction systems. Also, the corrosion effects of AC current have been being further investigated. Both these activities have also included contact with personnel in the relevant committees in ISO - International Organization for Standardization.

Many of those people involved in MT-014 are also quite active in the ACA Australian Electrolysis Committee (the AEC has been involved over decades now). Many of these people will be involved in the revision of AS 2832.1.

Another standard which is currently being pushed for updating & revision is AS/NZS 4853:2012 Electrical hazards on metallic pipelines. The committee which prepared this standard was EL-001-23, which included people from both the powerline and pipeline industries. In more recent years some aspects within this standard have become quite concerning and seem to require revision. Standards Australia project managers from MT-014 and ME-038 have been in discussion with us and have been in contact and discussion with the EL-001 project manager. It is presently expected that a revision of AS/NZS 4853 will be authorised.

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Standards Australia continues to seek out the next generation of standards development contributors though NEXTgen, inviting a new generation's problem-solving approach to our world of standards.

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ISO DEVELOPMENT

Justin Rigby, an active member of the ACA and Chair of the AMPP Australia Chapter, represents Engineers Australia for Standards Australia Committee CH-003 and is nominated by CH-003 as an expert to joint working group 6 within ISO technical committee 35. This JWG is developing a new Standard: **ISO 24959 Competency requirements for coating inspectors.**

This document standardizes the competency requirements for certificate holders and companies that are engaged to perform inspection of the coating application process.

Although the role of the certificate holder may be found in many industries and processes, this document relates to the general minimum requirements for the available certificates, knowledge, skill level and competencies for persons operational in the field of application and inspection of paint, varnishes and related products on various substrates. Proper application and inspection are fundamental for the life expectancy of the paint and coating system, conformity to specifications and safety.

The document is in its first draft and will be issued for comment in coming months.

ACA Members are welcome to get in touch regarding interest in sitting on a Standard committee, such as BD-023 or ME-038. Or, if you would like to gain more understanding about any of these standards let us know.

The ACA is currently working on an opportunity to provide a cluster of related standards at membership prices. Discussions are underway to provide this service soon – so stay tuned!service soon – so stay tuned!

PLANS FOR A STANDARDS BOOTCAMP: *February 2025*

The ACA is working with Standards Australia to offer a Bootcamp style workshop for up to 25 participants in February 2025.

The Bootcamp is to provide more information about standards and how they are used. The audience is ideally our YCG delegates, or our members that haven't had much exposure to standards in the past.

The details are as follows:

Standards Australia's Bootcamp is a free (for ACA Members) 2.5 hour workshop tailored to boost your CV by developing practical skills and essential background knowledge on standards. Bootcamp is designed for university students, graduates, young professionals, and those new to the world of standards.

The Program Includes:

- Add practical standards knowledge to your CV
- Discover how standards play a role in your industry and career
- Understand the overarching role of Standards Australia
- Learn how standards benefit everyday life
- Find out how standards are created

Please review details of the bootcamp process (brochure pages 65 & 67) and keep an eye out for the bootcamp session when it is advertised at the end of 2024. For more details contact maree tetlow at maree.tetlow@corrosion.com.au

Warm Greetings and Ni Sa Bula Vinaka from Fiji.

Fiji, an Islands nation surrounded by beautiful blue waters has an issue of extreme exposure to corrosion.

The building and construction industry has seen a lack of knowledge and understanding on the importance of correct surface preparation, selection of materials and application.

Many with the view "I have done it before, and it works" or "getting the work completed quickly is important" accept and continue with what has been practiced traditionally. Further, some asset owners knowingly and or without any understanding of the real cost of rectification works try to complete projects quickly continuing the path of incorrect surface preparation, selection and application of coatings incurring huge costs later.

Fiji is being silently burdened with huge costs of rectification and replacement works that could otherwise have been avoided. Upon completion of CIP Levels 1 and 2, I have realized that there is an urgent need to educate our construction industry.

This is a long and challenging battle. 100% success won't be achieved easily if it were to ever be achieved. Getting our regulators involved is also important. Imparting correct knowledge for a better educated society is very important and working towards this goal shall remain my objective.

I am prepared to take this challenge of educating our society by contributing in the secondary and tertiary curriculums. Will focus on providing training to our educators, lecture sessions in universities and technical colleges and assistance with professional development for our consultants.

Due to the number of locals having completed CIP courses, forming a branch of ACA in Fiji will remain a dream. Assistance from ACA on technical matters for professional development will help keep us on track to achieving this objective.

I have planned to form "Association of Coatings Inspectors Fiji". AMPP members from most of the coating suppliers have given their approval to forming this association. Our members will also include senior executives and directors of the coating suppliers who are non AMPP members. This association will primarily focus on continued professional development.

