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The President Writes

As I mentioned in my last President Writes, I will hand over the job to John Fletcher at the AGM in November, and also as I mentioned this is not the end of the job, I now have two years as Immediate Past President to serve. However this is my last President writes for The Journal and the request to provide these words comes around with alarming speed. My period as President has been an interesting and challenging one, especially so when combining ICorr duties with full time work and overseas travel. There have been times when it was difficult to know which was the day job, things blurred into one, but being a member of ICorr for close to thirty years helped, as did being involved with various committees and conference organising bodies, not to mention five years chairing London Branch. However nothing really prepares one for the ultimate job, i.e. the Presidency, many things came as a surprise and much of what goes on day to day is hidden and unseen but just as important as the higher profile things that need to be attended to and which can be seen and are reported in The Journal.

Much has been done over the last few years, and in the preceding years, the course has been adjusted or changed regularly but the goal is the same, to advance our presence in the world of corrosion, to maintain a strong society and provide a service to members. To these ends we have recently signed a new training contract with ARL who are now owned by IMechE and there has been a strong uptake in the courses we offer and in the subsequent certification. We have also commissioned a new Marine Cathodic Protection course which was recently completed and is now in final review, the first course will be rolled out in early 2015 soon to be followed by the level 2 Marine course. We have also worked to improve relations with other organisations and to draw closer to them through working with committees and groups where the UK can be seen to be taking an interest in what is happening in other European countries. I have become a member of the EFC Board of Administration and have to date attended two meetings where nine countries were represented, all with a strong interest in corrosion matters. It is by this greater integration that we can better understand one another and bring common interests into closer focus and benefit all. It is not all work and I have to admit to enjoying some presidential receptions, luncheons and gala dinners but that is all part of the work and could be enjoyed by any member of ICorr by simply taking on the Presidency; so join the queue for the next Vice President and enjoy the ride, I have and can recommend it.

It is appropriate here to wish John Fletcher the incoming president and his Vice President Sarah Vasey the best for their terms of office and to pledge my full support to them both as soon to be Past President, I know I am not the only one who will be working with these two capable people in continuing the work which was started long ago and which grows anew daily. And also I thank the staff at Northampton for their support and great efforts in the day to day running of the office and ICorr affairs, and last but by no means least you, the members of ICorr, for your support which has been given so freely, I am grateful.

I look forward to seeing you at the AGM in November.

Trevor Osborne,
President of the Institute of Corrosion

Registered Marine Coatings Inspectors’ qualification launched

Leading players in the marine coatings and associated fields have come together to launch a new standard and formal qualification in response to concerns raised by the leisure vessel, superyacht and shipping industry.

Before this qualification was developed there were no specific qualifications for Marine Coating Inspectors. The Registered Marine Coating Inspectors (RMCI) qualification was instigated by the Super Yacht Builders Association (SYBAss) in conjunction with the International Confederation of Marine Industry Associations (ICOMIA) and working with the International Institute of Marine Surveyors (IIMS). The course, the qualification and the certification system have been produced in response to the request by these bodies.

To be accepted on this week long course, which includes a formal examination, candidates will have a NACE, FROSIO, or ICorr Level II qualifications, or significant relevant industry experience.

The pilot course is being held from 8-12 September 2014 at Portchester, Hampshire and is being attended by selected experts from the partner organisations and ship yards. The first live RMCI course for Inspectors will run from 20-24 October at the Historic Dockyard, Portsmouth with more planned around the world in 2015. More details to follow.

How the qualification will be used

In time, to carry out marine coating inspections, Inspectors will require the RMCI qualification. In future SYBAss members, the paint companies, ship yards and coating facilities worldwide will only accept Inspectors into their facilities who have this qualification.

The RMCI qualification is organised, managed and delivered by the International Institute of Marine Surveying through the Marine Surveying Academy. The qualification is jointly certified by IIMS and ICorr.

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Web: www.rmciinspectors.com
Partner Organisations:
SHE’S AN ENGINEER

LUCIA HELENA FULLALOVE - BSC (CHEM ENG), MSC (CORROSION), MICORR
LEAN PRACTITIONER - HIGHWAYS AGENCY

This is a tale that spans almost four decades and across two continents. In reporting it I hope my experiences will inspire the younger generation of women engineers.

