A journal of the Institute of Corrosion

Corrosion Management

Issue 187 September/October 2025

CATHODIC PROTECTION (CP) SPECIAL ISSUE

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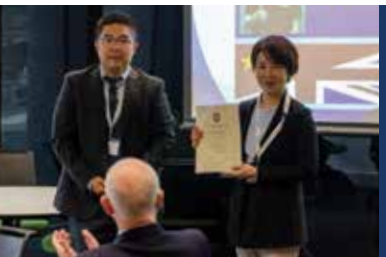

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Publisher and Managing Editor
Debbie Hardwick
Tel: 0114 273 0132
Email: debbie@squareone.co.uk
Consulting Editor
Shagufta Khan
Email: editor@icorr.org
Design
Square One Advertising & Design
www.squareone.co.uk
Advertising Manager
Jonathan Phillips
Tel: 0114 273 0132
Email: jonathan@squareone.co.uk

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Enquiries and subscriptions to the Institute of Corrosion at the address below:

The Institute of Corrosion
President
Yunnan Gao
Immediate Past President
Stephen Tate
Hon. Secretary
Brenda Peters

Institute of Corrosion, Corrosion House,
5 St Peters Gardens, Marefair,
Northampton, NN1 1SX

Tel: 01604 438222
Email: admin@icorr.org
Website: www.icorr.org

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The President Writes

Photo: Dr Yunnan Gao.

Dear Members,

I trust that you have all enjoyed a pleasant and restorative summer, whether here in the UK or abroad, and that you have returned to your work with renewed energy for the months ahead. For me, the past two months have been exceptionally busy and rewarding, filled with events and activities that have both strengthened the Institute's presence internationally and reinforced our role at home.

Since my last column, I have been privileged to represent ICorr in a series of significant engagements, three of which I would particularly like to highlight.

In July, I travelled to China, where I visited Northeastern University (NEU) and the University of Science and Technology Beijing (USTB) together with the President of the European Federation of Corrosion (EFC). These visits were an important opportunity to deepen our academic and institutional collaborations and to further ICorr's mission of supporting corrosion science and engineering on a global scale. I also had the honour of participating in a seminar on corrosion-control innovation in Zhengzhou, which provided a valuable platform to discuss emerging technologies and to showcase the pioneering work being undertaken within ICorr. At the same time, discussions around the establishment of an ICorr China Branch have advanced considerably, signalling a strong and growing appetite for our presence in the region and international collaboration.

Back in the UK, I attended the annual Aberdeen Corrosion Forum (ACF), always a well-attended key date in our calendar. This year's forum held on 26th August 2025 once again provided a vibrant exchange of technical expertise and industry experience, reaffirming the critical role Aberdeen continues to play as a hub for innovation in corrosion management in the energy sector.

September brought a particularly exciting milestone with the inaugural UK-China Corrosion Summit, held in Manchester on the 3rd and 4th. This flagship event, long in preparation, brought together leading experts from both countries to share insights, develop networks, and explore opportunities for joint progress. I am delighted to report that it was a resounding success, not only in terms of attendance and engagement but also in the quality of technical dialogue it fostered. I extend my heartfelt thanks to all those who contributed to making this summit possible.

Shortly afterwards, from the 7th to the 11th of September, I joined colleagues at EuroCorr 2025 in Stavanger, Norway. This year's conference was, as always, an inspiring gathering of the corrosion community across Europe and beyond. Our ICorr delegation was highly active, and the exchanges that took place will undoubtedly influence our work in the coming months. Of particular note was the announcement that preparations are already underway for EuroCorr 2026, which will be hosted in Dublin. ICorr, working in partnership with the Institute of Materials, Minerals and Mining (IOM3), has taken on a leading role in organising this major event. Planning is now in motion, and I can assure you that we are fully committed to delivering a world-class conference in 2026. We particularly reach out at this time, to any of our company members wishing to sponsor activities or exhibit at this key event.

Looking ahead, ICorr has a very rich programme lined up. I strongly encourage you to get involved, whether by attending events, contributing to discussions, or sharing your expertise with the wider community. Our Events Calendar, available at **www.icorr.org/events**, is the best way to stay up to date with what is coming.

As always, I warmly welcome your thoughts, insights, and aspirations for the Institute. Please feel free to contact me directly at **president@icorr.org** - I value every opportunity to hear from our members.

Thank you for your unwavering support and commitment to ICorr. I look forward to meeting many of you at our upcoming gatherings and to continuing our shared mission of advancing corrosion science and engineering worldwide.

With best regards, **Dr Yunnan Gao,**
President, Institute of Corrosion, president@icorr.org

From the Editor

Dear Members,

Welcome to the September–October issue of *Corrosion Management. This issue* is dedicated to the theme of Cathodic Protection (CP)—a technology that has safeguarded infrastructure against corrosion for two centuries and continues to evolve through both scientific research and practical experience.

We have featured a thoughtful contribution from B. S. Wyatt, Past President of ICorr, on *The Role of an Expert Witness*. Himself a CP specialist and drawing on his personal experiences, he offers a candid look at the challenges, responsibilities, and satisfaction of providing expert evidence in technical disputes. It's a perspective many of us will find both relevant and enlightening.

For our major CP Theme, B. Ackland, K. Dylejko, W. Green, and M. Büchler present *200 Years On: Sir Humphry Davy and Cathodic Protection*. This paper revisits the pioneering work of Sir Humphry Davy, whose electrochemical insights in 1824 laid the foundation for CP as we know it. The authors shed light on the historical context, the often-overlooked accuracy of Davy's experiments, and the unfortunate withdrawal of Admiralty support that curtailed further advancements by Davy and his assistant, Michael Faraday. Their contribution is both a celebration of history and a timely reminder of CP's enduring relevance.

Our second technical article by C. M. Stone and G. K. Glass, *A Critical Assessment of the Half-Life Ageing Term: Failure to Predict Future Galvanic Anode Behaviour*. The authors take a close look at the half-life ageing concept, challenging its predictive reliability with long-term data. Their work reminds us that while models and theories are valuable, their true strength lies in rigorous testing against real-world performance.

This issue also includes an important contribution on coatings and fire safety by C J (Chris) Fyfe of our Surface Treatment Governing Board (STGB): *Epoxy Passive Fire Protection over Galvanised Steel*. The article highlights risks in combining galvanising with EPFP systems, pointing to best practices and quality control requirements to ensure durability and life-safety standards are met.

We are always eager to make *Corrosion Management* even more engaging and valuable, and your input plays a vital role in this journey. Whether it's a technical article, a striking corrosion photo for our "Corrosion Around Us" feature, or your insights for "Ask the Expert" or "Fellow's Corner," your contributions help shape the magazine and strengthen the ICorr community. Do please email these to me at my contact address below.

I hope you enjoy this issue, and I look forward to hearing your thoughts and contributions in the issues to come.

With kindest regards,
Dr Shagufta Khan, FICorr
Consulting Editor, editor@icorr.org

CORREX Updates

New Board Members

We are very pleased to welcome Dr Bob Crundwell as a new Member of the Correx board. This was endorsed at the September 2025 Correx Board Meeting.

Bob is, of course, a past president of the Institute of Corrosion, 2010-2012, and has a long history of managing companies geared to corrosion prevention.

Photo: Bob Crundwell.

Construction Skills Certification Scheme, CSCS update

As reported in previous CM issues, CORREX is undergoing a computer change to have a compliant CSCS computer system with a reconfigured database. This has been a long and expensive journey but happily is due to be completed soon. Our go-live date will most likely be at the end of November. At that point we will have a new integrated conforming system fit for purpose for the foreseeable future.

Once we go live, our CSCS card checker found on the CORREX website will no longer work; we will have another checking method that will include an App to gather all essential information automatically. I will make further announcements about this when the date gets closer.

What is the Importance of CSCS and the Accreditation?

ICATS is one of the recognised schemes comparable to an NVQ2 qualification in the UK and contains much more than the basic health and safety requirements of any touch test that other individuals may take. Without the CSCS accreditation, you are simply not allowed onto many sites within the UK, and therefore its importance cannot be overstated. Our recent investment will pay great dividends.

ICATS Trainers and Course Attendees

We have also been making changes to our courses, updating text, photos and questions. This information will be going live over the next few days. As always with the questions, there is always one answer that is more suitable than the rest, a point to remember.

Trainers, do please check the 'trainer info' area in ProProfs before teaching, and you will see exactly what has been changed.

With kind regards

Kevin Harold
CORREX Managing Director | Email: correx@icorr.org

Announcement

BSI - Calling All UK Coatings Experts!

Are you passionate about shaping the future of coatings standards in the energy sector?

The BSI working group PSE/17/67/11 is responsible for developing national standards for coatings and coating-related technologies across the oil and gas and lower-carbon industries. We're currently inviting new members to contribute to the creation of new standards and help finalise documents already in progress.

We're particularly keen to hear from professionals with extensive coatings experience, especially those working within operator organisations. If you're ready to invest your expertise and time to help drive meaningful change in the industry, we'd love to hear from you.

To express interest, please visit BSI's Standards Maker page and complete the application form, including the working group reference PSE/17/67/11 and your CV. Be sure to follow the guidance on submitting personal information. **https://lnkd.in/eRk-3_iF**

An inaugural meeting is planned for the fourth quarter of 2025.If you're unsure whether this opportunity is right for you and would like to discuss it further, feel free to reach out to me directly at **simon.daly@safinah.com**

Let's shape the future of coatings together.

Awards

ICorr CED Announces Professor Damien Féron as the Winner of the 2025 Paul McIntyre Award

The Corrosion Engineering Division (CED) of the Institute of Corrosion is delighted to announce that Professor Damien Féron will receive the Paul McIntyre Award at the 2025 ICorr Annual General Meeting (AGM), to be held at the Henry Royce Institute in Manchester on Tuesday, 4th November 2025.

The Paul McIntyre Award.

The Corrosion Engineering Division (CED) of the Institute of Corrosion is delighted to announce that Professor Damien Féron will receive the Paul McIntyre Award at the 2025 ICorr Annual General Meeting (AGM), to be held at the Henry Royce Institute in Manchester on Tuesday, 4th November 2025.

This Award recognises a distinguished senior corrosion engineer who has demonstrated excellence not only as a leading practitioner in the field but also in fostering European collaboration and advancing international standards. A prestigious award, which includes an engraved trophy with the recipient invited to deliver a short presentation of their professional contributions and encouraged to submit an article for publication in Corrosion Management.

The Paul McIntyre Award is the highest honour presented by ICorr CED. It recognises an individual who has made significant technical contributions - reflecting the values and legacy of the late Professor Paul McIntyre.

Professor Féron has had a distinguished career at the French Alternative Energies and Atomic Energy Commission (CEA) and continues to serve as Scientific Adviser and Professor at INSTN, the National Institute for Nuclear Science and Technology. His work spans nuclear corrosion, marine corrosion, biocorrosion, and long-term prediction of corrosion damage, with wide-ranging applications in both civil and nuclear industries.

A globally recognised leader in corrosion science, Damien has authored or edited more than 25 books and special issues, delivered over 100 invited lectures, and participated in numerous international advisory boards. His international standing is matched by an unwavering commitment to collaborative science - evident in his leadership roles across the European Federation of Corrosion (EFC), where he served as Chairman of the Science and Technology Advisory Committee (2007-2013) and as President from 2017-18, and the World Corrosion Organization (WCO, President from 2019–2022)

Professor Féron was also instrumental in establishing and leading major educational and technical initiatives, such as the Nuclear

Awards

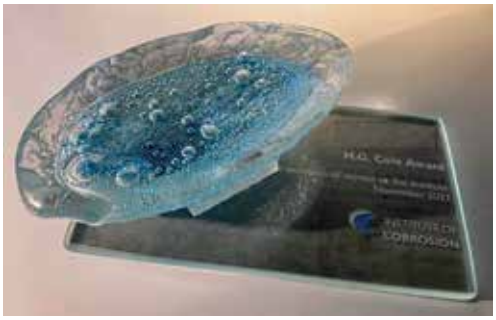
Corrosion Summer School (NuCoSS) and the long-running LTC Workshops on corrosion prediction in nuclear waste systems. Through these and many other efforts, he has mentored a generation of corrosion scientists and engineers across Europe and beyond.

The Paul McIntyre Award is a fitting recognition of Professor Féron's remarkable contributions to corrosion science, education, and international cooperation.

The award will be formally presented during the ICorr AGM in Manchester, jointly hosted by ICorr Northwest Branch and the Henry Royce Institute. Professor Féron will also be invited to contribute an article to *Corrosion Management* magazine.

ICorr Awards Committee Announces former President Brian Wyatt as the Winner of the H G Cole Award

The Institute is delighted to announce that Brian Wyatt will be presented with the H G Cole Award at the 2025 ICorr Annual General Meeting (AGM), which will be held at the Henry Royce Institute in Manchester on Tuesday 4th November.



The H G Cole Award.

The Institute is delighted to announce that Brian Wyatt will be presented with the H G Cole Award at the 2025 ICorr Annual General Meeting (AGM), which will be held at the Henry Royce Institute in Manchester on Tuesday 4th November.

The H G Cole Award is the highest honour that ICorr can bestow on an individual for their contribution to the success of its activities. It is awarded on an infrequent basis for exceptional services to the development of the Institute.

Brian is a long-standing senior figure within ICorr, having served as a Council member for several decades prior to stepping down in 2024.

He was President of the Institute from 1987 to 1989. Very few people have made a more significant contribution to the success and financial sustainability of the Institute over such an extended period of time.

Brian has made important and wide-ranging contributions to the Institute in many areas, but perhaps most significantly in the training and accreditation of cathodic protection (CP) personnel. He was the driving force behind ICorr's CP Training, Assessment and Certification Scheme, which has been instrumental in upskilling and certifying CP technicians, engineers and specialists in compliance with international standards. Brian showed great vision in advocating for the establishment of an in-house CP training offering, which has led to a step-change in revenue streams for the Institute. He has also been influential in establishing hands-on training facilities in support of course delivery, including for marine CP at Blyth and buried CP in Sheffield.

Brian's long-standing commitment to the Institute has been second to none. His passion, energy and vision have made a major contribution to supporting the objectives of the Institute and securing its financial sustainability. The H G Cole Award is fitting recognition of these efforts.

The inaugural H G Cole Award (in the form of a poignard) was presented to Charles Booker in 1997 by Gwen Cole (wife of the late Henry Cole), in recognition of his many years of service as Honorary Secretary of the Institute. The modern form of the award is a plaque whose design captures the essence of the original poignard.

Presentation of the award will take place at the ICorr AGM, which will be jointly hosted by ICorr Northwest Branch and the Henry Royce Institute. The 2025 AGM will be preceded by a series of technical presentations from renowned corrosion professionals in the region. If you would like to attend, please register now.

The H G Cole Award is named after Henry George Cole, who was Chief Materials Engineer at the UK Ministry of Defence and a former ICorr President. For more information on the award, including previous recipients, please go to **https://www.icorr.org/icorr-awards/**

UK-China Corrosion Summit

The very first UK-China Corrosion Summit, jointly organised by the Institute of Corrosion (ICorr) and the Chinese Society for Corrosion and Protection (CSCP), was held in Manchester on 3rd–4th September 2025. The meeting gathered leading academics, practitioners, and industry representatives from both countries under the theme – *'AI Impacts to Corrosion Management within UK-China Energy Industry.'*

Opening and Awards

The summit opened with welcoming remarks from ICorr President Dr Yunnan Gao, CSCP President Professor Xiaogang Li and EFC (European Federation of Corrosion) President, Professor Gareth Hinds, who highlighted the importance of international collaboration in tackling corrosion challenges.

An award ceremony followed when the ICorr President Dr Yunnan Gao presented the following ICorr Institute certificates to the recipients:

- **FICorr Certificates** were presented to newly elected Fellows, Professor Xuequn Cheng and Professor Dake Xu.
- **TICorr Certificate** was presented to newly elected Technician Member, Mr Jianjun Hu.
- **ICorr Scholarship Certificate** was presented to Miss Xinyu Zhang, a Chinese student at the University of Manchester studying for an MSc in Corrosion Control under the Institute scheme.

Photo: ICorr President Dr Yunnan Gao Chairing the Opening Ceremony of the 1st UK-China Corrosion Summit in Manchester on 3rd September 2025.

Photo: The President of EFC, Professor Gareth Hinds, Left, Giving the Opening Remarks During the Opening Ceremony of the 1st UK-China Corrosion Summit.

Photo: ICorr President Dr Yunnan Gao Presenting ICorr Certificate to the Recipient (Deputised by Mrs Jing Fang, ICorr Training Partner, China) During the Opening Ceremony.

Photo: All Delegates of the 1st UK-China Corrosion Summit.

Day One – Technical Presentations

Over the course of the first day, a dense programme featured keynote lectures and technical talks from both UK and Chinese experts tackled frontier topics at the intersection of corrosion science and digital technologies.

Keynotes

- **Prof. Xiaogang Li (China, University Science and Technology Beijing)** introduced the concept of "corrosion big data," demonstrating how multi-scale data mining links microalloying, microstructure, environment, and corrosion rate to design new low-alloy steels with improved resistance.
- **Andrew Duncan & Dan Lester (UK, Intertek CAPCIS)** debated whether AI is a "benefit or threat." Duncan warned against over-reliance on algorithms in early-career training, while Lester argued that AI can reduce errors and improve decision-making when used with oversight.

Technical Presentations

• **Prof. Dake Xu (China, Northeastern University)** explained how extracellular electron transfer drives microbiologically influenced corrosion (MIC). He described biofilm processes at the genetic and interfacial level, and how this understanding can inform MIC-resistant materials and sensors.

• **Dr Henry Tan (UK, Aberdeen University)** presented an AI-enabled framework combining Bayesian decision models with digital twins for subsea pipelines, offering real-time risk-informed maintenance planning.

• **Dr Wei Rong (China, China National Petroleum Corporation)** described novel inhibitors for acidizing operations on non-magnetic steels. Her formulation using quinoline ammonium salt with thiocyanate showed strong performance in high-temperature HCl-HF solutions.

• **Dr Vincenzo Bongiorno (UK, University of Manchester)** demonstrated machine learning for electrochemical impedance and noise data, automating model selection and surface damage classification for coatings and corroding systems.

• **Dr Yu-You Wu (China, Ningo Zhonghe)** highlighted AI-powered inspections of offshore wind turbines, stressing the gap between promising academic results and limited industrial adoption, and calling for UK-China collaboration in this fast-growing sector.

• **Dr Prafull Sharma (UK, CorrosionRADAR)** showed how predictive maintenance for corrosion under insulation can combine remote sensor data with AI analytics to forecast failure likelihood and optimise inspection schedules.

• **Prof. Lingwei Ma (China, University Science and Technology Beijing)** presented a two-stage machine learning approach linking environmental factors, physical properties, and coating performance. The method improved prediction accuracy for degradation across diverse climates.

• **Dr Yifeng Zhang (UK, Imperial College London)** outlined a hybrid inspection framework using reconfigurable sensors and robotics. His model improves detection reliability while reducing inspection frequency and cost.

• **Mr Xinpeng Lu (China, Shenzhen Coais Technology)** described how AI agent technology can support corrosion integrity management. His system employs multi-agent data collection and reinforcement learning to enhance anomaly detection and optimise maintenance.

• **Dr Kevin McDonald (UK, Sonomatic)** shared early applications of machine learning on ultrasonic inspection signals. His case studies showed potential efficiency gains in data classification and highlighted barriers such as dataset balance and industry acceptance.

The day concluded with an open forum, where speakers and delegates from both sides reflected on key themes. Discussions focused on the importance of high-quality data, the challenges of model transparency and interpretability, and the need for international collaboration to harmonise standards for AI-driven corrosion tools.

Photo: Andrew Duncan of Intertek CAPCIS Giving the UK Keynote Speech on Is Artificial Intelligence A Benefit or A Threat to Materials and Corrosion Engineering?

Photo: Session Chair, Professor Bowei Zhang of CSCP, Left, Presenting the Certificate of Appreciation to the Presenter of the Technical Presentation (Dr Henry Tan).

Day Two - Visits and Engagement

The second day of the summit, 4th September 2025, was dedicated to institutional and industrial visits for the Chinese delegation with ICorr Training Partners.