With Fiji being a group of small beautiful islands nation surrounded by blue waters, white sandy beaches, good food, adventure and sight-seeing locations, am hoping members of ACA who choose Fiji as their holiday destination would volunteer their time to speak to our members or provide technical support with their experience in the coatings industry.

Vinaka / Thank You,
Nilesh Prakash

High Resolution Corrosion Map of New Zealand

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Abstract:

Atmospheric corrosion is a process that results in the degradation of materials, particularly metals, when left exposed to the elements for extended periods of time. This is a highly relevant issue in infrastructure development, where atmospheric corrosion plays an important role in expected structure lifetimes and subsequent maintenance and repair. Consequently, corrosion modelling and management is important when trying to minimise the costs and other negative flow-on effects associated with atmospheric corrosion.

This project builds on previous work done by the Building Research Association of New Zealand (BRANZ) by using machine learning to develop a digital map modelling the behaviour of atmospheric corrosion rates throughout New Zealand. BRANZ conducted experiments over several years [1–3], measuring corrosion rates in over 200 locations nationwide. The data from these experiments were collated and preprocessed, then used to train a regression Kriging model, which in turn was used to estimate and interpolate a national map of atmospheric corrosion rates.

Regression Kriging is a geostatistical interpolation technique that separates the corrosion rate estimate into two parts: a deterministic part, estimated via a regression model, and a stochastic part, estimated via numerical interpolation of regression residuals [4]. The regression model was fitted to the BRANZ experimental data, drawing on domain knowledge of corrosion mechanics to populate the feature space. It is well known that atmospheric corrosion rates are driven by several climatic factors, including temperature, precipitation, and humidity, as well as the presence of certain pollutants – such as sulphur dioxide gas, or chloride ions (particularly near coastlines). Two data sources were used to build the feature space. The first data source, the New Zealand Environmental Data Stack (NZEnvDS) [5], contained 72 raster layers, with each layer containing an environmentally significant measure, such as average rainfall, distance to coastline, and maximum annual temperature. The other data source was locality and population data from the LINZ Data Service, used in lieu of atmospheric pollutant data.

Corrosion-causing pollutants such as sulphur dioxide are most concentrated in densely populated urban/industrial areas (as a result of fossil fuel combustion), so population density data, alongside categorical variables describing the urbanicity of various regions, was used as an analogue for atmospheric pollution data. The relevant attributes were selected via recursive feature elimination using multiplicative ridge regression. The 19 selected features were used to fit a second multiplicative ridge regression model for predicting the first-year corrosion rate of mild steel. The regression model was fitted and validated under k-fold cross-validation, and the entire pipeline was wrapped within a Bayesian hyperparameter optimisation framework. With the optimal regression model determined, the residuals were calculated and used to interpolate any outlying local corrosion rate fluctuations using a Kriging approach. Overall, the regression Kriging process yielded an R2-score of 59.4%. Although the result is promising, it must be considered that the model quality is limited by the sparsity of corrosion rate measurement data, as well as the quality of the attributes.

The high-resolution corrosion map of mild steel (Fig. 1) shows several trends that match known corrosion mechanisms: a north-south trend, likely due to the covariance between temperature and latitude; coastal regions showing significantly higher corrosion rates than inland regions – a result of sea salt (chloride ion) deposition near coastlines. On the other hand, the Central South Island has extremely low corrosion rates due to its low temperature, low humidity, high elevation, and distance from coastal areas. Lastly, there is a notable hotspot over Rotorua. This hotspot, with observed first-year corrosion rates of up to 4800 g/m2, was not captured within the ridge regression model but within the interpolation step and is likely a result of the significant geothermal activity within the area – which releases high concentrations of hydrogen sulfide [6], a corrosion-causing pollutant.

Currently, the project is extended to quantify the uncertainty of expected corrosionrates. Additionally, utilising more granular data sources, such as weather station time series data, is expected to further improve the high-resolution spatial corrosion model of New Zealand.