I was born and brought up in Rio de Janeiro, Brazil. From the time I could talk I wanted to be a medical doctor but I ended up studying Chemical Engineering at Rio de Janeiro State University graduating in 1975. You may be surprised to learn that from the class of 40, 50% were women.

After graduation I was torn between doing a master’s degree or getting a job, but the lack of money won and I went to work. Although, I enjoyed learning I wanted to try and influence things as well as to put in practice my innate characteristic of being bossy!

My first job was as a Quality Control and Process Control Engineer in a composite manufacturing plant, and was in the middle of nowhere. It took me six hours travelling daily to/ from work. I was responsible for selecting the materials and process resins, as well for ensuring the quality of the products which would be exposed to highly corrosive environments. The challenges of the job (one day I found a snake in the toilet) and the people I met on the way made it all worthwhile.

I have always been petite and this is not helpful when making a first impression on the shop floor. I looked young for my age and the foremen and production workers would doubt I had any knowledge. However, with a little persistence I found it was possible to overcome their initial reservations and there are occasions when not being a roughy-toughy male can have its advantages such as reluctance to shout at me as they would my male colleagues.

My second job was as a quality control engineer at manufacturing plant was more varied and more challenging due to the production rate. I had to learn and be responsible for selecting the materials and process resins, as well for ensuring the quality of the products which would be exposed to highly corrosive environments. The challenges of the job (one day I found a snake in the toilet) and the people I met on the way made it all worthwhile.

My second job as a quality control engineer at manufacturing plant was more varied and more challenging due to the production rate. I had to learn and be responsible for selecting the materials and process resins, as well for ensuring the quality of the products which would be exposed to highly corrosive environments. The challenges of the job (one day I found a snake in the toilet) and the people I met on the way made it all worthwhile.

I next accepted an employment offer from Rolls Royce Motor Cars, moving to the factory in Cheshire. I was a Research and Development Engineer in the paint laboratory planning testing procedures which could emulate the various exposure environments to get a profile on performance/ failures over time.

Eventually I landed a great position as Process engineer at Lotus in Hethel (Norfolk). I proposed process improvements which were later patented by Lotus.

I joined the Highways Agency (HA) in 1999, as an HA coating specialist to improve the quality and service life of coatings on bridges and other steel structures. During this period I helped to instigate the development of the Institute of Corrosion Coatings Applicator Training Scheme (ICATS). This Scheme has brought much-needed training for contractors working in the Industry and has resulted in a decrease of whole-life costs for structure owners.

More recently, within the HA I have been in the Lean deployment team doing Continuous Improvement, in support to Civil Service reform. I look at processes, to improve efficiency and effectiveness.

When away from my day job I volunteer work as a STEM (Science Technology Engineering and Maths) Ambassador to encourage youngsters to take up engineering.

I have experienced challenges during my career that have included cultural change, work in a foreign language and sometimes in gaining acceptance as a woman engineer in a field that still is predominantly male. I hope that some of the old prejudices are now being overcome.

So my message would be: Choosing engineering is still not the easy option for women in the twenty-first century. Nevertheless, I have enjoyed a productive, enjoyable and fulfilling career, and if I had to start again I would do go in exactly the same direction.
ICORR ABERDEEN
ABERDEEN BRANCH CORROSION AWARENESS DAY- AUGUST 2014

On the 26th of August, the ICorr Aberdeen branch hosted the Corrosion Awareness Day at the Palm Court Hotel. The event coordinator, Abdulmotaleb Suleiman introduced the course stating that the objective was to provide a basic introduction to the various aspects of corrosion and encouraged active participation from delegates proposed by our Branch Sponsors.

Paul Lambert of Mott MacDonald started the day with an introduction to corrosion principles and mechanisms. He explained in the first part of his presentation the basic principles of corrosion and identified the different components of a corrosion cell with everyday examples. In the second part of his presentation, Paul presented the main corrosion mitigation techniques and used an illustrative historical timeline of corrosion to explain how these techniques used in managing corrosion have evolved.