Photo: L-R, CSCP General Secretary Professor Xuequn Cheng, ICorr President Dr Yunnan Gao and EFC President Professor Gareth Hinds at the Closing Ceremony of the Day One Conference of the 1st UK-China Corrosion Summit.

In the morning, at the University of Manchester, delegates toured laboratories in corrosion and materials science, including imaging and advanced characterisation facilities. The visit highlighted the university's ongoing work in combining experimental and digital approaches.

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In the afternoon of 4th September 2025, the delegation travelled to Sheffield to visit Argyll Ruane, where they were given demonstrations in coating science, coating inspection, and non-destructive testing training - areas where ICorr certification and industry practice intersect closely.

Photo: One of the Four Groups of the China Delegation Visiting the Materials Laboratories of the University of Manchester on 4th September 2025.

Photo: China Delegation Visiting the Premises of Argyll Ruane (ICorr Training Partner, UK) in Sheffield.

Conclusion

The inaugural UK-China Corrosion Summit successfully combined technical exchange with academic, industrial, and training engagement. By bringing together researchers, students, and industry practitioners from both countries, the event created a platform for knowledge sharing and laid the groundwork for continued collaboration between the corrosion communities of the UK and China.

Appreciation and Future Plan

ICorr extends its sincere thanks to the summit's UK sponsors: exclusive Platinum Sponsor **Argyll Ruane**, Silver Sponsor - **ICR Integrity**, and Bronze Sponsors - **Beasy, Corrodere,** and **Corrpro Europe**, whose support made this whole event possible.

We now look forward to the 2nd China-UK Corrosion Summit, to be hosted in China in 2026, continuing the spirit of collaboration and knowledge exchange established so well in Manchester.

ICorr Member & Branch Updates

We are very sad to report in this issue the passing of two of our most valued former members.

Obituary

In Memoriam: Dr Desmond (Des) Barker

Photo: Desmond Barker Pictured with His Wife Valerie.

It is with deep respect and admiration that we remember Dr Desmond (Des) Barker, a dedicated professional member of the Institute of Corrosion for over 20 years. Dr Barker served as Principal Lecturer in Corrosion Science at Portsmouth Polytechnic, then University, throughout the 1970s, 80s, and 90s, where he taught corrosion as part of the Applied Chemistry course. His enthusiasm for the subject inspired countless students, many of whom became members of the Institute thanks to his engaging and passionate teaching. His lecturing in corrosion science, a continually evolving discipline, brought to life this subject for his students, leaving a lasting impact on generations of professionals.

Dr Barker was widely respected for his commitment to academic excellence and his ability to connect real-world applications with theoretical knowledge. While lecturing, he also contributed to the conservation of the Mary Rose, involving several final-year students in related projects. After retiring, he continued to support the Mary Rose Trust and lent his expertise to the preservation of HMS Warrior and the Submarine Museum in Gosport. He was also a keen tennis player; Des had been a member of The Avenue Club in Havant since 1981.

He also supported the artefact conservation course run by Southampton University, delivering lectures at Portsmouth Dockyard and sharing his deep knowledge with students and professionals alike. Known simply as "Des" to colleagues, students, and friends, he was admired not only for his professional achievements but also for his humility, warmth, humour, and unwavering dedication to corrosion control and education.

Desmond Barker MICorr joined our Institute many years back in December 1969 and remained a professional member until 2007. His legacy lives on in the many lives he touched—as a teacher, mentor, and friend.

Compiled: George Winning (Treasurer)

Obituary

Obituary- Dr Vic Ashworth

Dr Vic Ashworth died unexpectedly on 22nd July 2025 whilst walking near his home in Spain. The sad news spread around the international corrosion community, prompting numerous tributes. Bop Phull's response from the USA that Vic… *"was a quiet and unassuming man with a wealth of experience"* typifies the sentiments expressed by many.

Vic was born in Stockton-on-Tees on 24th July 1937. Named after his father, he was always "Vic", never "Victor". His family soon moved to Middlesex where he spent his childhood and early life. He later spoke little of his schooldays. Although, perhaps surprisingly even to those who knew him well, he played rugby as a wing three-quarter for Middlesex Schools.

Despite being destined to build a reputation in academic research and teaching, he did not follow the conventional undergraduate route. Instead, he left school at 16 and joined Johnson-Matthey in Watford as a laboratory chemist. He took the hard route to qualification, spending many long evenings working his way through the wide-ranging Royal Institute of Chemistry syllabus, achieving the Licentiate qualification in 1961. The self-discipline needed to master a subject by this onerous route manifested itself later in his precise and lucid lecturing style. Not one to settle for a comfortable life at the laboratory bench, he moved to the Department of Metallurgy at Nottingham University in 1967 to carry out CEGB-sponsored research under the supervision of Dr Peter Boden. He was awarded his PhD in1970. Then in January 1971 he moved to Manchester where Prof. T.K. (Ken) Ross recruited him to the corrosion research group in the Chemical Engineering Department at UMIST. In April of that year, UMIST's corrosion activities were formally consolidated in the new Corrosion and Protection Centre headed by Prof. Graham Wood, the UK's first Professor of Corrosion. Vic, Robin Procter and David Miller also joined the Centre as part of the inaugural academic staff, and were joined in the early days by John Dawson, Tony Richardson, Peter Elliott, Howard Stott and David Scantlebury. George Thompson and Bob Cottis had also augmented the teaching staff by the time he left. Vic delivered the pivotal 20-lecture "Principles of Corrosion" introduction to the flagship MSc course "Corrosion Science and Engineering." His talent for communicating complex electrochemical concepts to students, many with non-chemistry backgrounds, made him an outstanding lecturer, then Senior Lecturer and Reader. His growing reputation also inevitably brought conference invitations; further enhancing his international standing as a corrosion communicator.

His research interests at UMIST were wide ranging and innovative. With Robin Procter and Bill Grant (of Salford University) he studied the corrosion effects of surface modification by ion implantation. Some of this work also crossed into his research on cathodic protection where he collaborated with David Scantlebury, and with industrial sponsors including, among many, Chuck Schreiber, Brian Wyatt and Bob Crundwell. His publications on CP remain much cited. Other areas of research included pitting mechanisms in titanium with Peter Gilbert of IMI and corrosion of concrete reinforcement. He also continued Prof. Ross's seminal 1960's research on corrosion under heat and mass transfer, work which also contributed to his CP oeuvre.

A cadre of UK and international research students benefited from his astute supervision. Always helpful and constructive, he gave generously of his time. His opinions on less-than-competent thesis drafts were invariably delivered with his characteristic wicked dry sense of humour. It is little surprise that many of his students remained life-long friends.In addition to a full programme of teaching, research and sharing the Centre's administration workload as Admissions Tutor, Vic was also increasingly involved in consultancy work. He formed a consulting partnership with Robin Procter and also contributed to the setting up and early activities of the Corrosion and Protection Centre Industrial Services (CAPCIS – later Intertek CAPCIS).

Photo: Dr Vic Ashworth.

Dr Ashworth joined the Institute of Corrosion in 1972 as fellow. He had been member till 2005.

His direction of travel changed in 1983. He left UMIST and, after short-term visiting positions at the Universities of Monash (Australia) and Bucaramanga (Columbia), he joined the nascent Global Corrosion Consultants in Telford (UK) in 1984. There, together with Robin Jacob and Chris Googan, he participated in the management buy-out of the company in 1985.

His move from academia into industry enabled him to capitalise on his corrosion experience, and occasionally to exercise the innovative faculties he developed in his research work, albeit that he was now serving clients who discouraged publication. For example, he was instrumental in developing corrosion risk assessment for an offshore hydrocarbon production facility and an onshore petrochemical complex in the late 1980's. This was over a decade before the concept of risk-based inspection was enshrined in codes such as API 580. Later, he and Robin Jacob pioneered the practical use of potential-limited sacrificial anodes to mitigate hydrogen cracking problems in offshore jack-up drilling rigs. His attention to detail during on-site investigations was notable, even extending to donning a boiler suit and entering a soot filled reaction column little wider than himself and climbing to the top.He travelled internationally even more than he had as an academic. But now, rather than being hosted in universities and conference centres, he was more likely to find himself in a hot and dusty industrial facility. For example, he was in Libya in 1986 when the Americans bombed, and in Baghdad on the night two years later when the Iran-Iraq war ended. He observed with characteristic wryness that it was a lot noisier in a country when a war ended than when one kicked off!

Vic, Robin and Chris remained at Global until its pre-planned closure in 2001. Vic then transitioned into retirement. He and his wife Basma moved to a farmhouse in Cornwall in 2002, where Vic particularly enjoyed cliff top walks with Basma and their dogs. They also developed a liking for rail travel, journeying entirely by rail from Cornwall to Syria and back in 2009; and then enjoying lengthy rail tours annually until the pandemic. Even into his 80's he retained both his interest in corrosion and his penetrating mind. Bijan Kermani and Don Harrop acknowledged this in their 2019 book: thanking him for his meticulous review of every chapter and his *"significant and valuable comments"*.

In 2020 Vic and Basma relocated to Nerja in Spain. He embraced the new life, staying active, walking his dogs every day, and relishing the challenge of learning a new language. One of life's true gentlemen, he is survived by Basma, his daughters Katie and Sammy and six grandchildren. His son Stephen died in 2021.

Compiled: Dr Chris Googan and Prof. Robin Procter

ICorr Branch Updates

ICorr Aberdeen Annual Corrosion Forum (ACF) - 2025

The following is provided as a supplement to the shortened web and social media posting of 03/09/2025 - https://www.icorr.org/2025-aberdeen-annual-corrosion-forum-acf/

On **26th August 2025** the Aberdeen Branch again successfully held its annual corrosion awareness event at the Palm Court Hotel with **key sponsor** AUTOMA.

Main Photo: Aberdeen ACF 2025 - Attendees, Speakers and Sponsors.

The Aberdeen branch has been active for more than 40 years now and has been providing awareness training since before 2010 through generous industry support and a dedicated committee.

This year's Forum was kindly sponsored by AUTOMA of Italy, specialists in automated monitoring, and themed on Cathodic Protection (CP).

AUTOMA provided the venue and all catering for the day.

Introductory talks on the principles and costs of corrosion were followed by a series of talks explaining cathodic protection principles, methods and anode manufacture. Thereafter, some excellent case studies presented some recent cathodic protection applications in order to raise awareness of some of the practical considerations, such as electrical isolation from the plant, electrical interference and fault-finding methods for CP system commissioning.

Photo 2: Aberdeen ACF 2025 – ICorr President Dr Yunnan Gao giving the Introduction of ICorr Global Activities.

Yunnan is a Chartered Lead Corrosion Engineer with nearly 20 years of experience in the oil and gas industry. His presentation discussed:

- The recent expansion of ICorr's operations over the last 3 years.
- 2 New Branches in the UK at Grangemouth and Port Talbot.
- 2 New Branches overseas in In India and the UAE.
- A New Branch opening soon in China.
- A Profile of the current ICorr membership.

The afternoon sessions continued with several presentations by the sponsor AUTOMA on advanced CP system monitoring and AI-assisted data management and analysis. AUTOMA then provided some excellent demonstrations of their devices and their software, both widely used within Europe.

This popular annual in-person event attracted 43 registrants, including many from its 16 local sponsor companies and also from our ICorr national sustaining companies. There were some excellent networking opportunities throughout the day.

Proceedings will be posted to the Aberdeen branch web page in due course at **https://www.icorr.org/aberdeen/** 'Local Technical Programme'.

The Aberdeen ICorr Committee expresses its immense gratitude to all attendees, speakers, sponsors and particularly to its event chairs – Eilidh MacDonald/Stephanie Okoye and to Fatemeh Faraji, the ABZ Events Coordinator.

Photo 3: Aberdeen ACF 2025 – Stephanie Okoye (Vysus) Presenting on the Principles of Corrosion.

Stephanie is a Chartered Lead Corrosion Engineer with nearly 20 years of experience in the oil and gas industry. Her presentation discussed:

- The Fundamentals of corrosion and electrochemistry.
- Common corrosion mechanisms.
- Corrosion control and management.

Photo 4: Aberdeen ACF 2025 – Eilidh MacDonald (Subsea 7) Presenting on the Topic "Costs of Corrosion", (Presentation Supported by Izabela Gajewska).

Eilidh is an ICorr YEP Graduate (2022), a Coatings and Corrosion Engineer, and also ICorr Aberdeen Branch Vice Chair. Her presentation discussed:

- UK parliamentary and science committee representations.
- Additional material on costs and practical difficulties of Subsea CP installations.

Photo 5: Aberdeen ACF 2025 – Nigel Owen Presenting on the Topic "Principles and Applications of CP", (Nigel also Presented on Anode Manufacture).

Nigel is a Manager - Sales and Technical at Aberdeen Foundries with 38 Years of Industry Experience. His presentation discussed:

- The principles and selection of a CP system.
- The pros and cons of Sacrificial and Impressed current systems.
- Anode manufacture.

Photo 6: Aberdeen ACF 2025 – Guest Speaker Zaynah Khalil of Balfour Beatty Presenting on the Edinburgh North Bridge CP (in Concrete) Project.

Zaynah recently graduated with a Master of Engineering – MEng (with First Class Honours), in Civil Engineering, from the University of Glasgow. Her presentation raised:

- Awareness of **some of the issues** that may arise when applying Cathodic Protection to bridges.

Photo 7: Aberdeen ACF 2025 – Stephen Tate (Immediate Past President) Presenting on Issues with CP Scheme Electrical Isolation.

Stephen is a Long-Standing, ICorr - Aberdeen Committee Member with over 40 years of experience in the Energy sector. His presentation raised:

- Awareness of **some of the issues** that may arise when applying Cathodic Protection to buried pipelines.
- Loss of electrical isolation.
- External interference sources.
- Investigative methods for CP system commissioning.

Photo 8: Aberdeen ACF 2025 – Ashokan Gopal - ICorr CP Specialist - Level 4 Presenting on ICorr Training Solutions – Cathodic Protection Course Options.

Ashokan is an ICorr CP Specialist - Level 4 and Tutor. His presentation discussed:

- Different course levels available and requirements.
- Career progression.
- Available tutors at ICorr's Sheffield and Telford training sites.

Photo 9: Aberdeen ACF 2025 – Guest Speaker Ivano Magnifico of AUTOMA Presenting on the Topic "Advanced Remote Automated CP Monitoring", (and also Spoke on the GIANT, (Gas Integrated and Automated Network Technology) Project.

Ivano is a Cathodic Protection Specialist (Level 4T), Remote Monitoring and Polarisation Coupon Expert. His presentation raised:

- Awareness of **the possibilities of deploying advanced monitoring** when applying Cathodic Protection to buried pipelines.

All speakers were presented with certificates of appreciation by the ICorr President and Branch Vice Chair – Eilidh MacDonald.As is normal, all Attendees were provided with an opportunity to request CPD towards their EngC and API qualifications.

Please contact **icorrabz@gmail.com** if you have any queries at all or if you wish to join its committee. The branch AGM will be held on **28th October 2025.**

ICorr Central Scotland Updates

Photo: Stuart McKay of CSNRI Composites presenting on Pipework Repairs.

ICorr Central Scotland Branch (which holds its meetings at INEOS Grangemouth) closed out its 2024/2025 technical programme in July 2025 with an excellent presentation from Stuart McKay, Engineering Manager for Europe and Middle East at CSNRI's Composites Division.

The presentation, given on the topic "Composite Repairs for Pipework – Standard and Advanced", attracted interest from members across industry. Stuart, a member of the ISO working committee for Engineered Composite Repairs, gave a compelling talk on the challenges of designing composite repairs to comply with and exceed requirements in international standards ISO 24817 and ASME PCC-2. He showed how additional design factors can be incorporated in complex design cases to ensure these engineered composite repairs can provide robust pressure containment on pipework over long periods.

Future Events

The Branch will commence the **2025/2026 technical events series** in October 2025. This hiatus is occasioned by the turnaround season in the petrochemicals sector.

The first technical meeting will be on **29th October 2025.**

New speakers are always welcome – please contact the branch with your abstract and presentation topic via **cschair@icorr.org**

ICorr India Updates

ICorr India hosted an online technical event on 15th September 2025, on the topic "Guarding Against Corrosion: Best Practices for Reinforced Concrete Design and Maintenance."

Photo: Dr S R Karade.

This talk was delivered by Dr S. R. Karade (pictured right), former Chief Scientist and Head of the Advanced Concrete, Steel and Composites Group at CSIR-CBRI, Roorkee, and Professor at AcSIR, who holds an MTech from MACT (NIT) Bhopal (1994) and a PhD from Brunel University, UK (2003).

Joining CSIR-CBRI in 1998, he has contributed to the development of alternative materials, composites, structural rehabilitation, and corrosion control. and has delivered 100+ publications, 2 patents, and 8 commercialised technologies. A past recipient of various awards including National Corrosion Council of India (NCCI) Meritorious and NACE best papers, Dr Karade continues to lecture and mentor MTech/PhD students. He chairs BIS CED 41, is past President of the International Symposium on Corrosion and Materials Science (ISCMS) (2022–25) and serves on multiple editorial boards. The following is a synopsis of the talk:

Corrosion of steel rebars is a critical durability issue for reinforced concrete structures, significantly affecting their lifespan and structural integrity. As construction practices evolve with the introduction of newer materials and techniques, the challenge of mitigating corrosion becomes increasingly complex, especially when compounded by use of untrained manpower with little experience of quality control procedures. To address these concerns, this comprehensive webinar focussed on the causes of corrosion and proposed effective strategies for prevention.

Participants learnt about the critical importance of implementing protective measures during the initial stages of construction. This includes selecting appropriate materials, ensuring proper mixing and curing processes, and adhering to best practices in design.

Additionally, this webinar explored advanced electrochemical techniques, such as cathodic protection, which can effectively combat corrosion in existing structures.

By understanding these methods and their application, professionals can enhance the durability of reinforced concrete, ultimately leading to safer and more resilient infrastructure. Attendees gained valuable insights and practical knowledge aimed at safeguarding against corrosion in reinforced concrete design and maintenance.

Future Events

You can stay updated on ICorr India activities and programmes by following us on LinkedIn **https://www.linkedin.com/in/institute-of-corrosion-india-branch-india-branch-ab3003379/ and also at: https://www.icorr.org/events/**

If you, or someone you know, would like to join the ICorr India Branch and mailing group to receive event communications, or if you have any queries regarding branch affairs, please contact us at: **INDIAchair@icorr.org**

ICorr Midlands Updates

During August and September 2025, ICorr Midlands delivered a vibrant mix of members engagement and strategic planning, including a successful webinar, preparations for upcoming events, and active participation in the joint ICorr summit with Chinese Society for Corrosion and Protection Society (CSCP), in Manchester.

Date	Activity
21st August 2025	Webinar held on AI-Powered Corrosion Mapping on Ships Link to recording: **https://www.youtube.com/watch?v=_yVXQBMWuxo&t=216s**
3rd September 2025	Participation in UK–China Corrosion Summit at Manchester University; Dr. Prafull Sharma presented article: *"Convergence of Predictive Maintenance, Remote Monitoring and AI: Case of Corrosion Under Insulation"*
9th October 2025	Advancing Subsea Pipeline Corrosion Inspection: Current Capabilities and Future Needs
Latter events will be reported in next issue of the Magazine.	

Webinar on AI-Powered Corrosion Mapping on Ships

ICorr Midlands branch hosted a webinar titled "AI-Powered Corrosion Mapping on Ships" featuring guest speaker Leroy Dias, founder of 'Steel Corr' and developer of the Digital Paint Report (DPR)© app. During the session, Dias introduced the cloud-based, AI-driven DPR tool, which analyses uploaded hull images using machine learning (ML) to detect coating breakdown, grade corrosion severity, and to monitor trends over time.

The presentation highlighted how DPR is already in use on over 500 ships worldwide, offering an intuitive dashboard that transforms conventional, labour-intensive visual surveys into proactive, efficient maintenance planning for ship owners/ managers.

The webinar concluded with an engaging Q&A session, underlining ICorr Midlands' focus on digital innovation in corrosion management.

Photos: Extracts from the Steel Corr presentation, illustrating AI capabilities for detecting coating damage on ship decks, as showcased in the ICorr Midlands Webinar of 21st August 2025.