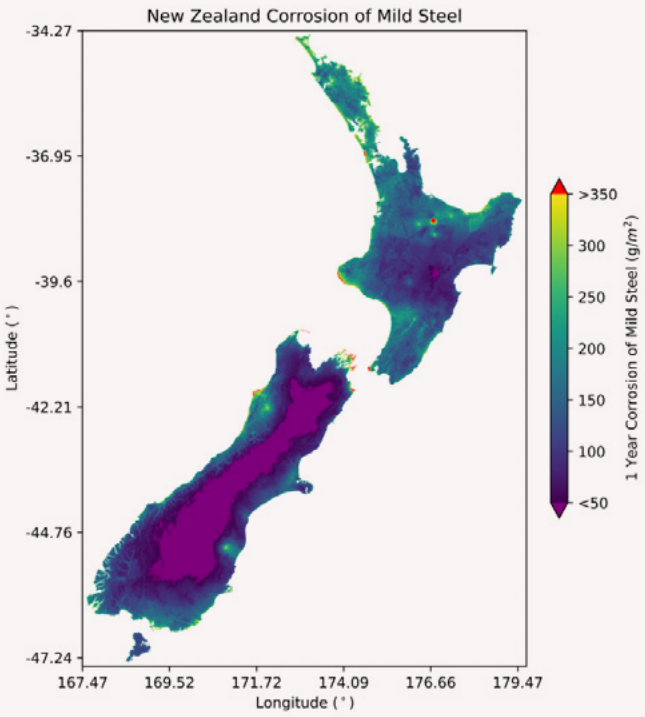

Figure 1: Estimated 1 Year Corrosion Rate of Mild Steel, interpolated at a 500m resolution.

Acknowledgement

The project is supported by BRANZ (project LR18079). Data sourced from the LINZ Data Service are licensed for reuse under CC BY 4.0.

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Innovative Platform for the Management of Multiple Cathodic Protection Systems

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Keywords:

Corrosion, cathodic protection, infrastructure, maintenance, ICCP, CPMS.

Abstract:

Over the past forty years, impressed current cathodic protection (ICCP) technology has been highly effective for the corrosion protection of reinforced concrete bridges and wharves in Australia.

One of the key requirements of ICCP systems is the ongoing maintenance and testing over the life of the systems. Establishing long-term maintenance plans and the costs associated with site inspections for functional checks and ongoing testing has sometimes been problematic.

Recent major advances in communications hardware and software, particularly in terms of improved reliability and lower costs, has driven new innovations in remote monitoring and control systems. These improved capabilities can provide an effective platform for the monitoring and maintenance of multiple cathodic protection systems.

This paper includes an example of a platform known as CPMS (Cathodic Protection Management System) which has been utilised by several CP system asset owners in Australia in recent years. The system allows for remote functional checks and testing to be performed securely from an off-site computer. The automated system also allows for 24/7 monitoring of CP systems and manages alarms, maintenance planning, historical documentation, original specifications, as-built drawings, maintenance and performance records.

This paper details the innovations in CPMS and the capabilities and efficiencies it offers asset managers who operate multiple cathodic protection systems.

1. INTRODUCTION

Reinforced concrete is a composite material that relies on the high compressive strength of concrete and the high tensile strength of steel for its mechanical performance. The concrete which encases reinforcing steel has good anti-corrosion properties. This is due to the hydration process of the concrete which leads to the formation of hydroxides and an increase in the pH level of the cement to around 12.5. This pH level allows the formation of a stable oxide layer on the steel surface, which slows down the kinetics (rate) of corrosion of the steel reinforcement within the concrete structures Reinforced concrete failure is caused by the corrosion of the steel reinforcing bars as a result of the destabilisation of this oxide layer. When the passivity of the steel partly or completely breaks down, either as a result of carbonation or chlorides affecting the concrete, corrosion of the reinforcing steel may initiate. The chloride ions react with the passive oxide layer on the steel surface. This reaction disrupts the passive layer and leads to the formation of soluble iron chloride compounds. This means that the electrochemical potential of the steel locally becomes more negative and forms anodic areas, while other portions of the steel with the passive layer intact will act as catchment areas for oxygen and will form cathodic areas [1].

Due to the substantial economic significance of corrosion problems for reinforced concrete structures, there have been significant attempts from the early 1970s until today to improve reinforced concrete quality by changing the material properties of both the steel reinforcement and concrete and/or by applying corrosion measures during construction. For concrete, the improvements include the use of high-performance concrete in conjunction with protective coatings, thicker cover to steel for certain concrete elements, and the use of corrosion inhibitors in the concrete mix. For steel, improvements include the use of stainless steel, galvanized steel and epoxy coated rebar instead of, or in conjunction with carbon steel. In various applications where a 100-year design life is specified, cathodic prevention has also been applied effectively during the construction phase.

Irrespective of the material improvements of reinforced concrete, corrosion of reinforcement is still a major durability problem, and in particular for structures exposed to chloride contamination.

During the past 30 years, various electrochemical protection systems have been used in Australia in conjunction with the repair of chloride contaminated structures. These systems include impressed current cathodic protection, galvanic based anode systems and more recently, various types of hybrid anode systems. The bulk of the systems were designed in accordance to the NACE Standard, the European Standard, and the Australian Standard for cathodic protection [2, 3 and 4].