Alan Taylor of North East Corrosion Engineers (NECE) covered the concept of corrosion monitoring, distinguishing between intrusive and non-intrusive techniques. He explained the process of evaluating coupons and probes data and covered the various types of access fittings, installation orientations and retrieval options. He also explained the concepts and benefits of the chemical monitoring wireless data transfer technology, data management, trending and reporting.

Carol Devine of North East Corrosion Engineers (NECE) covered Oilfield Microbiology explaining techniques used in monitoring bacteria activity and mitigation of Microbiologically Influenced Corrosion (MIC).

Alan Hunter of EconEng Limited presented the corrosion inhibitor applications and the types and deployment techniques of the oilfield corrosion inhibitors and biocides.

Laurie Mackay covered the use of protective coatings for corrosion mitigation and explained their applications in conjunction with CP. Laurie explained the working principles of coatings and outlined the factors that affect the effectiveness of a coating system. He gave examples of coatings with relation to use with CP and outlined damage mechanisms for coatings systems presenting these mechanisms pictorially as she concluded her talk.

Each presentation was followed by a question and answer session which created lively discussions on various aspects of corrosion.
Peter John Aylott, MA, 1959 – 2014

Peter Aylott was Commercial Director at Intertek (formerly CAPCIS) in Manchester, where he had worked since 1985, initially joining CAPCIS as a software engineer in the development of computer aided corrosion monitoring, based around the (then) new area of electrochemical noise analysis. As a sign of the times his first programmes were written for use on the then state-of-the-art “BBC Micro”.

He quickly moved on within CAPCIS developing more software programmes, including the specialist analysis tool “Alberto” for handling the stray current monitoring data being collected from the new Manchester Metrolink light rail (tram) system. From this initial small activity, Pete developed and expanded CAPCIS services in this area to provide support relating to stray current management, monitoring and rectification to promoters, contractors of light rail schemes and utility companies affected by the interference arising from the return of dc rail to city centres across the UK and beyond. These included Sheffield Supertram, Tyne & Wyre Metro, Midlands Metro, Nottingham Express Transit, Docklands Light Rail, Luas (Dublin), New York, Bangkok and others, as well as heavily rail work for Mersey Loop and Glasgow Underground.

Pete was the technical and commercial driver in the development of new and expanded services across a range of areas including developing close ties with Electrical Engineering Dept at UMIST (later University of Manchester) for computer modelling of stray current from both light rail, heavy rail and other electrical sources. He also worked closely with C3 (Amulet) and Babcock Wilcox in the development of CARE, an asset integrity database and model for high voltage electricity distribution towers combining atmospheric corrosion models, historical atmospheric data (temperature, time of wetness, chloride deposition and sulfur dioxide pollution), and maintenance history to allow estimation of tower conditions to aid in the maintenance management of the assets.

This work accelerated after Intertek acquired CAPCIS in 2007. In addition to a range of operational responsibilities, Pete lead the negotiations and technical specification for the extensive combined corrosion monitoring & stray current monitoring system for Copenhagen Metro Extension, delivery of corrosion monitoring systems for several nuclear storage facilities, and, as would be expected, further developments in stray current monitoring, including the new developments associated with tram / train where he was the chair of the Sheffield Tram-Train working party meetings looking at the implications for this new transport option.

Pete had attended Cambridge studying Natural Sciences, and in 1981 he started PhD research in the Corrosion & Protection Centre at University of Manchester Institute of Science and Technology (UMIST) on corrosion of sintered tungsten alloys. Pete never submitted his thesis, but instead joined CAPCIS where, as they say, the rest is history.

In June this year, he was diagnosed with cancer and he sadly past away only some 10 weeks later, on 24-August at St Ann’s hospice in Manchester with his wife Christine and his five children Helen, Andrew, Lucy, Harry and Oliver at his side. Throughout his devastating illness his fortitude and strength were both remarkable and inspiring. His passing was mourned at Altrincham Crematorium on 3-September by his family and wide circle of friends and colleagues, both past and present from Intertek & CAPCIS as well as from other organisations he had worked with on numerous projects over the years.

Pete was a one off, one of the good guys, a good friend and colleague; he is truly irreplaceable and will be sadly missed by all who had the pleasure and honour of knowing him.