UK–China Corrosion Summit

Dr. Prafull Sharma, Committee Chair, attended the UK–China Corrosion Summit in Manchester, where he presented the article: "Convergence of Predictive Maintenance, Remote Monitoring and AI: Case of Corrosion Under Insulation" to an audience of over 60 registrants many of whom were engaged in the energy and process industries globally. This successful engagement underscores ICorr Midlands' commitment to raise awareness of recent advances in corrosion management technologies.

Other Highlights

- Committee Meeting - A strategic gathering was held in early September 2025 to review the branch's upcoming events, future topics of interest, membership engagement, and operational priorities.
- Webinar - This webinar included an introduction to state-of-the-art and future trends in the corrosion inspection of subsea pipelines. The webinar "Advancing Subsea Pipeline Corrosion Inspection: Current Capabilities and Future Needs" was conducted on **9th October 2025.**

ICorr North- West Updates

Looking Ahead - ICorr AGM 2025 in Manchester!

The Institute of Corrosion's Annual General Meeting (AGM) 2025 promises to be an inspiring day of learning and networking. This year, AGM will be hosted by the ICorr Northwest Branch in collaboration with the Henry Royce Institute at the University of Manchester.

Before the AGM begins, attendees will enjoy a special technical presentation, setting the stage for an afternoon packed with knowledge sharing, fresh insights, and professional engagement. It's the perfect occasion for corrosion and materials science professionals to gather, exchange ideas, and discuss the future of both our industry and the institute.

Whether you are an ICorr member or new to the community, everyone is welcome, and attendance is completely free of charge.

Date: Tuesday, 4th November 2025

Time: 12:30 – 17:00

Venue: Henry Royce Institute, University of Manchester, M13 9SS

Join us for an afternoon that combines technical expertise, networking, and forward-looking discussion in one of the UK's most prestigious research environments.

Technical Presentations

Prof. Fabio Scenini: Fabio (Professor in Materials Performance, Dept. Materials, University of Manchester) will present an overview of the world-class equipment, infrastructure, training and outreach that Royce offers, explaining how Royce supports the UK materials community to develop solutions to national and global material challenges.

Photo: Fabio Scenini.

Photo: Steve Hodges.

Steve Hodges: Steve has extensive experience in the fields of oil and gas and, more recently, materials selection for catalysed chemical process technologies. He will reflect upon his experience of MS4DE and how different industries adopt varying strategies to address the challenge.

Beatriz Mingo: Beatriz (Senior Lecturer in Corrosion Science at the University of Manchester) will present a piece of research conducted using Royce facilities and expertise titled "Fibrous silica sealing post-treatments for Plasma Electrolytic Oxidation coatings".

Andrew Piercy: Andrew (Principal Engineer, Intertek CAPSIS), with over 36 years' experience of corrosion and metallurgical failure investigations and testing, will present a failure analysis from the Kashagan oil field in Kazakhstan, one of the sourest oil fields on the planet, involving cracked carbon steel piping.

Photo: Andrew Piercy.

If you have any special requirements such as accessibility needs or dietary preferences, please contact the ICorr North-West Branch at **nwchair@icorr.org** prior to the event, so that appropriate arrangements can be made.

Those wishing to attend, please register at: **https://www.eventbrite.com/e/institute-of-corrosion-2025-agm-and-ms4de-techical-session-tickets-1689501667969?utm-campaign=social&utm-content=attendeeshare&utm-medium=discovery&utm-term=listing&utm-source=cp&aff=ebdsshcopyurl**

Note: Only ICorr Members may vote at AGM.

ICorr Wales and South-West Branch Hosts Chartership Briefing in Plymouth

On Thursday 18th September 2025, the Wales and South-West Branch of the Institution of Corrosion (ICorr), in collaboration with the Institution of Chemical Engineers (IChemE), hosted its first Chartered breakfast briefing in Plymouth. The event focused on all aspects of becoming Chartered, offering engineers and academics valuable insights into the process.

As the day began, attendees were welcomed with a selection of bacon butties, fresh croissants, and hot coffee—setting the tone for a relaxed yet informative morning. The session was tailored for professionals across chemical, biochemical, process, and corrosion engineering disciplines, offering a clear and practical roadmap toward achieving Chartered status.

Delegates heard directly from Chartered professionals who shared their personal experiences and provided practical advice on navigating the application process. The discussion covered how to effectively demonstrate professional competence, what assessors look for, and how to avoid common challenges.

A key highlight of the morning was the announcement of a major milestone for ICorr: the institution was officially awarded its direct licence from the Engineering Council in July from May 2025. This means ICorr can now assess and recommend candidates for professional registration without the need for external sponsorship. This achievement represents a significant step forward for the corrosion engineering community, solidifying ICorr's position as an independent, fully licensed professional body with the authority to support and guide its members through the registration process.

Photo: Meurig Lennon-Lloyd (IChemE) and Sarah Bagnall (ICorr Wales and South-West Branch).

Whether attendees were recent graduates planning their next move, experienced engineers mentoring colleagues, or academics seeking professional recognition, the message was consistent and clear: there has never been a better time to start—or continue—your journey toward Chartered status.

The branch is currently arranging events to take place from November to May; details to follow soon. For further information or if you are interested in attending future events, please contact swchair@icorr.org. You can also keep up to date on events by visiting our LinkedIn page: https://www.linkedin.com/groups/12992293/.

Relaunch - ICorr Yorkshire and Humber Branch

The Yorkshire and Humber branch committee has been making plans for the relaunch event and branch AGM at the University of Leeds. We have confirmed a date of **19th November 2025**, and the theme of the technical talks will be on corrosion challenges of additively manufactured materials. It will run from 12:00 pm - 5:00 pm. **This event will be advertised on: Events for November 2025 – Institute of Corrosion in due course and members will be notified.**

Other Highlights

During the day, we will have a presentation from Yogi Pardhi, Global Head of Additive Manufacturing (AM) at Sulzer, and researchers at the University of Leeds. Dr Yogi Pardhi is a respected Fellow of The Institute of Materials, Minerals, and Mining with over 12 years' aerospace and turbomachinery industry experience. He holds a first degree in mechanical engineering and a Ph.D. in materials science, specialising in high-temperature and high-performance materials alongside additive manufacturing. Dr Pardhi's global outlook drives Sulzer's successful qualification strategy for additive manufacturing techniques. He has also overseen the manufacture and repair of industrial gas turbines and turbomachinery parts. As AM Lead for Materials at Rolls-Royce Plc, his expertise helped introduce AM parts in aeroengines and establish a landmark single crystal turbine blade facility.

Photo: Yogi Pardhi, Global Head of Additive Manufacturing at Sulzer.

We also plan to have flash presentations from industry members in the region to showcase the corrosion activities within the Yorkshire and Humber region.

If you are interested in presenting or have any other queries at all, please email: **yorkshirechair@icorr.org**

YICorr Update

The Young ICorr Committee is now officially up and running – and we've hit the ground sprinting!

Mentorship Scheme

Our brand-new mentorship scheme is all set to go. Please visit the website to register your interest and get matched with a mentor/mentee and follow our structured programme to develop your career.

Young ICorr Mentorship Scheme - Institute of Corrosion.

Young Engineers Programme 2026

Plans for our Young Engineers Programme are shaping up brilliantly. The venue has been set, the session plan is finished and we are now accepting applications, please visit the ICorr website to apply.

Application forms can be downloaded from the Young Engineers Programme area of the ICorr Website **https://www.icorr.org/young-engineer-training-programme/** and sent to **Youngicorrchair@icorr.org**

Awards and End-of-Year Celebration

We're cooking up an end-of-year event with a difference – including new awards to celebrate the achievements and innovations of our Young ICorr members.

Social

We held an exciting social event on the **16th October 2025** at the Northern Monk at 10 Tariff St, Manchester M1 2FF.

The committee's energy and ideas are in full flow, and the new session 2025-2026 is set to be an exciting year for Young ICorr.

Get in touch: Kathy Purnell (Chair),
Email: youngicorrchair@icorr.org

The Young Engineers' Programme 2026

The Institute of Corrosion (ICorr) will be running the Young Engineers' Programme (YEP) from January to November 2026, in Manchester, UK.

What is YEP?

YEP is a long-established ICorr training programme designed to deliver key topics related to the world of corrosion engineering. Monthly lectures are given by a field of experts delivering a corrosion-focussed curriculum of the following topics:

- Fundamentals of Corrosion
- Materials Selection & Integrity Management
- Plant Chemistry
- Welding
- Coatings & Linings
- Corrosion Under Insulation
- Cathodic Protection
- Failure Investigation

In addition to the technical curriculum, candidates will be grouped into teams and challenged to solve a real-life failure case study. Each team, guided by an experienced mentor, will investigate the cause of the failure and recommend potential solutions. Their findings will be presented at the grand finale to a panel of judges and an audience of peers.

The judges will choose a winning team who will be rewarded with a trip to the AMPP Annual Conference and Expo in 2027, which will be in Colombus Ohio. Additionally, one standout participant, who demonstrates exceptional commitment and leadership skills, will also receive a sponsored trip to AMPP.

How to Get Involved

Candidates

YEP is designed for early-career corrosion scientists and engineers, typically within the first five years of working in a corrosion-related field, who are eager to expand their knowledge and skillset.

The in-person sessions will take place monthly in Manchester from January to November 2026. The programme is open to all; you do not need to be a member of ICorr to apply. While participation is welcome from across the UK and internationally, candidates (or their employers) are responsible for travel and accommodation costs for the in-person sessions.

Testimonies from past participants:

"Through the YEP, I gained access to industry insights, professional development, and a network that genuinely wants to see you succeed." ***Ben Hudson, YEP 2024 Participant***

"The YEP allowed me to research and understand both broad and very specific areas of corrosion, giving me confidence as a mechanical engineer in a field I did not know well previously."
Georgie Bond, YEP 2024 Participant

"Each aspect of this journey has afforded many networking opportunities to better integrate me as an individual in the asset integrity industry and develop professional relationships and rapports with subject matter experts in the fields of asset integrity."
Christopher Slater, YEP 2022 Participant

"Thank you so much to ICorr and to BP for the opportunity to attend the AMPP Leadership course and Conference, I am incredibly grateful." ***Eilidh Macdonald, YEP 2022 Participant***

"After completing my PhD, the Young Engineers Programme was a valuable opportunity to bridge the gap between academic research and industry practice, offering real-world insight into corrosion challenges and meaningful networking through the case study." ***Josh Owen, YEP 2020 Participant***

"The YEP helped me grow my network and connect with industry experts. It also opened the door for deeper involvement with ICorr, leading to roles on various committees, including Chairing Young ICorr and the Corrosion Engineering Division."
Danny Burkle, YEP 2018 Participant

YEP

Application forms can be downloaded from the Young Engineers Programme area of the ICorr Website https://**www.icorr.org/young-engineer-training-programme/** and sent to **Youngicorrchair@icorr.org**

Sponsors

The Young Engineers' Programme plays a vital role in developing the next generation of corrosion professionals. Beyond technical training, YEP fosters industry connections, peer collaboration, and a strong sense of community, which is important for people at the start of their careers, as well as for experienced members of ICorr.

The programme is made possible through the generous support of sponsors. A range of sponsorship packages are available, offering promotional opportunities and the chance to support the future of corrosion engineering. If you or your organisation would like to get involved, please contact us to learn more.

Tier	Sponsor Type	What You Sponsor	What You Receive
Tier 1	**Main Sponsor – Programme Partner**	Funding YEP winners to attend AMPP 2027 in the USA	- Prominent logo placement on all YEP materials and presentations - Logo and write up feature in Corrosion Management journal - Brand mention in all YEP communications and CMJ entries - Advertisement in the YEP area of the ICorr Website - Recognition at the Final Ceremony and Opening Night - Opportunity to include branded materials or giveaways - Acknowledgment in all programme-related CPD certificates - Opportunity to speak at the Opening Ceremony - Option to provide a technical lecture (subject to approval) - Social media and newsletter highlights throughout the year - Logo on completion and winner certificates - Invitation to the Final Judging Panel - One fully-funded candidate space in the programme (subject to application criteria)
Tier 2	**Supporting Sponsor – Operations Partner**	Programme running costs: expenses, materials, etc.	-Prominent logo placement on all YEP materials and presentations -Logo and write up feature in Corrosion Management journal - Brand advertisement in the YEP area of the ICorr website - Brand mention in all YEP communications & CMJ entries - Recognition at the Final Ceremony and Opening Night - Priority inclusion in YEP promotional events and press - Acknowledgment in all programme-related CPD certificates
Tier 3a	**AMPP Entry Sponsor**	Entry fee support for YEP winners to attend AMPP	- All exposure benefits of Tier 1 (excluding candidate place) - Gratitude mention during the AMPP trip coverage - Logo on winner travel documentation and pre-trip briefing pack - Logo on winner certificates
Tier 3b	**Venue Sponsor – Lecture Host**	Venue and hospitality for Monthly lecture	- Recognition during the session you host - Logo on presentation slides for lectures - Option to provide a short welcome at sessions - Acknowledgment in programme materials and journal
Tier 4	**Opening Ceremony Sponsor**	Venue and hospitality for YEP 2024 launch	- Logo in *Corrosion Management* journal for entry related to opening - Mention during the opening ceremony - Opportunity to network with young engineers and speakers - Option to display materials at the venue
Tier 5	**Finale Sponsor – Closing Event Host**	YEP 2024 final case study presentation evening	- Logo in *Corrosion Management* journal for entry related to finale - Exposure to 50–60 industry attendees - Mention in closing remarks - Opportunity to network with judges, mentors, and finalists

YEP Diary

Rosie Bird – AMPP25 Participant

Graduate Mechanical Engineer | Co-Chair of Harbour Energy STEM Network, Aberdeen

My journey with the Young Engineers Programme (YEP) began in 2022, marking the start of a rewarding experience. It included invaluable monthly lectures and a group case study project on the corrosion management of mature offshore platform facilities, inclusive of the opportunity to develop a subsea tieback with sour service impact. This experience broadened my network, expanded my comfort zone, and enhanced my teamwork and presentation skills. A key highlight of the programme was witnessing the growth of myself and my team and seeing us flourish as all our collective hard work came together on the presentation evening. The prize for the winning team at the presentation evening was a trip to the AMPP (Association for Materials Protection and Performance) Conference and Expo, which is a premier event for professionals in the field of corrosion and materials protection. I was unfortunate to miss the 2023 AMPP Event in Denver due the Covid pandemic and my personal travel restrictions at that time.

Conference

My key focus for the 2025 AMPP Conference and Expo, in Nashville, was to expand my knowledge of asset integrity and gain a broader understanding of innovative topics, such as using artificial intelligence for optimising the analysis of corrosion, digital twins for corrosion modelling and degradation mechanisms of additively manufactured metals. The bar was set high by the keynote opening presentation given by Michael Massimino, a former NASA astronaut. His insights on teamwork and resilience were truly inspiring. Following this, I attended a series of presentations throughout the week, ranging from generic topics to technical research papers. A technical highlight focused on the effect of galvanised bolts on external crevice corrosion on SS316 gaskets. The study provided a comprehensive overview of duplex flange assemblies that originally used hot-dipped galvanised (HDG) carbon steel. These bolts corroded quickly, prompting an upgrade to corrosion-resistant alloy 25% Cr bolts. However, this change led to the initiation of crevice corrosion on the seal face between the 316 stainless steel gasket and flange. The study included a field inspection of over five thousand flanges, providing a robust dataset for analysis and to support the root cause. Some corrosion was also identified on 6Mo gaskets, highlighting the complexity of corrosion mechanisms in different materials. The role of zinc in the HDG bolts is crucial for several reasons: the corrosion product from zinc increases the pH in the electrolyte, zinc corrosion products reduce the cathodic reaction, and a continuous conductive salt film between the bolts and gasket creates an electrolyte that provides galvanic protection. Furthermore, the study also confirmed that zinc paint or spray was not a robust solution for preventing corrosion. The key takeaway was that galvanic protection from HDG bolts effectively prevents crevice corrosion on the SS316 ring gaskets, and upgrading materials may solve one problem but could cause another, as demonstrated in this case study.

Microbial Induced Corrosion (MIC) is a significant concern in various industries, particularly in offshore oil and gas processing facilities. MIC occurs where microbes attach to surfaces, form biofilms and produce corrosive substances like hydrogen sulphide (H_2S) that react with metal. This electrochemical process can lead to severe internal corrosion, compromising the integrity of critical equipment. During the conference, I attended a presentation which showcased three case studies where MIC was a primary contributor to failure, focusing on Sulphur-Oxidising Bacteria (SOB), Sulphate-Reducing Bacteria (SRB) and Iron-Reducing Bacteria (IRB).

- The first case study examined a crude oil pipe that experienced significant internal corrosion along the 6 o'clock position. Analysis revealed a high presence of IRB causing localised corrosion.
- The second case study focused on a produced water pipe, where SOB was identified, affecting the heat-affected zone along a circumferential weld.
- The third case study involved pipework which contained three-phase fluids. SRB was identified at the leak location and also within deep pits near the through-wall failure. MIC was the contributing factor to internal corrosion failures in these active microbial environments. A mitigating strategy involves the use of biocides; however, careful consideration of biocide application points should be reviewed to ensure sufficient carryover into the problematic areas, identified by inspection, is achieved.

Exhibition

The exhibition was a fantastic opportunity to engage with different companies, featuring interactive stalls, an array of giveaways and even popcorn machines. A group of us spent some time conducting coating thickness inspection and testing at the AMPP booth. Adding to the excitement was a Harley Davidson competition, which encouraged attendees to engage with nine different companies to collect playing cards. Once all nine cards were collected, participants could submit their details for a chance to win. The hands-on activities and competition make the exhibition both educational and enjoyable!

One of the highlights was connecting with four generations of ICorr YEP participants in Nashville, Tennessee (2019, 2021, 2022, 2024). It was lovely to bond with the winners of the 2024 Programme by trying on cowboy boots and hats, visiting museums, listening to some live music and enjoying breakfast together every morning. These cultural experiences added a unique and memorable element to the trip! We were honoured to be recognised on stage alongside talented, international young professionals at the EMERGing Leaders Bash, which is a scholarship awards ceremony. It was great to celebrate our achievements together!

The learnings and skills I developed from completing the programme, along with the Institution of Corrosion's (ICorr) core values, are principles I apply in my work and have been invaluable in my professional development. I highly recommend applying to the ICorr Young Engineers Programme. It offers an incredible opportunity to deepen your technical knowledge and solve real-world corrosion problems. This programme provides valuable membership, mentorship and networking with industry peers, making it a rewarding experience that benefits both personal and professional development.

I would like to express my gratitude to the following:

- The Institute of Corrosion, for designing such a comprehensive programme for young engineers.
- BP, for their commitment and sponsorship.
- My 2022 YEP team, who contributed to the successful solution of the case study.
- Our mentor, Alireza Aghasadeghi (Oceaneering), for his invaluable knowledge and time invested in the team.
- The 2024 YEP team winners, who made the trip even more memorable.
- Danny Burkle (YICorr Chair), for his continued support.

Photos: (Left) – My 2022 Winning Team with 2022-24 President, Case Study Lead, Judges and Mentor and (Right) – My 2025 AMPP25 Party with 2024-26 President and YICorr Chair.

CEng Updates

New applications are being processed, and assessors are adjusting to their new roles. The website is being updated to provide the documentation and processes as per the ICorr direct licence.

Our much-valued assessors come from varied backgrounds to review and assess the applications from ICorr's wide-ranging membership. These volunteers are contributing to ICorr to support our members to attain the registration status with the Engineering Council.

Anthony Setiadi: Anthony is a chartered engineer currently working for Wood Thilsted, an offshore renewable consultancy. He has more than 20 years in the industry covering various energy and infrastructure roles and studied materials science at the University of Sheffield. He works in materials selection, coating and cathodic protection. He is also supporting ICorr as vice president and has been leading the ICorr registration process for the past 3 years.

Greg Brown: Greg is a senior materials engineer at Mott MacDonald, and he is currently chair of the ICorr Northwest branch. He is highly experienced in destructive and non-destructive testing and is a chartered engineer. He has been part of the Registration committee for the past 2 years.

Jim Preston: Jim is Managing Director of Corrosion Prevention Limited. He has worked in the fields of structural concrete repair and cathodic protection for over 30 years, including 15 years working for contracting organisations and latterly 15 years as a consultant. He is a Chartered Engineer and a Fellow of ICorr. He is a certified Level 4 CP Specialist in accordance with ISO 15257.