While there is an overall acceptance that in most cases impressed current cathodic protection (ICCP) systems can achieve the best outcomes in terms of corrosion protection that meets the applicable standards, one of the main perceived disadvantages of ICCP is the need for ongoing maintenance and monitoring over the life of the system.

For galvanic anode systems, generally the performance of these systems is questionable in terms of whether they can achieve corrosion protection in accordance with the applicable standards. Nevertheless, in recent years these systems have been heavily promoted on the basis that there are no requirements for ongoing monitoring.

It is acknowledged that the reliability of some ICCP control systems and the costs involved for ongoing monitoring and maintenance has encouraged various asset owners to select substantially lower performing galvanic anode systems in order to eliminate the need for ongoing involvement with the monitoring of ICCP systems.

However, recent major advances in communications hardware and software, particularly improved reliability and lower costs, has driven new innovations in remote monitoring and control systems. These improved capabilities in conjunction with the use of an online monitoring and maintenance platform such as the one presented in this paper, has made the entire monitoring and maintenance process more routine, low cost and reliable.

Asset owners now have the opportunity to select corrosion protection systems that can deliver full corrosion protection to their structures while implementing state-of-the-art management systems that can make the entire monitoring and maintenance process for ICCP systems more transparent and simplistic.

This paper will present the key aspects of an online platform used for the maintenance and monitoring of over 60 cathodic protection systems operating on Australia's infrastructure assets.

2. WHAT IS CATHODIC PROTECTION?

Impressed current cathodic protection (ICCP) is a proven electrochemical technology applied to reinforced concrete structures. ICCP promotes the development of steel passivity as a result of the production of hydroxyl ions at the steel-concrete interface to stabilise the protective passive film. In addition, the direct effect of CP includes shifting the steel potential to more negative values, which inhibits the corrosion of iron, and moves the chloride ions away from the steel and towards the anode [5].

There are various types of impressed current anodes applied to atmospherically exposed reinforced concrete. In Australia, the most commonly used types of anodes are mixed metal oxide (MMO) mesh or ribbon anodes (installed in a cementitious overlay or in grout filled chases), and MMO discrete anodes (embedded in drilled holes in the concrete).

When steel corrodes in concrete, the process is comparable to that of a battery. In a battery, electrons are generated because two dissimilar metals are exposed to an acidic solution (paste or gel in practical batteries) that corrodes one metal and creates a harmless reaction in the other. This corrosion reaction at the 'anode' generates electrons that are consumed by the 'cathode'.

For the steel reinforcement that corrodes in concrete, one very small area is the positive pole (anode) and another much larger area is the negative pole (cathode). The corrosion current flows out of the steel at the anode (the corroding part), passes through the concrete and into another part of the steel where there is no corrosion occurring (the cathode). This current flow is called the corrosion circuit and the steel dissolved at the anode forms iron dioxide.

In a practical battery, the electrical connection between positive and negative poles can be disconnected. The circuit is then broken and the dissolution of metal stops. However, in concrete, the corrosion circuit is buried in the structure and the electrical current running through the concrete cannot be disconnected. The only method of stopping the current from running through the concrete is to provide new current from an external source via an external anode in/on the concrete. The flow of electrons between the new anode and the reinforcing steel changes the previously positive poles (anodes) into current receivers. Thus, all of the steel reinforcement becomes a negative pole or cathodic, and hence the name 'cathodic protection'.

The application of cathodic protection for concrete structures transforms the environment around the reinforcement over a period of time. The negatively polarised metal surface repels the chloride ions from the steel while the hydroxide ions generate at the steel's surface. These hydroxide ions are responsible for inducing passivity of the reinforcement [6].

It is important that the design of an ICCP system is carried out within the guidelines stated in the latest revisions of the applicable standards and by experienced cathodic protection engineers. This is to eliminate any side effect associated with the long-term operation of the system such as grout acidification and high voltage due to reduced system capacity. Etc.

3. MONITORING REQUIREMENTS FOR ICCP SYSTEMS

Australian Standard AS 2832.5-2008 (R2018) states that *"the procedures and intervals for routine inspection and testing vary from one cathodic protection system to another and are dependent on factors including the structure type, the CP system type, the reliability of the power supplies, the environment and the vulnerability to accidental or deliberate*

mechanical or electrical damage. In addition, those systems provided with electronically data logged or electronically data transmitted performance monitoring systems may require less frequent physical inspection as the routine testing can be undertaken automatically. Further to this, AS2832.5 states that consideration shall be given to extending the intervals between routine inspection and testing if no fault, damage or significant variation in system performance is indicated by successive inspections/tests". Typically, the functional check is undertaken monthly in the first year of operation and, subject to satisfactory performance, thereafter at 3-monthly intervals. Typically, the performance assessment is undertaken at 3-monthly intervals in the first year of operation and, subject to satisfactory performance and review, at 6-monthly to 12-monthly intervals thereafter."