Ashokan Gopal: Ashokan Gopal is an electrochemical engineer and an industry-recognised cathodic protection expert in the UK with over 18 years of experience in the field of corrosion mitigation and cathodic protection. He is a chartered engineer with a master's in corrosion control engineering from the University of Manchester. He is currently the vice-chair for the London ICorr Branch and an active member of the ICorr CPGB, working closely with the industry's best minds. He is a certified Level 4 CP Specialist in accordance with ISO 15257.

Emilya Abdullayeva: Emilya is a senior corrosion engineer in SLB with 20+ years of experience in corrosion engineering, integrity chemicals, and microbiological control across upstream oil and gas operations. She has a master's degree in engineering oil and gas and a PhD in corrosion inhibitors and MIC control in the oil and gas industry. Chartered Chemist from the Royal Society of Chemistry and Chartered Engineer from ICorr.

Ibtesam Hasan: Ibtesam is a chartered metallurgy and materials engineer with over 20 years of experience in offshore oil and gas. He currently manages P&L for IMR operations for the Fugro Middle East office. He holds degrees in metallurgy and materials and a PgD in corrosion control engineering, complemented by NACE and API certifications.

Azri Aziz: Azri is a chartered engineer and currently works as a senior corrosion engineer at Aramco. He has 14 years of experience in corrosion engineering and integrity management within the oil and gas industry. He holds a degree in Materials Engineering and an MSc in Corrosion Control Engineering, complemented by professional certifications from the American Petroleum Institute (API) and AMPP. Azri has a strong track record of developing and implementing integrity management strategies, ensuring asset reliability and driving industry best practices in corrosion control in operating assets.

Lian Ling Beh: Lian is a chartered engineer and professional member of ICorr. She is a materials and corrosion engineer with nearly 20 years of experience in asset integrity and management in the North Sea. Currently supporting operations across BP's NS assets, providing consultation to multidisciplinary teams, including pressure systems, pipelines, mechanical and rotating equipment, structural integrity and lifting equipment.

Olubayo Latinwo: Olubayo is an asset integrity specialist with over 20 years' experience across international oil and gas assets. He earned his PhD in Engineering Materials in 2012. Olubayo is a professional member of ICorr, IOM3 and IAM. He is also a Chartered Scientist and Chartered Engineer with the Science and Engineering Council, respectively, and also has multiple qualifications with AMPP and API. He has been part of the Aberdeen Branch of the Institute of Corrosion for 6 years in various roles, including Vice Chair. He has also been a formal PAC assessor for the MICorr grade for over 4 years with the Institute of Corrosion.

Syed Umair Niaz: Syed is a Chartered Scientist and Chartered Engineer with nearly 15 years of experience, having a degree in mechanical engineering with a strong focus on corrosion management, coating selection, and welding integrity. He has authored numerous publications in these fields and currently works with EDF France, based in the UK, leveraging his expertise to drive innovation and excellence. He is also serving ICorr as a member of the Professional Assessment Committee (PAC) and an assessor for CEng registrations.

CED - Join the New CED Committee

We're rebuilding – and we want you with us

The ICorr Corrosion Engineering Division (CED) is undergoing a major refresh – and we're looking for passionate corrosion professionals across the UK to help shape our next chapter.

Whether you're working in energy, infrastructure, materials, asset integrity or beyond – if you care about corrosion and want to share your knowledge, build your profile, and contribute to a growing technical community… **we'd love to hear from you.**

We're establishing a new committee to align with our refreshed structure and strategy. This is an exciting opportunity to join a supportive, cross-sector group with a shared vision:

Our Vision: To champion corrosion engineering through connection, collaboration, and contribution – bringing professionals together to share practical insights, tackle emerging challenges, and influence industry best practice.

Who We're Looking For?

We welcome expressions of interest from individuals who are:

- Based in the UK
- Working in or passionate about corrosion engineering and science
- Keen to contribute their ideas, experience and time
- Interested in building their network, shaping strategy, or supporting technical activities

Whether you're early in your career or a senior specialist, there's a place for you.

Committee Opportunities

We're currently seeking:

- **Vice Chair** (with possible progression to Chair)
- **Working Party Leads** – guiding topic-based technical communities
- **Committee Members** – supporting events, outreach, and growth

Working Parties – Lead or Get Involved

As part of our revitalised structure, we're forming broad, strategic working parties designed to be more inclusive, collaborative, and aligned with industry challenges:

Working Party	Focus Areas
WP1: Corrosion in Integrated Energy Systems & Extreme Environments	Hydrogen, CCUS, Geothermal, Oil & Gas, HPHT, Cryogenic, Downhole
WP2: Corrosion Mitigation Technologies	Coatings, CP, Inhibitors, Material Selection
WP3: Structures and Integrity Management	Concrete, Bridges, Offshore, Monitoring
WP4: Testing Standards & Methodologies (TBC)	Autoclaves, lab testing, test design, reproducibility

Each group will meet 2–3 times a year and contribute to events, discussions, and outputs.

What's involved?

We're a volunteer-led committee and aim to keep involvement flexible, rewarding, and well-supported. Typical contributions include:

- Bi-monthly online committee meetings (30–60 mins)
- Working Party involvement (2–3 short meetings per year)
- Helping shape or promote our events and outputs
- Supporting outreach, mentoring, or knowledge-sharing

Key Annual CED Events

- **ICorr CED One-Day Technical Conference**
  (April – aligned with Corrosion Awareness Day)
- **Paul McIntyre Award Presentation & Celebration**
- **Technical Webinar** *(November/December)*
- **ICorr AGM Participation and Reporting**

What's Next for the CED?

Our priorities for 2025–2026

- Rebuild a diverse, cross-sector committee
- Launch working parties aligned to current challenges
- Enhance our online presence and resource hub
- Strengthen collaboration with the Corrosion Science Division
- Celebrate excellence through the Paul McIntyre Award
- Continue growing our flagship events and technical visibility

Interested in Joining?

If you're motivated by collaboration, knowledge-sharing and professional growth – and want to help move corrosion engineering forward – we want to hear from you.

Get in touch: Danny Burkle, Chair, Corrosion Engineering Division, **Email: CEDchair@icorr.org**

Introducing ETGB

Advancing Corrosion Engineering Through World-Class Training

We are proud to introduce the **Engineering Training Governing Board (ETGB)** - a bold new initiative by ICorr, focused on shaping the future of professional development in corrosion engineering. This launch is especially timely, following ICorr's recent award of a Professional Engineering Institution (PEI) licence from the Engineering Council (EngC PEI), reinforcing our commitment to delivering internationally recognised, best-in-class training and certification.

ETGB will work alongside our existing Cathodic Protection and Surface Treatment Training Governing Boards (CPGB/STGB) reporting to ICorr Council.

ETGB Mission

- Develop and deliver new ICorr certified and general awareness courses aligned with evolving industry needs
- Provide access routes to ICorr membership via dedicated courses
- Strategically manage and expand ICorr's training portfolio of engineering courses globally
- Strengthen branch and global engagement within the international corrosion community
- Support ICorr's Continuing Professional Development (CPD) programme and chartership registration

What This Means for You

- Access to a wider selection of specialised corrosion-related training and membership pathways
- Curriculum tailored to the latest developments, standards, and best practices
- Tools to advance your expertise and confidently address complex corrosion challenges

Our ETGB Committee

ETGB which meets monthly, presently comprises the following members.

- **Tony Rizk (Chair)** – MIC Course Tutor, formerly of Saudi Aramco
- **Sarah Bagnall (Vice Chair)** – Wales and South-West Branch Chair and Materials Course Tutor
- **Stephen Tate** – ICorr Immediate Past President
- **Anthony Setiadi** – ICorr Vice President
- **Jane Lomas** – ICorr STSM and FOCE Course Tutor
- **George Winning** – Production Chemistry Course Tutor

Join Us

At ICorr, we are committed to delivering best-in-class training that fosters long-term growth, innovation, and resilience across the industry. ETGB is dedicated to expanding the range of training courses available to corrosion professionals, delivered directly at our UK training sites, in-company, or through global partners, to ensure a dynamic and relevant knowledge-sharing experience for professionals worldwide. A recent members survey received 128 responses, and this will help guide us towards future course development within ETGB which is already offering a good range of courses across – Corrosion prevention, Monitoring, Materials selection and Failure analysis topics.

Upcoming ETGB Courses

Please refer to the diary page for upcoming ETGB courses.

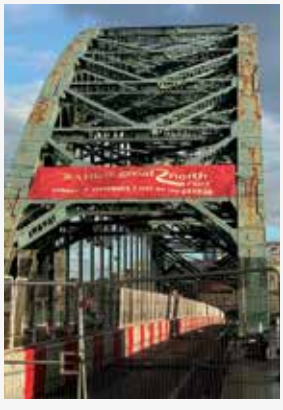
Get Involved: Register soon

Let us collaborate to advance corrosion engineering and empower the next generation of experts.

For all general enquiries or partnership opportunities, reach out to: Dr. Tony Rizk, PhD, FICorr, ETGB Chair: **etgbchair@icorr.org**

Dr Yunnan Gao, President ICorr

The Tyne Bridge, an iconic steel arch structure linking Newcastle upon Tyne with Gateshead, is both a feat of engineering and a cultural emblem of the Northeast of England. Designated as a Grade II* listed landmark, it has withstood nearly a century of environmental exposure since its completion in 1928. Unsurprisingly, the cumulative effects of atmospheric corrosion, exacerbated by the region's industrial heritage, now necessitate comprehensive intervention. In late 2023, a major refurbishment programme was initiated, encompassing essential structural repairs and a complete repainting of the steelwork, an undertaking as much about corrosion control as it is about heritage preservation. Scheduled for completion by the bridge's centenary in 2028.



Photos: Tyne Bridge (Image Courtesy of Dr Yunnan Gao).

Meet Our ICorr Coating Trainers and Assessors: David Eyre

Welcome back to our *Meet the ICorr Trainers* series, where we introduce the expert trainers behind our ICorr Coating Inspection courses.

This month, we're pleased to feature David Eyre, Training Director at Corrodere Academy and a long-standing ICorr trainer and assessor.

David Eyre - Corrodere Trainer Level 3

With nearly five decades of experience in the protective coatings industry, David has trained and mentored professionals around the world—and continues to play a key role in shaping the next generation of inspectors.

Can you tell us a bit about your background and how you got into the protective coatings industry?

I started in the coatings industry 48 years ago as an apprentice. After several years on the tools, I joined a coating distributor in the London area and moved into a technical sales role. From those early days, my career has taken me all over the world in both technical and commercial positions.

How long have you been delivering ICorr training and assessments?

Since 2013, so 12 years!

What does a typical training or assessment day look like for you?

I'm usually in the office around 7:30 am to clear as much of my inbox as possible before I begin training. I then prepare all the equipment and ensure the electronics and media are set up and working correctly.

At 9:00 am, the students arrive, and we spend some time getting to know one another. I always encourage interaction throughout the day—it makes the session more enjoyable and engaging for everyone. I try to end each day on a positive note, with every student leaving confident in the knowledge they've gained.

What do you enjoy most about delivering ICorr training?

The satisfaction of inspiring the younger students—seeing their enthusiasm for the industry and how it opens up a whole new world of opportunity. I was that person once!

What do you think sets the ICorr certification apart in the industry?

It has 100% global recognition. Wherever I've worked in the world, my ICorr Level 3 qualification has been respected as the benchmark standard in the industry.

How do you support students who may be struggling with certain concepts or assessments?

I'm a strong believer in the building-block approach. When introducing new concepts, I always link them back to something the student already understands. I also ask questions to confirm they've grasped the material.

Before a practical ICorr assessment, I take a little time to get to know the student and explain that it's just the two of us discussing inspection equipment and standards. I also reassure them that there's no need to rush—we have plenty of time. Usually, they're smiling before the assessment even begins.

What advice would you give to someone starting out in the protective coatings industry?

It's not just a job—it can be a lifelong career that can take you all over the world in many different directions. The harder you work and the more sacrifices you're prepared to make, the greater the rewards will be.

Candidate Feedback

"I had the privilege of being taught by David for both the practical and theory sessions. He is a great trainer who takes time with his delegates and goes above and beyond to ensure everyone understands the material and feels confident before their exams."

Johnny Morton – Project Engineer/Technical Authority at Bilfinger UK and ICorr STGB Chair

Employer Feedback

"David's dedication to his students and the protective coatings industry is evident in every workshop he delivers. At Corrodere Academy, we're incredibly fortunate to have him leading our training efforts and helping maintain the high standards of ICorr certification worldwide."

Stay tuned for more profiles in our *Meet the ICorr Trainers* series.

Industry News

News from ICorr Corporate Members and Other Industry News

Bilfinger Secures Major NDT Inspection Services Contract with bp

Aberdeen, United Kingdom – International industrial services provider Bilfinger has been awarded a significant contract to deliver Non-Destructive Testing (NDT) inspection services across all of bp's North Sea assets.

This new award builds on the longstanding collaboration between the two companies and follows the recent three-year extension of Bilfinger's insulation, access and painting (ISP) contract with bp in the UK, which was first secured in 2019.

Under the agreement, Bilfinger will deploy a wide range of advanced inspection technologies, including robotics and artificial intelligence, to enhance asset integrity management. These solutions are designed to increase efficiency, improve safety, and reduce carbon emissions, supporting bp's wider commitment to sustainable offshore operations.

A key feature of the contract is the introduction of a fully integrated, end-to-end digital workflow. This approach aims to transform inspection practices by enabling real-time data management, streamlined reporting, and AI-ready integration. By embracing smart digitisation, Bilfinger will deliver inspection services that not only meet but exceed industry expectations for reliability and sustainability.

The expansion of service scope across the North Sea assets demonstrates bp's continued confidence in Bilfinger's capability to provide safe, efficient, and innovative solutions. It also reinforces Bilfinger's position as a trusted partner for the oil and gas industry in the UK continental shelf. This latest contract strengthens the company's portfolio of asset integrity and inspection services, ensuring the continued safe operation of critical offshore infrastructure in one of the world's most mature oil and gas regions.

Source: https://www.bilfinger.com/

Jotun Unveils Advanced Powder Coating Technologies to Protect EV and Energy Storage Batteries

The accelerating shift toward electrification is driving unprecedented demand for high-performance batteries in electric vehicles (EVs) and energy storage systems. Recognising the critical need to extend battery life, improve safety, and streamline production, Jotun has launched powder coating solutions tailored to meet these challenges.

Stricter environmental regulations, particularly those targeting road transport, which contributes roughly 15% of global CO_2 emissions, are fuelling this transformation. According to the *IEA Global EV Outlook (2023)*, EV sales are forecast to exceed 40 million units annually by 2030, with global battery manufacturing capacity projected to reach 4,548 GWh. Against this backdrop, materials innovation has become pivotal to the performance and resilience of next-generation batteries.

Jotun's latest coatings are designed to address multiple performance parameters including electrical insulation, thermal management, fire protection, and corrosion resistance, each essential for safer, more durable, and efficient batteries.

Durability remains a pressing concern for OEMs, as EV batteries face harsh exposures to moisture, road salts, chemicals, and mechanical stresses. "Powder coatings can be applied to various components within high-voltage battery packs that undergo thousands of charge–discharge cycles under demanding conditions," explained Mehmet Ali Kamacıoğlu, Jotun's Global Sales and Marketing Director.

"Our systems are engineered to deliver reliable insulation, thermal stability, and robust corrosion protection—ultimately enhancing durability while safeguarding the integrity of electrical circuits."

Source: https://www.jotun.com/ww-en/industries/news-and-stories/news/jotun-launches-new-powder-coatings-technologies-to-safeguard-batteries

Other Industry News

Nickel Demand Mitigation: A $100Bn / Year Climate Action Issue

We have a huge opportunity to enable the energy transition and save money. If we reduce primary nickel use in stainless steels, we can have a big influence on the price and availability of nickel for batteries, electrolysers, etc., and also promote the cost-effective use of stainless steels. It will also make big reductions in CO_2 emissions.

In 2024, 65% of the 3.5 million tonnes of primary nickel production was still used to make stainless steel (STS).

Nickel is regarded as a critical or strategic material with rapidly growing demand, most prominently driven by the growth in demand for lithium-ion batteries (LIB) for electric vehicles (EV).

Fig. 1 shows a schematic diagram of the main nickel supply chains. In 2023 and 2024, there has been a surplus in primary nickel supply over demand, resulting in the LME price settling around $15k to $16k per tonne and the closure of some high-cost mines. Historically, shortages of nickel have driven the LME price to $30 or even $50k/tonne.

Recent studies show that evolving battery technology may be used to mitigate shortages and high prices of nickel. Manufacturers may select Ni-free LIB designs, which generally have lower energy density than LIBs with Ni-based cathodes. That infers reduced EV range, which makes them less attractive, as does higher EV price due to high nickel price.

STS Grades and Nickel Content

We have hundreds of grades of stainless steel, specifically geared to particular applications and corrosion risks.

- The global percentage of Ni in STS is affected by both the mix of STS grades produced and by the incorporation of Ni-bearing scrap.
- Generally speaking, less nickel usage = less cost.
- Early stainless steel contained 18% chromium, for corrosion resistance, and 8% nickel to stabilise the austenitic structure, which gave desirable mechanical properties. That was the basis of the '300 Series' austenitic STS, which has 8 to 12% Ni.
- Later 400 Series ferritic STS typically have <1% Ni, and volatility in the Ni price has driven companies such as IKEA to make a sustained effort to change from 300 Series to 400 Series STS for applications in benign household environments. The World Stainless Association has pointed out that 400 Series STS with enhanced corrosion resistance are available, which can replace 300 Series STS in most environments at ambient temperatures (see Fig. 2).

Source:

Roger Thomas, MA (Metallurgy and the Science of Materials), MBA, Retired Executive, Titanium Metals Corporation (TIMET)

https://www.researchgate.net/profile/Roger-Thomas-12

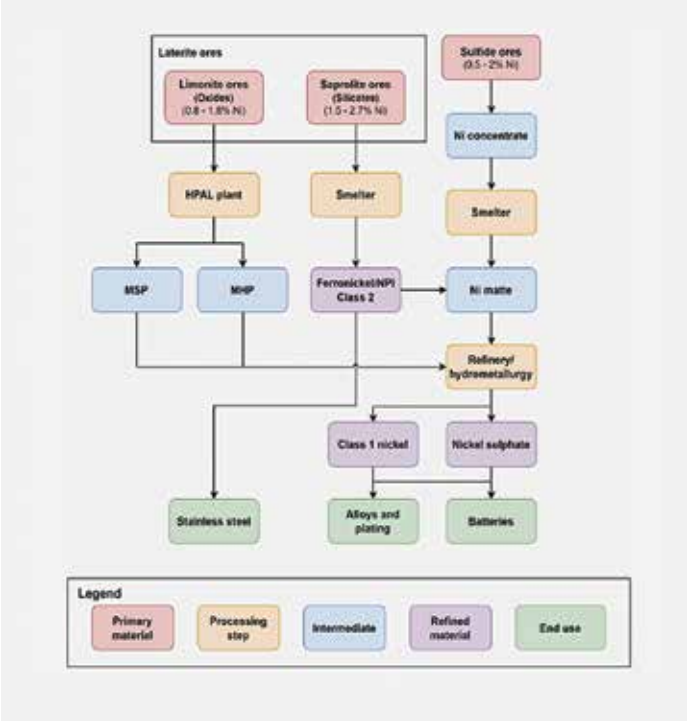


Figure 1: Nickel Supply Chain.

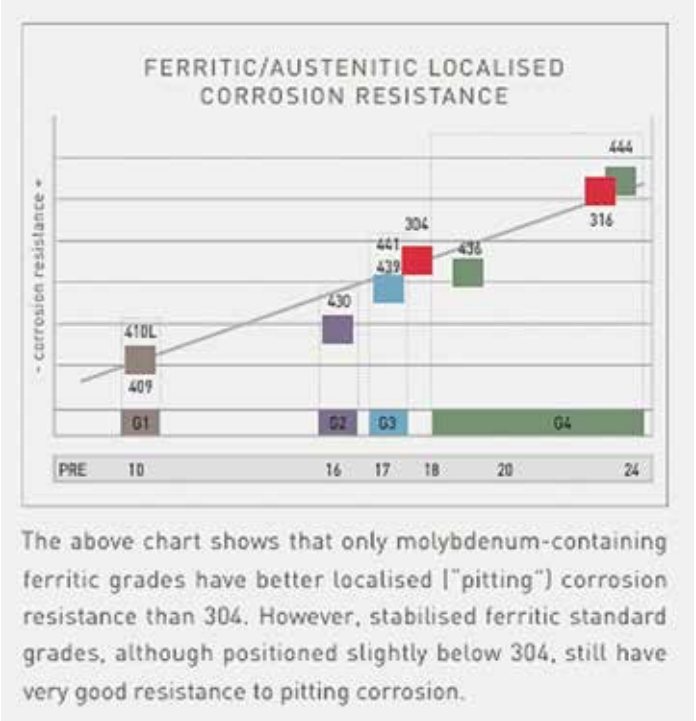


Figure 2: International Stainless-Steel Forum: Ferritic / Austenitic Localised Corrosion Resistance.

Reinforced Autoclaved Aerated Concrete in Hospitals: Managing Safety and Remediation

Concerns surrounding the structural integrity of reinforced autoclaved aerated concrete (RAAC) continue to shape policy and practice across the UK's healthcare estate. RAAC, widely used in public buildings between the 1950s and 1980s, is now recognised as a material with significant durability concerns. Its porous composition and limited reinforcement detailing have led to deterioration, with risks of cracking, water ingress, reinforcement corrosion and, in some cases, structural failure.

Within the health sector, these concerns are acute. The Department of Health and Social Care confirmed that as of 10 September 2025, 41 hospital sites in England contained RAAC and are therefore enrolled in NHS England's rolling remediation programme. This national initiative, in place since 2021, is supported by over £1.3 billion in dedicated funding to enable trusts to implement failsafe measures, mitigation strategies and eventual eradication of RAAC from their estates.

The challenge is both immediate and long-term. Updated monitoring guidance issued by the Institution of Structural Engineers (IStructE) in May 2023 led to the identification of 34 hospital sites with RAAC since that time alone. Encouragingly, 20 sites have now eradicated previously confirmed instances of RAAC through removal or replacement works. However, seven of the most heavily affected hospitals have been earmarked for complete replacement under the government's New Hospital Programme, with delivery targeted by 2030.

The structural risks associated with RAAC are increasingly well characterised. IStructE's detailed guidance emphasises that risks often arise from short or inadequate end bearings, absence of transverse reinforcement, historic water ingress, and changes in service loading. Panels may exhibit wide variability even within the same structure, necessitating extensive surveys. Inspection regimes include deflection measurement, crack mapping, hammer tap testing, and in many cases intrusive surveys to confirm reinforcement detailing and bearing conditions.

Where RAAC is confirmed, management strategies must balance patient safety with the pressing need to maintain clinical capacity. NHS England's approach aligns with IStructE recommendations: mitigation and monitoring are prioritised to keep facilities open safely while longer-term remediation plans are enacted. This often involves the use of temporary propping, installation of secondary supports, or full panel replacement. In higher-risk cases, exclusion zones and restricted access have been adopted until structural safety can be assured.

The importance of sustained oversight cannot be overstated. The guidance highlights that deterioration mechanisms—particularly reinforcement corrosion exacerbated by moisture ingress—may remain hidden until advanced. As such, regular inspection, coupled with clear communication with staff and building users, forms part of the wider management strategy. Awareness campaigns ensure that leaks, debris or unusual structural changes are reported promptly, integrating building users into the safety process.

The RAAC issue underscores a wider lesson for infrastructure management. Materials once considered innovative can reveal unforeseen vulnerabilities over time, particularly under changing service conditions. The NHS RAAC programme demonstrates how systematic monitoring, risk classification and phased remediation can safeguard critical assets while maintaining operational continuity.

Sources:

https://www.gov.uk/government/publications/reinforced-autoclaved-aerated-concrete-raac-in-hospitals-management-information

https://www.istructe.org/resources/guidance/reinforced-autoclaved-aerated-concrete-(raac)-inve/

Fellow's Corner

This series of articles is intended to highlight industry-wide engineering experience, guidance and focussed advice to practising technologists. It is written by ICorr Fellows who have made significant contributions to the field of Corrosion Management.

The Role of an Expert Witness

B S Wyatt Eur Ing, BSc (Hons), C Eng, MIMMM, FICorr, FIHT, FCS, FNACE, Past President ICorr 1987-1989

INSTITUTE OF CORROSION

Meet the Author

B S Wyatt

B S Wyatt is an ICorr Past President, a member of the CP Governing Board (CPGB) and CEOCOR Immediate Past President. Brian is an independent Consulting Corrosion Engineer, a CP specialist in applications for steel in soils, waters and concrete. Experienced in design, performance assessment, detailed survey techniques and remedial work for:

- Onshore buried and offshore pipelines
- Offshore new build and retrofit CP for oil, gas and renewables structures
- Internal and external surfaces
- Coastal and port/harbour structures
- Steel in concrete for bridges, tunnels and buildings.

Brian is an expert witness in multiple sectors of CP, he has carried out technical consulting and project management of large and complex CP systems. He is a UK Nominated Expert by BSI for CEN/TC219 and ISO TC156/WG10. He is active in the ICorr Training, Examination and Certification of CP personnel in accordance with BS EN ISO 15257. Brian has competence Certification to ISO 15257 Level 4 in all 4 Sectors: Buried, Steel in Concrete, Marine and Internals and Certification to Level 5.

Introduction

I have been requested by the Editor to submit a paper on the role of an expert witness. For reasons I will explain below, this is quite a difficult task, but I will do my best within the necessary confidentiality of cases in which I have been appointed to this role.

There are several other Fellows of ICorr working as expert witnesses. Some, like me, only occasionally undertake such work, others have chosen this activity as a major part of their fee earning activities. One is resident in and very active in the USA.

I explain below, how I assess approaches from legal teams and determine if I think I am suitable for, and if I am prepared to act as an expert, in the case in which they are involved.

For those readers who have not experienced technical or construction disputes, and whose exposure to the actions of expert witnesses may be limited to newspaper reports of criticisms of expert witnesses, or the reported inadequate understanding of expert witness testimony by the courts, for example in UK medical negligence cases, or to fictional US cases in criminal cases, please be ready to be disabused.

General Rules

Firstly, the rules for expert witnesses are quite different in the UK and the USA. I have taken guidance in the summary below from the Global Arbitration Review[1] and from Bond Salon[2].

England and Wales have established the Civil Procedure Rules: Rules and Directions, Part 35 (CPR Part 35)[3], which set out the requirements for expert evidence, specifically requiring that an expert witness has an overriding duty to the court to be independent and impartial. As a result, *'experts should constantly remind themselves through the litigation process that they are not part of the Claimant's or Defendant's "team" with their role being the securing and maximising, or avoiding or minimising, a claim for damages. Although experts always owe a duty to exercise reasonable skill and care to those instructing them, and to comply with any relevant professional code, as CPR 35.3 expressly states, the experts have at all times, an overriding duty to help the court on matters within their expertise. That they have a particular expertise and the court and parties do not (save in some professional negligence claims) mean that significant reliance may be placed on their analysis, which must be objective and non-partisan if a just outcome is to be achieved in the litigation.*[4]

From Ref 1 'The UK judiciary has made criticisms of expert evidence in, for example, ICI v. Merit,[15] Riva v. Fosters,[16] Energy Solutions v. NDA[17] and Russell and Anor v. Stone,[18] which highlighted that a 'hired gun' who pretends to be independent is of little help to a tribunal and may damage the position of the instructing party. It may cause the parties to incur higher expenses in the whole proceedings, prevent any settlements or render the expert evidence of little assistance to the tribunal. An expert must maintain objectivity and independence. The English courts have given many judgments regarding the bias of experts; for instance, in Jones v. Kaney,[19] the Supreme Court of the United Kingdom removed the immunity of an expert witness from lawsuits for negligence.'

Expert witness reports are required to contain a 'statement of truth' which would typically be in the following form:

'I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true.

The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

I understand that proceedings for contempt of court may be brought against anyone who makes, or causes to be made, a false statement in a document verified by a statement of truth without an honest belief in its truth.'

In one case in which I was involved, I was asked to attend chambers of the leading barrister who would be putting the case for the party who

had appointed me. One of the expert witnesses for the other party had made claims that I considered to be spurious and that were directly contradicted by a published document that the expert had previously written; I had identified this in my opinion report. The barrister [many of whom can be quite robust] described the expert as a 'man of straw' and said that he would 'enjoy picking the wings off this fly'. The case was settled before the hearing.

In the United States, Federal Rules of Evidence (US FRE) Article VII sets out the requirements governing the rules for opinion and expert testimony, which are less prescriptive. The conduct of expert witnesses, and their overriding duty to serve and assist the court, is not established under the US FRE. I am advised by my expert fellow colleague that there are differing rules in different states.

Corrosion expert witnesses in the USA and elsewhere, must be experienced and have specialized knowledge or skills to offer unbiased opinions to help attorneys, judges, mediators and juries understand complex corrosion issues. The Daubert Standard[5] is now the law in federal court and in other courts over half of the states. Related to Daubert, attorneys may question expert witnesses if they are knowledgeable in the Scientific Principle[6 7], which is intended to eliminate bias.

In the USA, a corrosion expert – before testifying – must stipulate that their scientific or engineering knowledge will assist the court or tribunal understand the facts in issue. These responsibilities should ensure that expert witnesses are able to play a crucial role in ensuring fair and informed decision making in legal cases.

In international disputes the contract terms will normally have defined the rules and jurisdiction under which any dispute will be subject to arbitration or settlement, if the latter, often by an expert tribunal. In all in which I have been involved the CPR Part 35.3 rules have been applied either formally as these rules by name or by direct copying of their requirements. In large international construction contracts, the parties may have agreed to use a particular form of arbitration to address any disputes; one such is prepared by the United Nations Commission on International Trade Law (UNCITRAL).

With all this being said, the reality is that once appointed, all the information related to the case that the expert requires to properly execute his or her work comes from the instructing party's legal team, and it is normal for there to be meetings with the legal team and with the instructing party's personnel who have information on the matters in dispute. Eventually, some of these personnel with intimate knowledge of the matters in dispute will present their own witness statements. During the process there will be a need for legal advice for the expert in respect of procedures for the hearings in court or before a tribunal. Draft expert reports may be commented on by the instructing party's legal team and barrister(s); *however,* at no time should the expert be prepared to receive or act on instruction to change his or her expressed opinion. During a long preparation for a hearing there is a risk that a 'team spirit' is developed, particularly if there are multiple experts with interlocking expertise; hence the emphasis in Ref. 4 above: *'Experts should constantly remind themselves through the litigation process that they are not part of the claimant's or defendant's "team", with their role being the securing and maximising, or avoiding or minimising, a claim for damages.'*

In all of the expert witness cases in which I have been involved, before tribunals or an arbitration expert, the evidence and the outcome, where it has become known to me, have been strictly confidential. The details remain so. Therefore, my description of the process is necessarily restricted. In cases that are heard in the Technology and Construction Courts , the CPR Part 35 rules apply, however, the judgements are published.

In my experience a typical process has been:

1. The Initial Contact

A phone call or e-mail, out of the blue, often from a legal professional, but occasionally from a technical or scientific professional with expertise in a related or unrelated field, typically asking guarded questions regarding expertise, availability and, very soon, regarding conflicts of interests.

This might proceed to the exchange of limited documents regarding the dispute and the parties, under a confidentiality agreement. It is at this point where, historically, I have sometimes declined to be involved, either because I am not comfortable acting for the 'instructing party', or I think from the limited information available the instructing party's case is likely ill-founded or indefensible, or I consider that my expertise is not appropriate for the scope of the case. Where I can, I have pointed the enquirer towards people, often also Fellows of ICorr, who I think are either more competent than I am in that field or more likely to wish to work on the particular case.

If I am interested and available and the key issues are within my expertise and still under confidentiality agreements, there are exchanges of more technical details, sometimes preliminary timetables and suggested fees. It is at this stage, before any appointment that I detail, that I describe, I hope honestly and self-critically, my relevant technical strengths and weaknesses.

2. The Appointment

Typically, quite quickly, a draft engagement letter will be sent by the instructing legal team, detailing who they act for, who are the parties to the dispute, and the jurisdiction which will hear the details of the dispute by way of the claims and counter claims, which may be an Arbitration Board, Tribunal or a Court. The engagement letter may also detail other experts already appointed, providing other expertise [e.g., coating, testing, etc.], and it may outline in more detail the provisional timetable. The legal team will have obtained approval from the court or tribunal for the appointment of experts and their anticipated costs.

The engagement letter will require confidentiality and 'legal privilege'; likely all documents to and from the expert will be marked 'Privileged and Confidential – prepared for use in XYZ proceedings. It will require disclosure of any conflicts of interest [which will likely exclude the expert from the proceedings] and either directly or indirectly, compliance with the CPR Part 35 rules. In all such cases, the workload and the attention to detail required are abnormal. I have had multiple boxes of small print A5 files of evidence arrive by courier on a Friday evening with a requirement for initial comments the following Monday morning. Every word on the page of an expert witness report, or ppt. presentation to be used in evidence should be 100% accurate and impossible to be misinterpreted.

In one of the largest cases in which I was involved, I gave evidence for a day and a half and 'suffered interrogation' from the most aggressive barrister I have ever met. My expert technical report, which I had worked on for many, many hours, was hardly addressed. I was advised afterwards that he could find nothing of substance in it to challenge, and his challenges were primarily of me and my expertise. Before this long tribunal hearing, I was grateful to have taken part in some expert training in how to deal with such questioning and how to react in front of the tribunal.

3. The Work Process

The overall Work scope typically falls into 4 stages:

- Outline and Scheduling
- Assessment
- Review and Final presentation
- Proceedings

Outline and Scheduling

Initially the expert will be presented with the claims and counter claims from the parties in the dispute, the claimant and the respondent.

At a relatively early stage in the process a draft timetable will be published advising when expert reports are to be submitted, if an 'experts meeting' is required, and when court or tribunal hearings are planned. At around the same time a list of experts will be exchanged between the claimant and respondent. This may result in an

continues on page 30

assessment of particular areas of expertise being brought to bear on the evidence by one party and the need for the other party to strengthen the expert witness team in this area. It is critical at this time for any appointed experts to be realistic in respect of the limits of their expertise and experience. I have advised a legal team that a particular expert in the team for the other party had expertise beyond mine in what could be a relevant sector, and that the legal team should consider adding another expert in order to competently address matters within this sector.

Assessment

Then the real work begins, with a thorough review of all the available evidence, possibly requesting additional information if any is available, or suggesting additional testing in order to better inform if there is any 'fault' or to better determine the impact of any such fault on the required performance of the asset at the core of the dispute. All such requests and any additional data or site visits and their outcomes must be openly shared between all of the parties.

Depending upon the complexity of the dispute there may be many hundreds of relevant documents. Different legal firms have different methods of presenting these to experts, some largely in hard copy bound documents, some in well-constructed and easy to access electronic systems and some in less easy to use systems.

Review and Final presentation

I have been involved in a number of cases as an expert where I have been required to prepare power point presentations for the tribunal or arbitration board. The purpose is to present an accurate summary of the previously prepared expert opinion report which can be presented before the tribunal. Draft expert reports or opinions are presented, and questions can be submitted between claimant and respondent, in order to seek clarity.

It may also be required that experts appointed by both claimant and respondent meet, in what is termed an 'experts meeting' with the intention of determining what, if any, matters in dispute can be agreed between the experts, and thus to be removed from, or closed off in, the later revisions of the expert opinion reports and the eventual proceedings. The intention is to simplify and reduce the costs of the process, whilst retaining the key issues in the dispute to be assessed by the court or tribunal without the distraction of matters that can be agreed. These meetings between experts are normally 'without prejudice' and the legal teams for the claimant and respondent may determine not to accept removing the agreed items from the dispute.

Proceedings

Experts should be prepared for the parties to a dispute to reach a compromise agreement in the weeks or even days before the planned court or tribunal hearing. This has happened to me in several cases.In one particularly complex overseas case I had been to the job site for some weeks, collecting more information and, in parallel, preparing the final version of my expert opinion report, along with a power point presentation to be used in the hearing. On the day before my planned time before the tribunal, for which I considered I was well prepared, I was phoned and told to go home; the matter had been settled. At the time I was disappointed, thinking that part of my work was incomplete; on reflection on this and other disputes settled before the planned court or tribunal hearing, the appropriate conclusion is that the expert has, to the best of his or her's ability, clarified the matters in dispute for the parties and the court/tribunal in order to facilitate an agreed settlement. Job done.

Personal Experiences

Over the years I have been appointed as an expert in cases related to CP failures on sheet steel piles in seawater and saline infills, hot oil pipelines, to district heating schemes, to pipelines in swamps with disputed field joint coating quality, a buried pipeline with disputed field joint coating quality and disputed CP system adequacy, offshore wind farm monopile foundations, ship hull coatings and related CP performance and others. The Figures to the right are NOT from expert witness cases in which I have been appointed [due to confidentiality issues] but examples of some of the sectors in which I work.

External Corrosion on Buried Gas Transmission Pipeline:

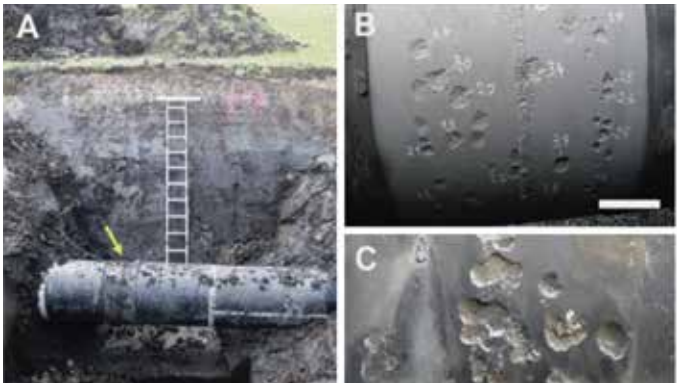


Figure 1 (A) External Corrosion on Buried Gas Transmission Pipeline Excavated from a Water- Logged, Anoxic , Sulfate -Rich Soil. (B and C) Details of Corrosion Under a Disbonded Asphalt Coating, Illustrating Cluster of Pits. Numbers in (B) Denote Pit Depths in mm and the bar is 20 cm. The Bar in (C) is 2 cm. Source: Enning and Garrelfs (2014). Source https://doi.org/10.17226/26686. (Example pictures unrelated to my expert witness work).

The Thames Barrier London (not a dispute but a success where independent experts were assessing the corrosion protection performance)

A project on which I was involved for many hours alongside another Past President of ICorr, David Deacon. David was a respected coating expert, but not a believer in CP. He was persuaded of the efficacy of CP on this project, which was well designed by our mutual expert predecessors and we had the pleasure of assessing their success:

Photo: The Thames Barrier London (Example picture unrelated to my expert witness work).

In my non-dispute related experience, often with colleagues, I have investigated and assisted in developing and executing remedies for failed corrosion protection schemes [CP, coatings and other related matters] or as independent technical expert(s) advising employers in complex CP related schemes being designed and executed by others. Much of the same rigour and obligations mandated to be applied in technical or construction dispute resolution outlined above are applicable to these activities. From my personal experience, expert witness work can be significantly disruptive to other professional activities and to personal life, but I have enjoyed the intellectual challenge of attempting to make the evidence to the court, or tribunal, complete, clear, detailed and as far as possible, difficult for a barrister whose role is to demolish my evidence or credibility to the benefit of his or her client, to misinterpret. In all of this, the evidence is not for the barristers, it is for the judge or tribunal panel and is intended to make what can be quite complex and subtle technical matters clear to all.

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Quotation from a Bond Salon briefing note regarding a 2022 dispute.
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200 Years On: Sir Humphry Davy and Cathodic Protection

B. Ackland, K. Dylejko, W. Green, and M. Büchler

INSTITUTE OF CORROSION

Meet the Authors

Dr Bruce Ackland

Dr Kathryn Dylejko

Dr Markus Büchler

Dr Bruce Ackland obtained a Bachelor of Science with Honours in Physics in 1979 and a Doctor of Philosophy in 1984 from Monash University, in the Department of Materials Engineering. Bruce has worked in the corrosion and cathodic protection industry since 1982, forming Bruce Ackland and Associates in 1985. Cathodic protection projects have involved work throughout Australia, New Zealand, Asia, SE Asia, the Middle East, North Africa and the USA. Bruce maintains an active role as a member and chairman in Australian Standards committees, participates in relevant ISO standards working groups, is the current chairman of the Australian Electrolysis Committee and is an accredited ACA Corrosion Technologist.