Based on the above monitoring requirements, it can be concluded that manually operated systems would require extensive physical inspections for the purpose of performing functional checks and performance testing. The standard outlines that less frequent physical inspections can be achieved for systems with facilities for automatic transmission of data.

4. CONCEPT OF CATHODIC PROTECTION MANAGEMENT SYSTEM (CPMS)

Cathodic Protection Management System (CPMS) is an advanced management tool for the efficient monitoring and maintenance of cathodic protection (CP) systems.

The online management system offers a simple and efficient platform for the maintenance and monitoring of multiple CP systems. The platform includes a live monitoring portal which allows the asset owner to view on their PC real time monitoring data from the cathodic protection system. In addition, CPMS allows permanent access to all historical performance data, construction drawings, operational manuals and maintenance records for the CP systems.

The attributes of this management system include:

- A permanent database for the CP systems incorporating all key system data which is required for the long- term CP system operation and the maintenance of the structures.
- The platform can monitor the continuous delivery of CP current to all structures at all times.
- The owners of structures can verify the status of the CP systems allowing for the systematic planning of maintenance work to the structures.

CPMS allows for the immediate identification of any issues which may affect the corrosion protection of the structure. Any issues are promptly identified and can be rectified within the appropriate time. One of the unique benefits of CPMS is the elimination of duplicate reports and documents which are irrelevant (and often slow down and clutter any decision-making process). With the management platform, the asset owner is directed only to the key important facts about the CP system and the actions required and this makes long-term maintenance planning transparent, simple and achievable.

An initial major site audit of the CP systems and the structures is a central component of the CPMS. Based on our experience, every audit performed has revealed some non-performance issues with the CP protection of the structures. Some issues are minor while others reveal serious deficiencies in the protection systems with some problems having been consistently overlooked for years.

5. TYPICAL APPLICATIONS

CPMS can be setup for multiple systems operating on various structures and can provide a global view of the status and performance of each CP installation. An example of the main page of CPMS setup for three systems is demonstrated below in Figure 1

The monitoring of performance of ICCP installations is based on the relevant standard for cathodic protection of steel in concrete, Australian Standard AS 2832.5-2008 (R2018). The standard sets out the criteria used for system testing and adjustment of CP current. For the main decay criterion, the monitoring procedure involves measuring the difference in potential between each reference electrode and the reinforcing steel immediately after switching OFF the