Dr Kathryn Dylejko is a corrosion engineer based in Australia at the Defence Science and Technology Group, specialising in minimising and controlling corrosion on Navy platforms. With roots as a mechanical engineer in armoured vehicles since 2006, she transitioned to corrosion 12 years ago, leveraging computational modelling to optimise cathodic protection systems for Navy vessels. Kate's expertise spans various facets of corrosion, with a keen focus on cathodic protection systems for maritime platforms. Her research includes electrochemical studies on calcareous deposits and corrosion potential monitoring across Navy vessels and wharves. Actively contributing to the Victorian branch of the Australasian Corrosion Association, Kate recently achieved certification as an AMPP CP2 Cathodic Protection Technician, reinforcing her commitment to advancing the practice of corrosion control technologies.

Dr Markus Büchler FICorr, is Director of the Swiss Society for Corrosion Protection, President of the European Committee for the Study of Corrosion and Protection of Pipes and Pipelines Systems (CEOCOR), and convenor of ISO TC 156 WG10 on cathodic protection of buried and immersed metallic structures.

Introduction

The year 2024 marks the 200th anniversary of the first two of three remarkable papers [1-3] by Sir Humphry Davy describing the earliest scientific investigations into what we now call cathodic protection (CP). Although the word "cathode" was not in use until proposed by Michael Faraday in 1834 [4], this paper will keep using the modern abbreviation "CP" for convenience. Similarly, Faraday also proposed using the word "anode" in his 1834 paper and we will call the anodic metals used by Davy as anodes, rather than "protectors".

Davy presented three seminal papers to the Royal Society in London, beginning with his first on January 22, 1824 [1] giving the scientific reasons, background and laboratory research results for the application of CP to prevent corrosion of copper sheeting on timber ships in seawater. His second paper describing additional experiments and observations for copper sheeting on vessels in Chatham and Portsmouth Navy dockyards was presented on June 17, 1824 [2] and his third paper detailing full scale research and results for ships on the high seas was read on June 9, 1825 [3].

There was controversy then, as there is now, about some aspects of Davy's work [5, 6]. This paper discusses some of these issues and demonstrates that Davy was well aware of any shortcomings but importantly, he also suggested possible solutions to overcome the occasional problem of an increase in fouling of the copper sheet under specific circumstances [3, 7]. Notably, the application worked unambiguously to prevent corrosion of the copper in all cases, with fouling only occurring on some vessels and Davy was in the process of understanding the differences in operational circumstances. It will be shown that it was primarily a loss in funding and a wish by the British Admiralty (after pressure from some ship's captains and the media) for quick solutions that cut short further investigatory work after just two years (i.e. 1823 to 1825). It was left to future scientists and engineers to show how CP could be used effectively and efficiently to protect any metal or alloy immersed in an electrolyte, including even reinforced concrete [8]. When reviewing his work, it must be seen in the context of the scientific understanding of electrochemical processes at the time. For instance, Davy was able to formulate the principles and application of CP decades before the electron was discovered by J.J. Thomson in 1897 and long before chemical and electrochemical reactions were written in the format used today. Judging his discoveries against modern principles is unfair at best and anyway, he was spot-on about plenty of technical points, as will be seen.

Previous Discoveries Leading to Davy's Understanding of Electrochemical Processes and "Cathodic Protection"

Humphry Davy quickly adopted and contributed to the electrochemical technology developed by luminaries such as Luigi Galvani [9], Alessandro Volta [10], Nicholson and Carlisle [11] and others. An example of the terrific electrical power he was able to produce can be seen in Figure 1 which shows the battery banks below a lecture theatre where he was demonstrating electric arc lighting. The portrait of Davy in Figure 2

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includes a typical Voltaic pile (typically consisting of alternating stacks of brine-soaked cards sandwiched between pieces of copper and zinc or other combinations of dissimilar metals), a common feature in portraits of electrochemical scientists.

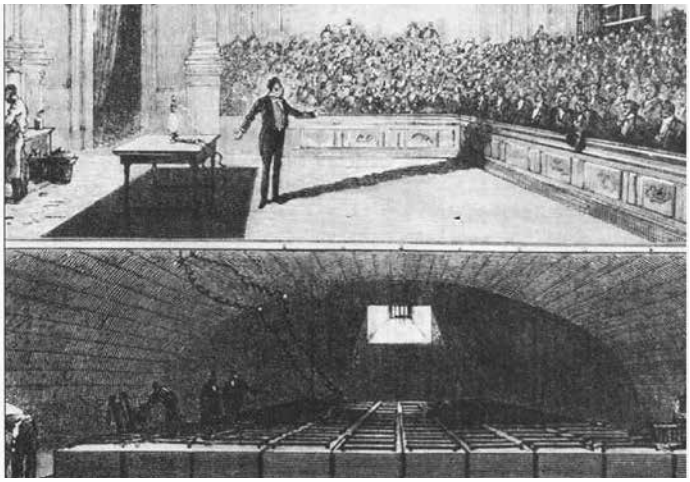

Figure 1: Sir Humphry Davy Demonstrating The Electric Arc Light. Note The Enormous Banks of Batteries Below The Theatre.

This background placed Davy in a perfect position to investigate a costly corrosion issue for the British Navy. In 1822, Davy was first approached by the British Navy Board to provide advice regarding the corrosion of copper sheeting on the Royal Navy's timber ships [5]. The copper sheeting was effective at protecting the ships' timber from worms and preventing the growth of "weeds" which otherwise had the effect of slowing the ships movement through the water. Davy read the board's letter to the Council of the Royal Society of which Davy was President. The Council formed a committee (with Davy as President) to investigate the matter and decided to test copper specimens supplied by the Navy. Davy eventually dispensed with the committee and began working personally on the problem in 1823, reported directly to the Admiralty on 17th January 1824 and then read a groundbreaking paper to the Royal Society on 22nd January 1824.

Figure 2: Portrait of Sir Humphry Davy. Note the Voltaic Pile On His Desk.

Davy's Paper of January 22nd, 1824

This, Davy's first paper on CP, proves the ability of CP to prevent corrosion. There may well be other consequences, but the beneficial effect upon corrosion was unambiguously proven and is not in dispute.

Let's look at some of the key issues raised in this first paper:

Davy, along with his assistant Michael Faraday, proved incorrect the general supposition at the time that the *"rapid decay"* (i.e. corrosion) of copper was due to impurities, surmising that *"pure"* copper was acted upon more rapidly than the specimens which contained alloy (although the type of alloying was not provided) and that *"changes"* (corrosion) in various specimens of ships copper collected by the Navy Board *"… must have depended upon other causes than the absolute quality of the metal"*. The quality of the metal is important but other factors were also believed by Davy to play a critical role including *"temperature, the relative saltness (sic.) of the sea, and perhaps the rapidity of the motion of the ship; circumstances in relation to which I am about to make decisive experiments"* [2].

Davy described *"the nature of chemical changes taking place in the constituents of sea water by the agency of copper"* and especially the importance of oxygen in the process.

Davy repeats his hypothesis from 1807 [12] (read 20 November 1806) *"that chemical and electrical changes may be identical"*; a feature clarified and enumerated by his assistant Michael Faraday [4] several decades later with what is now popularly called Faraday's Law of electrochemical equivalence [4]. Davy then describes how, by this hypothesis, *"that chemical attractions may be exalted, modified or destroyed, by changes in the electrical states of bodies"*. In other words, change the electrical state from its natural positive or negative state (i.e. change the potential, another word not yet in electrochemical use) and you will cause the chemistry to change. Davy then notes that it was the *"application of this principle that, in 1807, I separated the bases of the alkalies from the oxygene with which they are combined and preserved them for examination; and decomposed other bodies formerly supposed to be simple"*.

All of these past works by Davy led him "to the discovery which is the subject of this Paper".

It is a testament to Davy's scientific method that he supported his hypothesis by past research results, created an understanding of the processes involved and then went on to test it in the laboratory and with full scale trials, collecting and analysing the data for comparison with the predictions of the hypothesis.

Once he had established the basis of his hypothesis, he went on to suppose that if copper *"could be rendered slightly negative, the corroding action of sea water upon it would be null;* (i.e. polarise the copper negative) *and whatever might be the differences of the kinds of copper sheeting and their electrical action upon each other* (i.e. galvanic effects), *still every effect of chemical action must be prevented, if the whole surface were rendered negative"* He then astoundingly says *"But how was this to be effected? I first thought of using a Voltaic battery; but this could be hardly applicable in practice"*. So, Davy first thought of using an impressed current CP system! He could hardly know that future DC power supplies would make impressed current an easy and common means of cathodically polarising a structure. Davy then says *"I next thought of the contact of zinc, tin, or iron"*; i.e. galvanic anode CP.

Davy, assisted by *"Mr Faraday"* then conducted a series of experiments using these three metals to mitigate corrosion on copper. He then reports that although tin was initially effective, *"it was found that the defensive action of the tin was injured, a coating of sub-muriate* (chloride compound of tin) *having formed, which preserved the tin from the action of the liquid"; t*he tin chloride deposits reduced the effectiveness of tin as an anode. *" With zinc or iron, whether malleable or cast, no such diminution of effect was produced"*. Davy now knew for certain that he had effective anodes for the galvanic CP of copper.

Davy and Faraday then proceeded to conduct numerous experiments using zinc and iron in various shapes and sizes attached to copper, including small pieces *"as large as a pea"*, wires, nails, sheets connected directly by wires, filaments, soldering etc, and always with areas of zinc or iron much smaller than the copper being protected.

Near the end of the paper Davy notes *"…. that small pieces of zinc, or which is much cheaper, of malleable or cast iron, placed in contact with the copper sheeting of ships, which is all in electrical connection, will entirely prevent its corrosion"*. It is an important note by Davy that the iron anodes were much cheaper, and we will return to this issue when discussing the next two papers presented to the Royal Society.

Finally, Davy says that in future communications he might describe other applications that the principle can be used *"to the preservation of iron, steel, tin, brass, and various useful metals"*. He was definitely aware that the principle is widely applicable to any metal or alloy, a feature we enjoy today [13].

Davy's Paper of June 17th 1824, Additional Experiments and Observations

Davy reports the results of sheets of copper connected to zinc, malleable and cast iron for many weeks in Portsmouth Harbour. He notes that cast iron, which is the cheapest and most easily procured of the materials tested *"is likewise most fitted for the protection of copper"* and lasts longer than malleable iron or zinc. Davy later however, after further research, recommends a preference to use zinc anodes rather than iron [3].

Davy anticipated and observed *"the deposition of alkaline substances"* on the copper being "carbonated lime and carbonate and hydrate of magnesia". Nicholson and Carlisle had discovered the decomposition of water using a voltaic pile [11] (described by Davy as a "capital fact" [7]) and included a description of *"the separation of alkali on the negative plates of the apparatus"*, hence Davy's anticipation. These now familiar calcareous deposits of calcium carbonate and magnesium hydroxide are crucial to the efficiency of CP systems in seawater. Davy was clearly aware of the increase in alkalinity at the cathode and acidification at the anode. (Note: Even though the concept of pH and the quantification of acidity and alkalinity was not formulated until 1909 [14], Davy talks extensively about the alkalinity and acidity produced during galvanic coupling of different metals).

Davy also understood and documented that when the calcareous deposit completely covered the copper sheets, it could result in *"weeds"* and *"insects"* collecting on them. Davy then considers the amounts of calcareous deposits generated by various quantities of anode material. He found that using zinc and iron anode to copper area ratios from 1/35 to 1/80, the copper became coated with calcareous deposits but "weeds" eventually adhered to the surface as well. He then reports that when the ratio was reduced to 1/150 *"… the surface, though it has undergone a slight degree of solution, has remained perfectly clean; a circumstance of great importance as it points out the limits of protection; and makes the application of a very small quantity of the oxidable metal, more advantageous in fact than that of a larger one"*. So, Davy here cautions about the excessive application of anodes for the specific protection of copper in seawater when fouling is unwanted and illustrated that fouling could also be mitigated if careful selection of the anode quantities was made for the specific circumstances in which they were used.

Davy's Paper of June 9th 1825, Further Research

Davy's full-scale trials were generally very successful, certainly he prevented the copper corrosion, and he makes the comment that the fouling was usually not an issue if the vessel is on the move. He notes that mooring stationary in harbour allows calcareous deposits to form more readily (surface pH will rise more than when in motion) and weeds etc can adhere. He also mentions the quality of the copper may be important and that the proportion of the anode: cathode area ratio affects deposits.

He observed that the marine growths are often initiated on the iron oxides deposited near the anodes (*"protectors"*); he recommends here a preference to use zinc anodes rather than iron, *"Zinc, in consequence of its forming little or no insoluble compound in brine or seawater, will be preferable to iron …"*

Davy defends his work from page 341 onwards in his 1825 paper where he says *"A false and entirely unfounded statement respecting this vessel* (the 28-gun "Sammarang") *was published in most of the newspapers, that the bottom was covered in weeds and barnacles. I was present at Portsmouth soon after she was brought into dock: there was not the smallest weed or shell-fish upon the whole of the bottom from a few feet round the stern protectors to the lead on her bow."* He goes on to describe other instances of fouling and non-fouling when protected and at least attempts to understand the various circumstances.It appears that cast iron anodes were used in most of the field trials on ocean-going copper sheathed ships. For instance, Davy states in the Bakerian Lecture of 1826 (p. 420) [7], when discussing the field trials and operations *"… in the only experiment in which zinc has been employed for this purpose in actual service, the ship returned … perfectly clean"*. Davy wanted to conduct further experiments on ships in service, because the mitigation of corrosion was proven and fouling only occasional for reasons he thought could have been elucidated by further work.

It seems reasonable to expect the vessel captains, wanting the most from the protection system, to add iron anodes at possibly excessive rates since they were relatively cheap, easily procured and then complain that fouling was unacceptable. This is corroborated by Davy's observation [3] when discussing several ships returned from the West Indies that *"The proportion of protecting metal in all of them has been beyond what I have recommended, 1/90 to 1/70; yet two of them have been found perfectly clean, and with the copper untouched after voyages to Demarara; and another nearly in the same state, after two voyages to the same place. Two others have had their bottoms more or less covered with barnacles; but the preservation of the copper has been in all cases judged complete"*. Davy was therefore not reluctant to report fouling on some ships but balanced this with positive reports. Clearly it was possible to obtain both corrosion protection and no fouling; it would just require continued methodical research (and with ship owners/captains installing the recommended quantities of anodes rather than excessive amounts).

On the issue of fouling, F. James' otherwise excellent article on Davy [5] claims that "*Davy does not seem to have appreciated the side effect, and he was certainly unable to overcome it"*. This is incorrect on two points; Davy did appreciate the issue if one refers to the scientific articles as we have above where Davy addresses this specific issue and he was in the throes of trying to better establish the conditions in which corrosion mitigation and acceptable amounts of fouling could be achieved. Unfortunately, ongoing pressure finally led the Admiralty to issue orders to the Navy Board on 19 July 1825 to discontinue the project [5], thus ending further research just two years after first being initiated. The historian S. Ruston, in an essay discussing Davy as the philosopher [6], seems to draw heavily on James' article where Ruston writes *"Unfortunately, what had worked in the laboratory did not work at sea …"*. This is incorrect since there was no disputing that the corrosion was fully mitigated; it worked perfectly well and was the original aim of the Admiralty's directions, with only fouling being a troublesome and sometimes unacceptable side effect. On this Ruston goes on to write *"…the electro-plating (sic.) had a chemical side effect, which stopped the poisonous copper salts from going into the sea and resulted in ships' bottoms being fouled thus slowing them considerably"*. Although Ruston mistakes electrochemical protection used by Davy as *"electro-plating"*, the essay ignores the actual scientific words of Davy within his papers to the Royal Society where, as discussed above, he understood the effect of calcareous deposits, the effect on fouling and the need to strike a practical balance between corrosion protection and fouling.

There was a lot riding on Davy's work and competition from other inventors tied with the newspapers [5]. Plenty of *"fake news"* and "*alternative truths"* - not much has changed! If we study these works with our scientific, objective eyes we can establish a good understanding of the success or otherwise of Davy's work. Davy makes so many great and insightful statements about his observations, many of which are equally valid today. Also don't forget that he had the greatest assistant one could imagine in Michael Faraday in these works. The veracity of Davy's publications is not in doubt, especially with Faraday on board.

Today's Navy

The world's navies to this day use cathodic protection on virtually every ship, submarine and marine vessel on the oceans and waterways across the globe to mitigate corrosion, both external to the hull and within internal water filled spaces [15-17]. Ships hulls are of course now predominantly coated steel, but Davy would surely have been pleased to know that zinc anodes are still used extensively as shown in Figure 3, using the same basic principles [17]. Impressed current systems are used for larger current demand applications on bigger vessels but even these are often supplemented with zinc anodes around high current demand areas and shielded locations such as sea chests, ballast tanks, propellers or shafts. Aluminium alloy anodes also provide excellent, cost-effective performance in seawater, but zinc is especially versatile when vessels experience waters of varying salinity such as estuaries and harbours with freshwater inflow.

continues on page 34

Figure 3: HMAS Arunta - an Anzac-Class Frigate of the Royal Australian Navy (RAN) Showing Zinc Galvanic (Sacrificial) Anodes Along the Hull.

Conclusions

Although the intent of this paper is to focus on Davy's work, it is important to note that in the decades and now centuries following Davy's work extraordinary advances were made in the understanding of the science that underpins CP [13, 18, 19], amongst other fields of science and engineering, this included:

- Michael Faraday's discovery and experimental proof about the electrochemical equivalence between electric current and corrosion already mentioned.
- Josiah Gibbs' development of the thermodynamics that lets us determine whether an electrochemical reaction can occur.
- Julius Tafel's investigations and descriptions during the 1890's and early 1900's about how changes in the metal potential can regulate the anodic and cathodic reaction rates and
- Walther Nernst who showed how the potential of a metal could be calculated if the concentrations of reactants and products were known and in doing so, the stability of chemical species could be predicted if the potential and pH were known.
- Marcel Pourbaix summarised all of these features into his first beautiful Pourbaix diagrams [20, 21].
- Mears and Brown [22] also provided a clear kinetic description of CP in 1938 that is still valid today.
- R. J. Kuhn [23, 24] first suggested the earliest criterion for CP of polarising to -0.85 VCSE or more negative, which was shown to be suitable for steel, not only in seawater [25] but also in soils [26].

The increase in pH at the metal surface [27] and the subsequent development of passive oxide films during cathodic polarisation and their role in mitigating corrosion for steel, when considering both the kinetics and thermodynamics, is now well established for iron and steel alloys [28-30] and our deeper understanding continues to evolve, as good science always does.

Role of Calcareous Deposits

- It was recognised very early on [31] that the primary protective action of the calcareous deposits is to; (i) act as a barrier to oxygen or other depolarisers, (ii) increase the internal resistance of the local corrosion cells and (iii) increase the pH of the water film in contact with the metal surface above that of normal seawater. The benefits to marine cathodic protection systems are now well known, particularly in reducing the current density requirement for corrosion mitigation [31-35], a feature reflected in various industry standards for marine structures [36-38].
- The formation of calcareous deposits anticipated and observed by Davy is also still of special interest today and the circumstances of their formation continue to be investigated [17, 39]. R. J. Kuhn [24] also noted the formation of calcareous deposits that varied from *"… practically nothing in neutral areas to an inch in thickness in heavily drained areas"*, and hence in the degree of the protective or beneficial efficiency.
- The calcareous deposits formed by CP can also have detrimental effects such as accelerated bearing wear in water-lubricated propeller shafts and seizing of hull valves due to clogging [17], or in non-seawater applications such as limiting heat transfer of pumps causing overheating. Means of avoiding these adverse effects continue to be investigated [17], along with understanding the effects of CP upon biofouling [40].

Davy achieved remarkable success even though after 200 years, issues with the protection of metals and alloys using CP are still the subject of ongoing research and refinement. The future remains bright, with vigorous research continuing worldwide into CP, advancing the science and range of applications to an ever-widening array of structures. Science never sleeps and no doubt each new generation of scientists and engineers will, bit by bit, keep adding to our knowledge and advance Davy's legacy.