CPMS - Cathodic Protection Management System

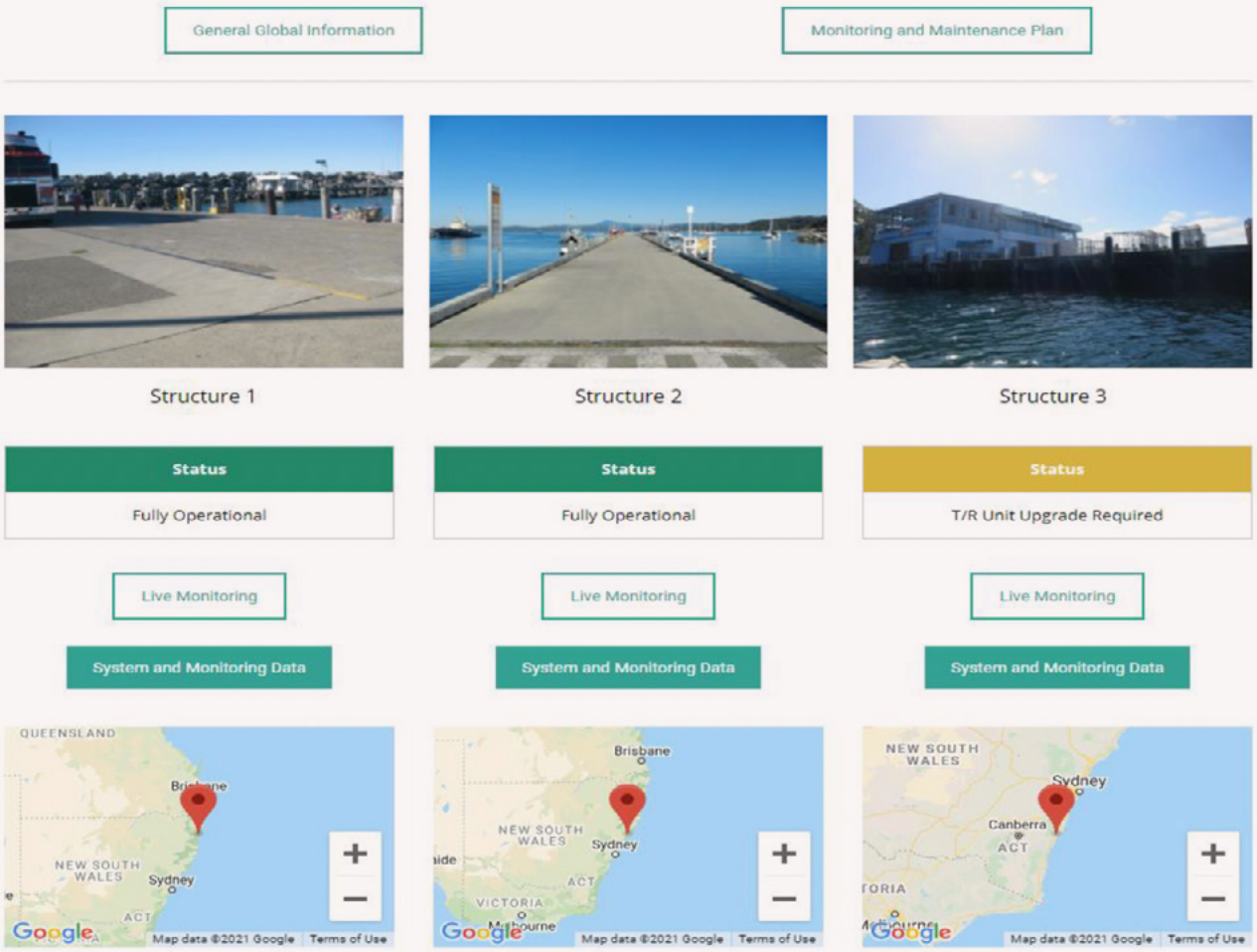

Figure 1: an example of main page of cpms. This page is setup for 3 cp-protected structures which are displayed side-by-side. The system status bar for structure 1 notifies the user of current maintenance.

cathodic protection current, and again after 24 / 72 hours after switching OFF the current.

In Figure 2, a typical program is displayed for the monitoring of sixteen ICCP systems and ten galvanic and hybrid anode systems. The monitoring process is managed using CPMS with all data presented electronically to asset owners. The type of systems included in CPMS are full remote monitoring and control systems, systems with remote connectivity for functional check only, manually operated ICCP systems with requirements for site testing attendance for functional checks, and remote monitoring and galvanic and hybrid systems that require site attendance for testing.

6. INNOVATIONS OF CPMS

The recent innovations with this CP management system have delivered the following advancements for asset owners:

- Improvements in reliability – System verification tasks can be carried out with only an internet connection. There is no need for special modems or software from the manufacturer to be installed on asset manager's computer.
- Interchangeable and non-proprietary components inside the control system – While the advantages of remote monitoring and control are essential for optimal system adjustment and full assurance of continuity of cathodic protection current delivery, this function has in the past been overshadowed by