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A Critical Assessment of The Half-Life Ageing Term and Failure to Predict Future Galvanic Anode Behaviour

C M Stone, and G K Glass

INSTITUTE OF CORROSION

Meet the Authors

Christian Stone

Gareth Glass

Christian Stone, M.S., M.Phys., is a corrosion scientist and technical expert at Concrete Preservation Technologies (CPT) who specialises in the development of next-generation corrosion management systems, supports the use of cathodic protection worldwide, and is a leading expert in corrosion in RAAC concrete. Christian sits on a number of professional organisations, is a member of the Loughborough University RAAC Research Team and is currently undertaking further research on RAAC with Loughborough University.

Gareth Glass is a Director at Concrete Preservation Technologies (CPT), a position he has held since the inception of the company in 2005. He has extensive experience in materials technology, durability and rehabilitation of structures with over 100 publications to his name in the area of corrosion protection. He obtained his PhD from the Corrosion and Protection Centre, University of Manchester.

Introduction

The term 'ageing factor' (sometimes referred to as 'ageing constant') for galvanic Anodes, was first coined by Sergi et al in 'Monitoring results of galvanic anodes in steel reinforced concrete over 20 years' in Construction and Building Materials, 2020 [1]. The principle behind this idea is that discrete measurements of galvanic current data from precast anode systems, when plotted on a logarithmic graph, could be fitted with a straight line. Therefore, they claim that their anodes exhibit a 'half-life' model with the current trending to zero, halving over set time intervals, the 'ageing factor'. They further claim that when the anodic current density falls below a threshold, the anodes no longer adequately protect the steel reinforcement.

Modelling – Apparent Discrepancies

The first site analysed by Sergi et al. was a bridge in Leicester; current was measured. approximately 26 times for 12 individual patch-anodes from a single patch over 20 years. The initial description of the anodic current describes three distinct stages of relatively stable current output, each below the prior level: 0-6 years, 7-14 years and 15-20 years. This was described, at least in part, due to a drop in pH of the pore solution of the electrolyte. A half-life ageing constant of approximately 7 years over which the current would half was then generated by the plotting of the current readings on a logarithmic scale and a straight line being fit to the data [1]. The reason for the choice of a logarithmic scale is not fully explained, with decreases in surface area and depletion of lithium hydroxide being cited.

This concept was furthered in the next year in the Journal of Building Engineering (June 2021) [3], at the Corrosion Conference (November 2021) [4], Structural Faults and Repair Conference (2022), an ICRI webinar, 'Design Considerations for Galvanic Anodes' (December 2022) [5], in the book Life-Cycle of Structures and Infrastructure Systems [6], and 3rd Conference & Expo Genoa (2024) [7]. Throughout these publications, 'ageing factors' were published for approximately 12 elements using precast Vector Corrosion Technologies (VCT) anodes and their precast precursors, and included both site and laboratory data. Of particular note was the ICRI webinar and the AMPP Italy Corrosion Conference white paper, where the half-life style 'ageing-factor' hypothesis was applied to non-precast anodes manufactured by other companies, including Concrete Preservation Technologies (CPT) and an 'ageing factor' was published for CPT's hybrid anode, one that is initially powered externally before being wired galvanically, the DuoGuard™ anode system [5,7]. The predicted 'ageing constant' published for these anodes was 2.9 years, and was compared unfavourably to the 11 year 'ageing factor' for their own products.

There were however, some significant changes made to use of this empirical model. Rather than being a model for some precast patch anodes manufactured by a single company and their precursor anodes the hypothesis was now being applied to anode arrays cast with a different geometry, embedded in a different cementitious material, located in the host concrete rather than a patch, and very importantly not activated using the same chemistry that was cited as a major cause of the exponential decay in the original paper [1]. DuoGuard™ is activated chemically in such a way that the activator is not depleted but recycled, continually drawn back to the anode. Therefore, the theoretical underpinnings cited by the authors do not appear to hold for these anodes. This has led to the need for a closer look at this model and whether it can tell us anything about the behaviour of these anode systems or whether the model can reliably predict the behaviour of CPT anodes.

In order to understand this model, it is important to first explore the stated and hidden axioms behind the hypothesis and how these lead Sergi, Whitmore and others to interpret their data in such a way. In this section, we will place to one side the fact that there is no stated theoretical underpinning to the choice of a logarithmic scale and allow for the strength of the predicted current data to judge its veracity.

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Photo: The Whiteadder Bridge.

Half-Life Theory Axiom - There is A Set, Minimum Current Threshold For the Protection of Steel In Concrete

The corrosion risk of steel is due to its environment. This should be a relatively uncontroversial statement, as it is known that steel in fresh concrete is passive and requires no cathodic protection, and steel in carbonated concrete has a lower corrosion rate on average than steel in chloride-rich environments [8]. Furthermore, corrosion rates can vary due to the exposure to moisture, availability of oxygen and be changed by coatings applied to the steel. It is therefore reasonable to assume that the amount of protection steel in concrete requires for protection is a product of its environment.

Although the authors do acknowledge the importance of chloride in the amount of current needed to protect steel in concrete [7], they ignore many of the other factors. This inherent complexity is why it is often much easier to measure changes in the steel due to protection rather than purely the current output of the system. Such measurements are common with impressed current cathodic protection (ICCP) systems that use ISO 12696:2021 [9], which gives steel potentials in the immune region and polarisation held in the steel. originating from Mixed Potential Theory [10,11], as criteria for protection. Within galvanic cathodic protection (GCP), it is common to track the depolarised steel potentials [12] to measure changes in corrosion risk, polarisation [13] and corrosion rates [14,15]. These measure the effect of the anodes on the steel rather than the output alone to determine the level of protection achieved.

Comparison of Anode Systems

This is further complicated by the fact that some anode systems are installed in different ways, leading to varied current spread. It matters very little how much current an anode produces if it is not reaching the at-risk steel it is installed to protect. To explain this concept more clearly, two anode systems for patch repair will be compared: a precast anode designed to be tied onto the reinforcement in a patch and a patch anode that is installed into a putty in the periphery of the patch, away from a single steel rebar. Below CPTs precast anode RebaGuard™ and drilled anodes PatchGuard™ can be seen. RebaGuard™ is similar to the anodes installed in many of the author's works.

Photo: Precast Anode (Left) Attached To The Steel Within A Patch Repair During Installation And Discrete PatchGuard™ Anode Schematic (Right) Showing Its Installation Into The Periphery of The Patch.

The steel being protected by patch anodes is the steel outside of the patch, as the steel in the patch is in fresh, alkaline, contaminant-free concrete. The precast anodes are tied to the steel within the patch. It is not difficult to see that it is likely that a large portion of the current will take the easiest path between the zinc and the steel, to the reinforcement onto which it is tied. The current that does exit the patch must avoid taking the easiest path, passing through the interface between the patch and the host concrete, which will have a resistance and spread to the steel outside of the patch which is at some distance from the anodes. These anodes can and do work, but it is unlikely that all the current they produce is available to the steel they are protecting.

The PatchGuard™ anode is installed into the periphery of the patch, in the host concrete into a conductive putty, much closer to the steel it is designed to protect. Unlike the precast anodes, it is not tied to a single reinforcement, and the current will therefore more easily spread to the at-risk reinforcement. Furthermore, due to the increased resistivity of most patch materials and the resistive interface of the patch making current flow into the patch more difficult, it will favour passing current to the steel outside the patch rather than within the patch. It is therefore logical to think that the current from this PatchGuard™ anode will protect the rebar much more efficiently than the precast anode. Having the same current requirement for each of these anodes is illogical.

The validity of their threshold may be tested using the author's data. The first work published in this series was the 20-year data from a 'bridge in Leicester' [1]. This site is a site which staff at CPT is quite familiar, and many senior members of staff were present at the installation of these anodes. Though the paper claims that after 20 years that the anodes are reaching the end of their life, with the current output dropping under their threshold for protection at approximately 14.5 years. In a statement to the Cathodic Protection Association (CPA) from March 2023 by CPT [16], it was shown that in 2015, ten years after the installation of the anodes, there was cracking in the element following the line of the reinforcement extending from the repairs. This is not a measure of success in a galvanic anode system and shows a flaw in their current threshold.

Photo: Patch Repair Cited as Being Protected By Precast Galvanic Anodes in 2015.

Potential Measurement Error - Taking Current Data From A Responsive System

One of the most important concepts with galvanic anodes is their responsive behaviour [17,18]. The driving voltage, as long as the anodes are activated, is due to the galvanic series and therefore can be approximated as constant; the current delivered to the steel is therefore largely dependent on the resistivity of the electrolyte in the circuit, the concrete. So, when the concrete is wet, full of ions, warm, etc, the circuit has a lower resistance and the cell between the zinc and the steel produces a higher current. This is a part of the draw of these anode systems as they give a level of protection which changes with the corrosion risk of the environment.

One of the issues that comes with this fluctuation in current is that when the anode currents are measured infrequently without other corresponding data, such as the weather. Steel polarisation or natural steel potentials – the data can be misleading. Currents taken on wet and warm days may be much larger than those taken on dry and cool days, which can make seeing trends in current output difficult, unless Adequate data is collected.

Furthermore, anodes installed into wet patches, or into slow-curing putties may have initial currents which are atypical due to the moisture surrounding the anode, decreasing the resistance between the zinc and the steel. In CPT's anode systems, the putty may take many years to cure, a design feature to initially provide a larger current to aid in the passivation of the steel due to the reduction reactions at the steel surface producing hydroxide ions.

This ageing constant generated for CPT DuoGuard anodes was created from a few data points using anodic current data from only the first nine years of the galvanic protection [7]. This was during the period when the putty was curing. This may have led to some inaccuracies in predicting the long-term behaviour of these anodes.

Whiteadder Bridge – Duoguard Hybrid Anode System CASE Study

The data used by Sergi et al to calculate the ageing factor for DuoGuard™ anodes was taken from data published from Whiteadder Bridge in the UK [17].Here, two zones of anodes were installed within a proprietary putty in regularly spaced, drilled holes, and wired together to form arrays which protect the upper and lower portions of the structural element supporting the span of the bridge over a river. The anodes were installed to counteract the corrosion issues caused by de-icing salts and moisture ingress, including tidal flooding of the river.

The anodes were initially powered until at least 50kC of charge had been passed for every square meter of steel surface area to realkalise the steel environment, utilising the zinc's ability to pass much higher currents than MMO titanium anodes when powered, and then connected directly to the steel via a junction box. Reference electrodes were installed in the zones, and the current output of the anodes alongside the reference potentials were measured by a data logger installed in an enclosure. This gives a constant stream of data, far in excess of those sites of similar ages used in the work by Sergi and Whitmore.

The element has been protected for 18.5 years now without the need for any maintenance beyond the replacement of SIM cards in the enclosure which transmit the data wirelessly to our office, and has been monitored with over 100,000 data points collected over the first 17.5 years of protection in each zone and over 1,000,000 data points collected in sum. The data used for the predicted 2.9-year ageing factor found in the AMPP Italy white paper [7] was taken from the first 9 years of data [17], which was not the most recent publicly available data set at the time [18] and appears to include only a small number of data points. It is unclear how these data points were selected. Due to the initial charging of the anodes, the authors claim that it would be expected that such anodes would likely have a decreased life due to having to pass a large amount of current early in their design life [7].

Although this model is now used in specifications and design documents worldwide, this will be the first predictive test of their empirical model and, importantly, a test of whether this model can be applied to anodes other than their own, for which they likely have a greater abundance of data. The aim of the following section is to analyse the predictive power of this model using data from the CPT site used in their analysis using the most recent data collected which presumably they had little access to.

Site Data – Responsive Behaviour

Below are the current and the polarised steel potentials for the lower zone of anodes installed on Whiteadder Bridge above, the same data used in the author's work [7,17], but now with an additional 8 years of data. The red line is the galvanic current data showing the characteristic responsive behaviour with currents rising and falling in yearly cycles due to temperature changes and peaking during periods of increased moisture due to rainfall or flooding. This supports the theory that current is being driven in these anodes due to changes in resistance in the concrete electrolyte. The blue line is the polarised steel potential. When the current increases, we see a corresponding peak in the steel potential as the current generates a polarisation in the steel. Polarisation is a sign of steel passivity, with more passive steel polarising more easily than corroding steel. A green line has been added to show that over time the steel potentials are trending less negative, an indication of increased steel passivity.

Figure 1: Lower Zone Current (Red) and Polarised Steel Potential (Blue) Taken From Whiteadder Bridge 17.5 Years After Installation of The DuoGuard™ system.

The first few years of the data do show an increased current output from the anodes. As was previously stated, this is likely due to the putty into which the anodes were installed curing. After this period, the current appears to become more stable and respond to changes in resistivity from a relatively stable baseline. Taking a closer look at the data from around 9 years after installation, we can see the current from both zones increases due to fluctuations in temperature during the day as well as throughout the year. This response to corrosion risk with increased protection is one of the hallmarks of a naturally smart corrosion management system that is driven by electrochemistry.

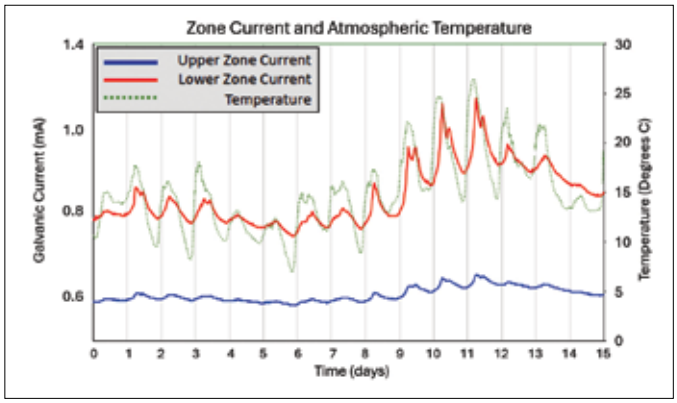

Figure 2: Data Showing Upper (Blue) and Lower (Red) Zone Currents Responding To ChangesIn The Temperature (Green) Approximately 9 Years After Installation.

After flooding and rainfall, we can see that not only does the current increase due to the moisture ingress, but it also falls slowly as the moisture evaporates, leading to increased protection during the entire period of increased risk. Furthermore, some of the peaks in current seen during periods of increased moisture are larger than

continues on page 38

the initial anode current, indicating that the current output is not being primarily driven by a build up of corrosion products or a depletion in activator for these systems but a reaction to the environment and the corrosion risk.

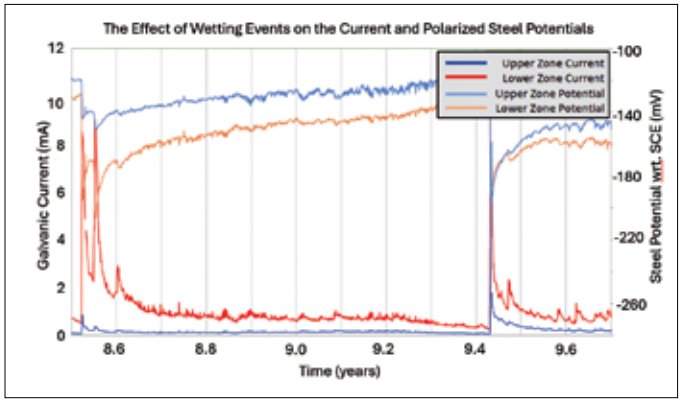

Figure 3: Data Taken During Rainfall and Flooding at Whiteadder Bridge.

Testing he Predictive Power of The Half-Life 'Ageing Factor'

In order to test the predictive power of the model, we must choose a null hypothesis against which it will be compared. The simplest null hypothesis would be that the median current the system was producing between 8 and 9 years, the last year of the data set utilised by the authors, stays constant. This appears to be a fair null hypothesis to test their predicted values against, as one predicts a decrease and the other predicts no decrease in current.

The authors published a half-life 'ageing factor' of 2.9 years, where the current halves every 2.9 year period. Here we have plotted the predicted values for each hypothesis against the data collected from the site during the period from year 8 to year 17, approximately 3 ageing factors or an expectation that the current, if the model is correct, will fall by more than 87.5%. A log current graph was chosen to transcribe the half-life model data into a straight line in a similar fashion to that employed by Sergi in his work.

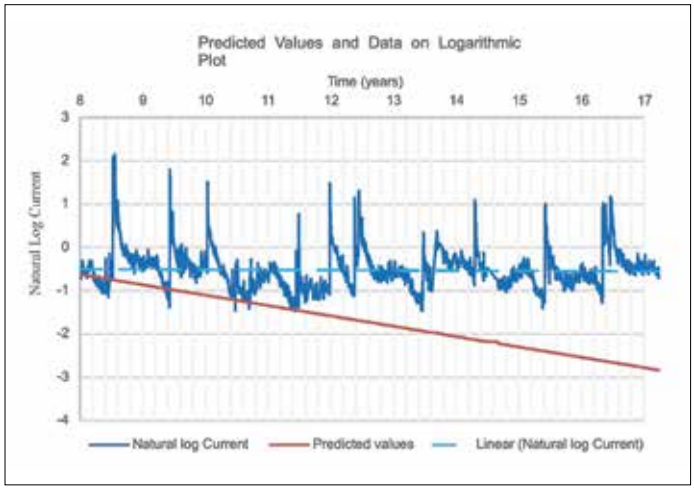

Figure 4: Real Current Data (Dark Blue) Plotted Against Predicted Values From The Null Hypothesis (Light Blue Dashed) and Ageing Factor Model (Red) On a Natural Log of Current Over Time Graph.

As can clearly be seen, the values predicted by the 'ageing factor' model (red) diverge from those measured on site over time, whereas the constant current model fits the data much more closely. This becomes evident when the mean squared error (MSE) of each predicted data set is measured; with the half-life hypothesis having an MSE of 0.237 mA^2 and the MSE of a simple constant value model being 0.0135 mA^2, an order of magnitude smaller.

The error is likely due to a misunderstanding of how these anodes will behave differently over time due to their activation chemistry and presuming that the same methodology should be employed without testing other hypotheses, leading to the authors choosing to fit the same exponential decay that fit their own data. A simple change in their methodology to presume an exponential decay overlaying a more stable pattern can lead to a much better fit in the data and a lower MSE over the previously available data.

Below is an empirical model presuming a decay plus a constant current calculated using the first 9 years of data only. It should be noted that this is not a lifetime predictive model for these anodes, which will depend on many factors, as the anodes will not continue protecting the steel indefinitely and it is expected that when the volume of the anodes reduces beyond a threshold the ratio of zinc to steel surface areas will be insufficient to pass the same current. This fact in included in the design calculations of these anode systems. This is also not an endorsement of current being used as a benchmark for anode performance. However, as around 7% of the anodes on this site have currently been consumed, in the lifetime provided for this system it is unlikely to reach this threshold and this basic model may suffice, depending on environmental conditions. Therefore, over this limited time period, a relatively stable current may be used as changes in surface areas are relatively slow due to the anode geometry chosen by CPT and the activator should continue to keep the zinc active. An initial period of higher current due to the resistivity drop from the curing of the putty is also included in this limited model.

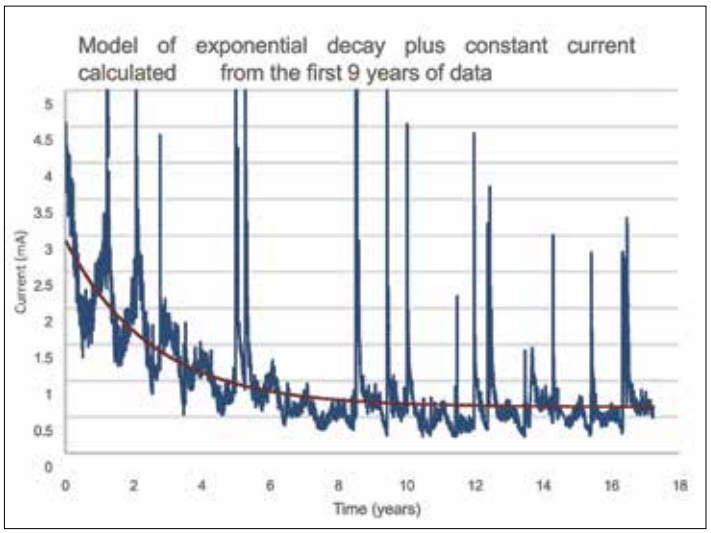

Figure 5: Real Data (Dark Blue) Plotted Against Empirical Model (Red).

We believe that much of the error in the predicted value of the ageing term is due to the presumption that the overall behaviour would be similar. However, the difference in the activators used to keep the anodes active may lead to differing behaviour giving precast anodes an exponential decay of current to zero. This depletion in their activator, may lead to the amount of protection being in a large part dependent not on the amount of zinc but rather on the amount of activator utilised. Activators such as lithium hydroxide are consumed, may be leached away from the anodes, and carbonate after manufacture. Anodes activated in similar ways to PatchGuardTM and DuoGuard™ are likely to age very differently, as the availability of activator will not deplete in the same fashion and are therefore unlikely to show the same ageing characteristics. This can be seen clearly by calculating their hypothetical ageing constant using the data from years 8-17 using the same method as Sergi et al. Here we calculate the ageing constant over which the current is halved to be over 36,000 years. This is plainly absurd, as the zinc will be completely depleted after around 100-250 years. The underlying ageing of CPT anodes is therefore very unlikely to be exponential in nature.

Conclusions

It is clear from this data that the major factor driving the current output of CPT's discrete anodes, is changes in the resistivity of the environment. After 17 years, the current was still responding strongly to changes in moisture, producing currents in excess of the median galvanic current from the first year of installation when moisture ingress reduces the resistivity of the environment. Precast anodes, such as the type used in the creation of the half-life model, may also be limited by a second factor, the depletion of their activator. This is concerning as these anode types are very popular worldwide and are often sold based on a mass of zinc, when, without sufficient activator, that mass of zinc will not be fully utilised. With lithium hydroxide as an activator, the mass of the activator would likely need to be much greater than the mass of zinc. It is likely, therefore, that only a portion of these anodes will be sufficiently activated before the current declines substantially.

Due to the depletion of activator, some form of ageing term may well apply to VCT style products as stated by their authors. However, due to this hypothesis failing to accurately predict the behaviour of other anode systems, it should be avoided in all specification documents as it may be unique to a certain set of products. It is important to ensure that clients are getting the same level of protection from anodes sold as equivalents in the market.

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Epoxy Passive Fire Protection Over Galvanised Steel

C J (Chris) Fyfe, CSci, FICorr, AMPP Senior Corrosion Technologist, AMPP Senior Certified Coatings Inspector

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Meet the Author

Chris Fyfe

Chris Fyfe, an ICorr Fellow member, is a senior field auditor and coach at International Paint (a division within AkzoNobel) with over 40 years of experience in protective coatings and corrosion control. He has a strong background in passive fire protection (PFP). He has provided on-site technical support and managed complex fabric maintenance projects within the oil and gas sector. He is a strong advocate for professional development and has championed the training and upskilling of many Epoxy PFP applicators.

1. Introduction

Epoxy Passive Fire Protection (EPFP) systems are safety-critical coatings that are installed in high-hazard process facilities and sometimes also in public buildings. Their requirement is often driven by legislation and are considered of life-safety importance.

Epoxy Passive Fire Protection (EPFP) is designed to insulate critical steel structures from the temperature rise (heat) in a fire event. This safety-critical insulation function slows the temperature rise to maintain structural or pressure retaining integrity, giving time for emergency shutdown, inventory blowdown, and/or safe abandonment. Therefore, correct quality control activities during the whole installation process are critical; this is because the entire system holds a function but ultimately is only as strong as its foundation. For example, when the EPFP is applied to a galvanised surface, the galvanising itself becomes that foundation, and therefore, it's critical that confidence (quality assurance) is demonstrated. If the galvanising fails, then the EPFP may become compromised.

Hot-dip galvanising creates a metallurgical bond between zinc and steel. When executed correctly on a properly prepared surface, this bond is incredibly robust. However, several factors in the galvanising process

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can create a weak and unreliable substrate that may be unsuitable for supporting a safety-critical EPFP system. It is crucial to understand that these issues are not restricted to EPFP alone; they are a fundamental concern for all high-build coating systems that rely on a strong foundation to function. An example of galvanised steel section with EPFP applied is shown below in Photo 1.

Photo 1: An Example of Galvanised Steel Section with EPFP Applied Ready for Transport.

This article will explore:

1. The inherent risks associated with galvanising including excessive thickness, metallurgical defects, and inadequate repair methods that can compromise the bond and ultimately could detract from the overall durability of the system.

2. This article will argue that the best practice is the direct application of EPFP paint systems to properly prepared steel substrates as a correctly installed EPFP system can give a comparable durability range. Therefore, galvanising should only be considered as a substrate for EPFP when there are no other design options available, and even then, only with additional (stringent) quality control measures that may go beyond typical industry/project expectations. This article will explore the inherent risks associated with galvanising including excessive thickness, metallurgical defects, and inadequate repair methods that can compromise the bond and ultimately could detract from the overall durability of the system.

2. The Challenge with Galvanising

The ability of a galvanised coating to support an EPFP system can be severely impaired by several influencing factors:

- **Excessive galvanising thickness:** The primary source of impairment.
- **Metallurgical defects:** Inclusions and weak layers that may form during the galvanising process.
- **Poor bonding:** Initial or Inadequate surface preparation leading to a weak bond.
- **Surface passivation:** Post-galvanising treatments that can impair adhesion.

The "Thicker is Better" Concept

Standard galvanising specifications like ISO 1461 and ASTM A123 are written with no consideration that EPFP system may also get specified and are typically for corrosion protection, **they do not consider any additional thick film coating such a EPFP system.**

They often imply that exceeding the minimum with no consideration to maximum thickness is not a cause for concern. However, for EPFP applications, this is a dangerous misleading understanding. Experience has shown that as a galvanised coating thickness increases, its cohesive strength may decrease. The primary drivers for this excessive growth are the chemical composition of the steel—typically its silicon (Si) and phosphorus (P) content—and the thermal mass of the steel section [2].

- **High Silicon and Phosphorus Content**: Steel with high levels of silicon (particularly in the range of 0.04% to 0.14%, known as the "Sandelin range") and phosphorus accelerates the growth of the zinc-iron alloy layers (eta, zeta, and delta).
- **Uncontrolled Growth:** Rapid growth results in a thick, brittle, and often friable zeta layer. Instead of a dense, tightly bonded coating, there is an increasing likelihood that a coarse crystalline structure which is inherently weak may result.

Therefore, a galvanised coating that is too thick—for example, exceeding 250 µm (microns)—may not be robust when coated with thick EPFP coatings. It may have micro-cracks and a high degree of internal stress resulting in voids and weak layers. When the EPFP is applied over this type of surface, the galvanised layer itself can delaminate due to stress imparted by the EPFP.

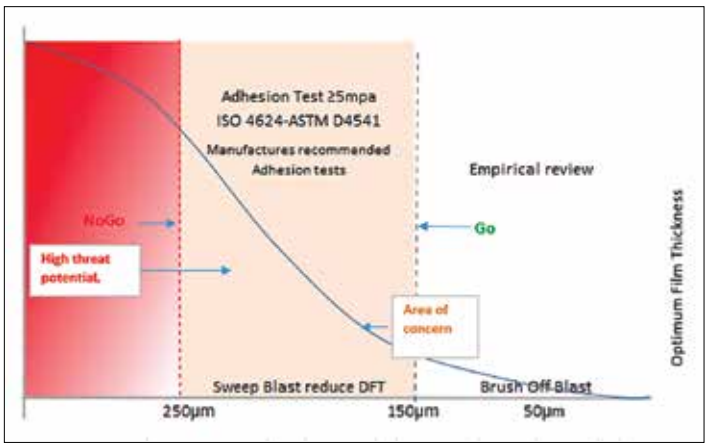

Figure 1. Growth in Galvanising Threat Visualisation Chart.

3.Setting Strict Limits

Therefore, a robust, well-written project specification should consider the standard galvanising process and procedure but, in addition, set its own quality control and quality assurance requirements. The following limits should be considered important:

- **Upper Galvanising Limit:** The galvanising thickness must be strictly controlled. Any measurements **exceeding 250 µm** should trigger a formal integrity assessment. Sections with thicknesses **greater than 250-400 µm should be quarantined until additional quality control testing can give assurance of acceptability.** This includes but is not limited to. Adhesion testing using both internationally recognised standards and EPFP manufacturers' recommended procedures.
- **Mill Test Certificates:** Engineers and specifiers should always review the steel's Mill Test Certificate (MTC) **at the design stage**. An MTC (specifically a Type 3.1 certificate as per ISO 10474) provides a detailed chemical breakdown. If the silicon and phosphorus levels are high, excessive galvanising growth could be considered predictable, and the required additional inspection protocols can then be implemented by the engineer early **at the galvaniser's facility.**

4.Defects Which Could Impair Performance

Defects within the galvanising layer that may create points of failure.

- Ash and Dross Inclusions: Ash (zinc oxide from the zinc bath surface) and dross (iron-zinc particles from the bath bottom) can become entrapped in the coating. These inclusions can be poorly bonded, creating an area of instant non-adhesion for the primer and EPFP [3].

Photo 2: Ash Also Known as Zinc Ash or Skimming's from the Hot Zinc Bath. These Imperfection Can Cause Adhesive Impairments.

Photo 3: Dross Inclusions Appear as Small, Round Bumps on the Galvanised Surface. These Imperfection Can Cause Adhesive Impairments.

5.Process Factors which Could Impair Performance

Properties at the surface of the galvanising layer that may create immediate points of failure.

- **Passivation and Quenching**: Post-treatment of galvanised surfaces with chromates or water quenching is common. Water quenching creates a thin, weak layer of zinc oxides and hydroxides on the surface. Chromate treatments are often used for aesthetics.This layer is completely unsuitable for coating adhesion and should be prohibited in the project specification. Any steel that has been water-quenched should be rejected before an EPFP application.
- **Use of Cold Spray Repair Compounds:** Where surface defects are observed by the galvaniser, cold spray repair compounds may be used to improve the aesthetic appearance of the galvanising.

Note. These repair compounds are not compatible with EPFP systems and may lead to coating system delamination. Any items where cold spray repair compounds have been used should be **rejected** prior to EPFP system application.

6.High Film Builds: A Closer Look at the Implications

When a thick-film material like EPFP is applied over a cohesively weak galvanised layer, several critical issues could materialise.

1. **Adhesion Failure:** The primer for the EPFP system cannot achieve a proper bond to a galvanised surface which is contaminated with weak oxide layers or has incompatible treatments applied. The failure point is within the incompatible treatment in the case of cold spray repair compounds or between the primer and the galvanised steel.

2.**Internal Stress:** The EPFP can induce stress during cure, and a brittle or weak, over-thick layer may crack or delaminate.

7. Remedial Actions: No Half Measures

When non-conformances are found, the remedial actions need to be appropriate to the EPFP system application. **The goal is not to "repair" the galvanising in the traditional sense but** to create a sound substrate for the EPFP.

1. **Quarantined:** For issues like water quenching or thickness exceeding 250 µm to 400 µm, the section should be **quarantined.** Until quality assurance can be demonstrated.
2. **Thorough blasting with appropriate media:** For sections with excessive thickness (250 µm - 400 µm) or surface defects like ash, the only acceptable method of repair is to aggressively abrasive blast. The goal of a "sweep blast" is not merely to create a profile; it is to r**emove the defective and friable outer layers of the galvanising** until a sound adherent zinc layer is exposed. If this means blasting through to harder alloy layers in localised areas, then the justification can be presented: "Lifetime expectation is met by the application of the EPFP system." However, this must be brought to the client's attention as a technical or engineering query, as it fundamentally changes the specification requirement.
3. **Stop Inadequate Repairs:** Standard galvanising repair methods, such as cold spray repair compounds detailed in standards like ASTM A780, or the use of zinc-based solders ("zinc sticks"), **should not be accepted** for surfaces receiving EPFP. These repairs do not possess the cohesive strength or compatibility with the EPFP system and could create a point of failure.

All galvanised steel specified for EPFP application should always be sweep blasted to remove surface contaminants and any weak oxide layer, providing an angular profile of 50-75 µm for the EPFP system to anchor against. This should be stated clearly in the specification.

8. Conclusion: A Call for Best Practice

The industry must shift its mindset. Applying EPFP over hot-dip galvanising introduces significant, unnecessary risk to a facility's most critical safety infrastructure. The default specification should always be EPFP applied directly to appropriately primed steel prepared to the EPFP manufacturer's requirements.

When galvanising is unavoidable, it must **not** be treated as **a finished product** but as a substrate in need of quality control and further preparation for the EPFP system.

To achieve a safe and reliable outcome, the following actions should be considered essential.

- **Early Intervention:** Review mill test certificates at the project's outset to identify reactive steels and plan for heightened inspection.
- **Specify Correctly:** Write a detailed coating specification that explicitly prohibits water quenching and surface treatments and defines strict lower and upper thickness limits for the galvanising coating.
- **Mandatory Surface Preparation:** Mandate that all galvanised surfaces receive an aggressive sweep blast to remove weak layers and create a suitable surface profile before priming.
- **Consult the Experts:** Engage the EPFP manufacturer at the design stage to assist with specifications and inspection test plans (ITPs).

By prioritising the integrity of the substrate, we can ensure that these vital safety systems perform as designed, protecting assets, the environment, and, most importantly, lives.

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LBBC BASKERVILLE
Tel: 0113 2057423 www.bbcbaskerville.com

LLEWELLYN RYLAND LTD
Tel: 0121 4402284 Email: research@llewellyn-ryland.co.uk

PRESSERV LTD
Tel: 01224 772694 Email: stuart.rennie@presserv.com

SCANGRIT
Tel: 01469 574715 Email: sales@scangrit.co.uk
www.scangrit.co.uk

RECIPROCAL ORGANISATIONS

CEOCOR
Website: www. ceocor.lu

ELSEVIER SCIENCE LTD
Tel: 01865 843000

GALVANISERS ASSOCIATION
Tel 0121 355 8838 Email: Ga@hdg.org.uk

INSTITUTE OF MATERIALS FINISHING (IMF)
Unit 2 The Coutyard, Roman Way, Coleshill
Birmingham B46 1HQ
Contact Helen Wood Email: helen@materialsfinishing.org
Tel: 0121 622 7387 www.materials-finishing.org

OIL & COLOUR CHEMISTS' ASSOCIATION (OCCA)
4th Floor Clayton House, 59 Picadilly, Manchester M1 2AQ
Contact Ann-Marie Etherington Email: admin@occa.org.uk
Tel 0161 257 6488 www.occa.org.uk

MARINE CORROSION FORUM
Website: www. marinecorrosionforum.co.uk

QUALITY CONTROL

ELCOMETER
Tel: +44 (0) 161 371 6000 www.elcometer.com

TRAINING AFFILIATES

ARGYLL RUANE LTD
Contact Kristian Hampson at kristian.hampson@argyllruane.com
Web: www.argyllruane.com

CORRODERE ACADEMY
Tel: 01252 732236 Web: www.corrodere.com

ICATS / CORREX
(**Kevin Harold** -ICATS courses) **Email:** kevin@paintel.com
(Admin) **Email:** correx@icorr.org

Institute Events & Training

INSTITUTE OF CORROSION

DIARY DATES 2025/6

Latest event details are posted at: https://www.icorr.org/events/

BRANCH EVENTS

4th November 2025, North West Branch
In Person: ICorr Global AGM hosted by North West Branch.
Contact: nwchair@icorr.org

11th November 2025, India Branch
Online Technical Talk.
Contact: INDIAchair@icorr.org

13th November 2025, London Branch
Protection of Renewable Energy structures.
For further details see the events calendar on the website

18th November, UAE Branch
Online Technical Talk.
Email: UAEchair@icorr.org

19th November, Yorkshire & Humber Branch
In Person: ICorr Yorkshire & Humber relaunch event and AGM - Corrosion challenges in additivelymanufactured metal alloys.
Email: yorkshirechair@icorr.org

25th November, Aberdeen Branch
In Person: Joint Event with IOM3.
Email: ABZchair@icorr.org

26th November, Central Scotland Branch
In Person: Technical Talk - Embracing change, the role of asset integrity on new product introduction.
Email: cschair@icorr.org

4th December 2025, London Branch
Christmas Luncheon, ROSL, Piccadilly.

OTHER EVENTS

26th-28th November 2025
CEFRACOR Conference

COURSES AND EXAMS

CPGB

The new CP scheme has been developed based on ISO 15257:2017 and has three elements: Training / Examination / Certification. All courses are delivered only by ICorr approved tutors who are themselves Certificated to Level 4 or higher in the CP sector of the courses that they deliver. For available courses please check: Cathodic Protection Courses – Institute of Corrosion.

Corrosion Mechanisms in Stainless Steels

6th November 2025 Aberdeen,
Course is delivered in collaboration with the British Stainless-Steel Association (BSSA) and R-TECH Materials.
Contact: sarah.bagnall@r-techmaterials.com

STGB

ARGYLL RUANE

ICorr Training Partner

Hot Dip Galvanising Inspector Level 2
Online. Sign up anytime.

Protective Coatings Inspector Level 1
3rd – 10th November 2025 (Sheffield)
8th – 15th December 2025 (Sheffield)
12th – 19th January 2026 (Sheffield)
23rd Feb – 2nd March 2026 (Sheffield)

Protective Coatings Inspector Level 2
17th – 24th November 2025 (Dunfermline)

Protective Coatings Inspector Level 3
26th – 20th February 2026 (Sheffield)

Insulation Inspector Level 2
Online. Sign up anytime.

Passive Fire Protection (PFP) Coating Inspector (Cementitious) Level 2
Online. Sign up anytime.

Passive Fire Protection (PFP) Coating Inspector (Epoxy) Level 2
Online. Sign up anytime.

ICorr Recertification Programme
Available for all core methods. Online. Sign up anytime.

Transition to ICorr Programme
Online. Sign up anytime.

corrodere academy

ICorr Training Partner

Coating Inspection Level 1
Online - enrol anytime. Practical workshop and assessment dates available at corrodere.com/events

Coating Inspection Level 2
Online – enrol anytime. Theoretical workshop and assessment dates available at corrodere.com/events

Coating Inspection Level 3
Online – enrol anytime. Advanced workshop and assessment dates available at corrodere.com/events

Insulation Inspection Level 2
Online – enrol anytime

Pipeline Coating Inspection Level 2
Online – enrol anytime

Hot Dip Galvanising Inspection Level 2
Online – enrol anytime

Thermal Metal Spraying Inspection Level 2
Online – enrol anytime

Transition to ICorr Level 1
Online – enrol anytime

Transition to ICorr Level 2
Online – enrol anytime

Visit the ICATS website
www.icats-training.org

BRANCH CONTACT DIRECTORY

ABERDEEN:
ABERDEEN: Mei Ling Cheah (Chair)
Email: ABZchair@icorr.org

CENTRAL SCOTLAND:
Philip Enegela (Chair)
Email: cschair@icorr.org

LONDON:
Paul Brooks (Chair)
Email: londonchair@icorr.org

MIDLANDS BRANCH:
Prafull Sharma (Chair)
Email: midlandschair@icorr.org

NORTH EAST:
Matt Fletcher (Chair)
Email: nechair@icorr.org

NORTH WEST:
Greg Brown (Chair)
Email: nwchair@icorr.org

WALES and SOUTH WEST:
Sarah Bagnall (Chair)
Email: swchair@icorr.org

YORKSHIRE and HUMBER:
Joshua Owen (Interim Chair)
Email: yorkshirechair@icorr.org

OVERSEAS CONTACTS:

UAE
Dr Muhammad Ejaz (Chair)
Email: UAEchair@icorr.org

INDIA
Arpit Goyal (Chair)
Email: INDIAchair@icorr.org

DIVISIONAL CONTACTS:

CSD DIVISION:
Julian Wharton (Chair)
Email: csdchair@icorr.org

CED DIVISION:
Danny Burkle (Chair)
Email: cedchair@icorr.org

YICORR:
Kathy Purnell (Chair)
Email: youngicorrchair@icorr.org

ENGC REGISTRATION:
Anthony Setiadi (Chair)
Email: ECReg@icorr.org

SCI.C REGISTRATION:
Brenda Peters (Chair)
Email: Hon.Sec@icorr.org

PAC REGISTRATION:
Paul Lambert (Chair)
Email: pac.chair@icorr.org