Proposed Testing Program for 36 Months

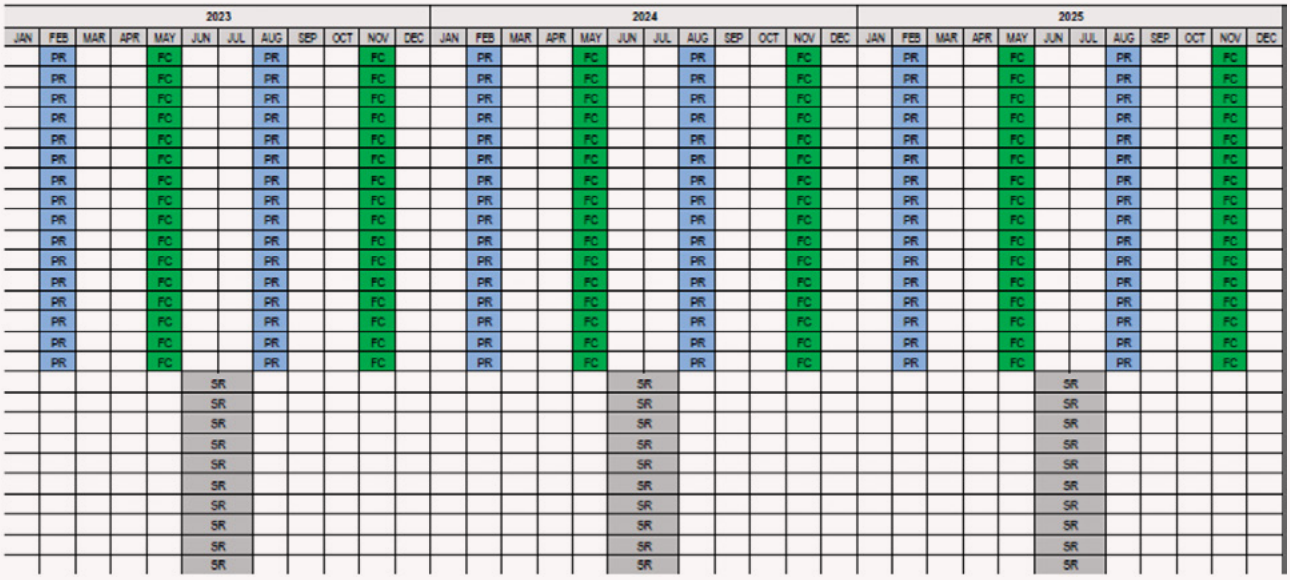

Figure 2: a 3-year monitoring program for 26 structures. The program details the frequency of testing including cp system functional checks, performance testing and system reviews for each installation.

frequent failures and high costs to maintain systems with complex proprietary software and hardware.

- The latest advancements in design have been based on using heavy duty, low heat and interchangeable components for cathodic protection system control units. The interchangeability of components using modular design assembly has made the entire process of maintaining and upgrading ICCP systems simpler and more cost efficient.

- Increased accuracy for decay testing – The majority of impressed current cathodic protection systems in Australia are designed to protect the tidal and splash zones of concrete infrastructure. In these environmental conditions, with the daily wetting and drying of concrete, the tidal variations greatly impact on the performance of the cathodic protection system. This can be assessed in the monitoring and decay testing data. During decay testing, switching OFF the current causes the reinforcing steel to become depolarised. The potential relative to the reference electrode becomes less negative, therefore, these measurements (Instant OFF and 24h/72h OFF) provide an indication of the extent to which the CP system is functioning in accordance to the applicable standards. In order to perform the test correctly, it is essential that the difference of potential over the test period is measured under exactly the same tidal conditions and in most cases over 24 hours and 72 hours period. It is important to note that when the absolute potential or/and absolute passive criteria of AS 2832.5 -2018 are used for system assessment, drift in potential cannot be detected and unless the references are calibrated, these criteria should not be used for system adjustment and assessment.

- Remote monitoring access for system testing, in conjunction with the data related to the daily tidal levels for a particular structure, allow for selection of the exact timing to switch OFF the system and to retrieve the initial Instant OFF data and subsequent 24 or 72 hour data at the correct tidal levels.

- On-demand remote system verification and fewer site visits to the control system - Following CP system testing and adjustment as applicable (based on the applicable standard), additional verifications of current and voltage can be performed at a later time to assess whether the level of current adjustment was sufficient to deliver the optimum corrosion protection. The reliable access to system data over the testing

period and subsequent verification of data after current adjustment cannot be achieved by work personnel performing this test manually on-site as physical attendance is required every time for the testing period. The reliable access to remote data contributes substantially to accurate system testing and consequently to improve corrosion protection of the structure.

- CPMS and solar powered CP systems for remote locations - The use of solar power for impressed current cathodic protection systems is not a new concept. The technology can eliminate the need for permanent 230 VAC power supply and can rely on solar power to deliver CP current to the structure.
- The connection of CPMS to solar powered sites (often in remote locations where mains power is unavailable) can allow for verification of CP system operation at all times. Recent developments in high precision digital control buck converter technology, lithium-ion battery technology, improved phone regional coverage, and increased efficiency of modems and communications components

7. SUMMARY

A significant challenge associated with impressed current cathodic protection is the ongoing maintenance of operating systems, which can often extend over a system's design life of 30 years or more and the ability for successive maintenance managers to access all of the relevant data to operate their ICCP systems over that period.

Cathodic Protection Management System (CPMS) was initially designed as an internet-based monitoring and maintenance tool for ICCP systems. The continual development of the platform increased the reliability and ease of system verification checks using more reliable modem and communications technology. The latest capability of CPMS allows for remote system testing and adjustment of current as per the applicable Australian Standard for cathodic protection of steel in concrete.

The overall benefit has been clearer and more efficient monitoring and maintenance of impressed current cathodic protection (ICCP) systems. The CPMS platform has effectively addressed some of the perceived shortcomings associated with monitoring and maintenance planning for ICCP systems. This management tool and its associated benefits have generally promoted the adoption of impressed current cathodic protection technology for reinforced concrete assets in marine environments.

8. REFERENCES

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9. AUTHOR DETAILS

Martin Cheytani has a PhD from the UNSW, and he is the technical manager of Remedial Technology Pty Ltd. Remedial Technology is a consultancy company specialising in the corrosion protection of reinforced concrete infrastructure assets in Australia. The author's main expertise is in the monitoring and maintenance of impressed current cathodic protection systems. The author's research work at the University of New South Wales involved the mitigation of grout acidification problems associated with impressed current cathodic protection systems and the impact of concrete resistivity on the performance of cathodic protection systems.

Samir Cheytani has comprehensive experience in the condition assessment of concrete structures affected by steel reinforcement corrosion. He is involved in investigative site work including concrete testing, electrochemical testing, data analysis and the development of rehabilitation solutions for reinforced concrete structures. Samir has completed a Bachelor of Property Economics degree in 2005 from the University of Technology, Sydney (UTS), and a Master of Philosophy in Material Science and Engineering in 2020 from the University of New South Wales (UNSW).

Atef Cheaitani is the Principal and Managing Director of Remedial Technology, a consultancy company specialising in the corrosion protection of reinforced concrete infrastructure assets in Australia. Atef's expertise is in the development of various rehabilitation solutions including the application of electrochemical protection systems and the design and maintenance of impressed current cathodic protection systems for reinforced concrete structures in marine environments.

2025 Training Calendar

AMPP Coating Inspector Program Level 1	
New South Wales	13-18 Jan 2025
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Queensland	24 Feb-01 Mar 2025
Victoria	31 Mar-05 Apr 2025
Western Australia	05-10 May 2025
South Australia	16-21 Jun 2025
Western Australia	04-09 Aug 2025
Western Australia	13-18 Oct 2025

AMPP Coating Inspector Program Level 2	
New South Wales	20-24 Jan 2025
Western Australia	17-21 Feb 2025
Queensland	03-07 Mar 2025
Victoria	7-11 Apr 2025
Western Australia	12-16 May 2025
Western Australia	11-15 Aug 2025
Western Australia	20-24 Oct 2025

AMPP Cathodic Protection Level 1 Tester	
Victoria	03-07 Feb 2025
Queensland	12-16 May 2025
Western Australia	07-11 Jul 2025

AMPP Cathodic Protection Level 2 Technician	
Victoria	10-14 Feb 2025
Queensland	19-23 May 2025
Western Australia	14-18 Jul 2025

AMPP Cathodic Protection Level 3 Technologist	
Online/AEST	28 Apr-2 May 2025

AMPP Cathodic Protection Level 4 Specialist	
Online/AEST	5-9 May 2025

ACA Corrosion Technology Course	
Victoria	2-6 Jun 2025

ACA Coating Selection and Specification	
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ACA GAA Hot Dip Galvanizing Inspector Program	
TBC	TBC

AMPP Corrosion Under Insulation	
TBC	TBC

AMPP Concrete Coating Inspector	
New South Wales	3-7 Feb 2025
ACA ACRA Concrete Structures and Buildings	
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Click here to review the Training Schedule:

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Surface Preparation Paint Application C6 is designed to certify industrial and marine painters in proper hand and power tool surface preparation methods, brush and roller coating application, in accordance with industry-standard paint practice.

Abrasive Blaster C7 is designed to certify contractor personnel who wish to obtain certification in blast cleaning of steel and nonferrous surfaces. It covers principles of surface preparation, surface cleanliness, surface profile, dust and debris control, and abrasives.

Spray Application C12 assesses the skills of sprayers who have a minimum of 800 hours applying protective coatings with airless/conventional spray in an industrial or marine environment. Candidates are certified through a brief, written certification exam and a practical, hands-on skill assessment. This course is designed to train and certify marine/industrial applicators to operate airless/conventional spray equipment.

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The newly released AMPP suite of three coating application certificates in Australia: C6, C7 and C12, offered in partnership with BlastOne. The Craftworkers Series course delivers a six-day theoretical and practical course that will provide established Marine and Industrial Coating Applicators with three certificates.

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Course highlights:

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- Corrosion control process
- Solvent cleaning
- Hand-tool cleaning to SSPC-SP 2
- Power-tool cleaning to SSPC-SP 3, 11, and 15
- Assessing surface cleanliness according to SSPC-VIS 3
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- Brush and roll application
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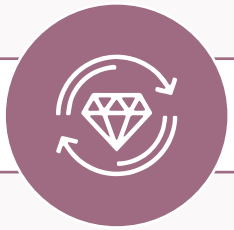

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