Dr Gareth John, FICorr
EuroCorr, the biggest annual Corrosion conference in Europe, took place this year at Pisa, Northern Italy. The meeting was held in the Palazzo dei Congressi of Pisa about a couple of km from the leaning tower. Perhaps because of the example of the leaning tower the conference was essentially held on just one floor (the ground floor!). Despite some inclement weather (very hot for the reception on the Monday; but cool and wet at times thereafter) this was an enjoyable and very well organised event. Thanks must be extended to Professor Luciano Lazzari, the congress chairman and his team for this. Lunches (with wine) were provided and a good feature was that these, and the coffee and tea breaks, did not involve long queues and there was somewhere to put your plate down.

There were over 948 delegates from 58 countries worldwide including 56 delegates from UK, the fourth largest number after Italy, France and Germany. ICorr Council was quite well represented with Trevor Osborne, Douglas Mills, Gareth Hinds and Brian Wyatt all there. Chris Googan, Herman Potgeiter, Neil McMurray and Don Harrop were also present.

The proceedings consisted of nine parallel sessions of mainly twenty minute presentations, preceded each day by a forty minute plenary lecture held in the main auditorium. The first of these lectures was entitled “Critical” approaches to reveal Corrosion Mechanisms” and was given by the European Corrosion Medal winner Herman Terryn from Vrije University, Brussels, Belgium.

The plenary on the Wednesday was “From the object scale to the nanometer: issues associated with the corrosion of archaeological iron artifacts” by Philippe Dillmann from the Commissariat à l’Energie Atomique (CEA), Gif sur Yvette, France. And on Thursday it was “Theory and practise of cathodic protection and cathodic prevention” given by Luciano Lazzari from Politecnico di Milano, Milan, Italy. On Friday it was the turn of the Cavallaro medal recipient Mario Ferreira from University of Aviero near Lisbon who gave “Development of Inhibitor containing Zeolites for protective coatings”. A total of 440 other oral papers were presented. The main sessions were Coatings, Mechanisms, Methods and Modelling, Oil and Gas, Archaeological, all of which ran for two days or more. Nuclear, Microbial, Corrosion in Concrete, Hot Gases and Environment Sensitive Fracture all ran for at least a day plus there were a dozen other half day sessions.

There was a somewhat smaller than usual (130 displayed) poster session. A reasonable fraction of the papers on the memory stick (first time we have not had a CD ROM) were full papers. The exhibition was medium size (21 companies) with a good range of products being exhibited. There were several fringe meetings including a NACE Working Group on Corrosion Protection of Wind Power Units and a joint EFC/NACE task group looking at NATO standards. Regarding EFC administrative meetings, your President, Trevor attended the Board of Administrators (BOA).

The Welcome Party on the Sunday evening was an enjoyable networking opportunity. Early evening on the Tuesday your correspondent represented ICorr at the General Assembly (GA). Bids were requested for Eurocorr 2018 which have to be in by 15/1/15. There is the possibility of new working party on corrosion protection in sustainable and green technologies (support is being sought for this). Ray Millbank has retired as EFC Honorary Treasurer and the interim treasurer is Ms Julija Bugajeva, the chief finance officer at IOM3.
She gave a report on the state of the EFC finances. Reserves have been built up to over £200,000. Again there was discussion about whether smaller societies could pay a reduced Annual Subscription. But a vote resulted in the status quo (everybody pays the same) being retained. Lorenzo Fedrizzi retires as President at the end of the year and will be replaced by the current Vice President Fatima Montimor from IST, Lisbon, Portugal. Immediately after the GA, Trevor Osborne and myself attended the EFC President (Lorenzo Fedrizzi)’s reception held in a compact restaurant in the centre of the town. This was a, help yourself to the food and drink and find somewhere to eat it, event: but nonetheless very pleasant with some excellent white wine.

On the Tuesday your correspondent went to the Coatings Working Party (WP 14) meeting. This was well attended. There was some discussion on ISO standards and your correspondent was reminded that he has to produce Technical Report on application of the Electrochemical Noise Method to assessment of coated substrate. There was a request for a delegate to lead the coatings input into the joint EFC/NACE taskforce to revise NATO standards. This was followed by an enjoyable Poster party where more wine flowed.

The winner of the best poster prize was from the coatings session (as was the winning poster two years ago by Kasia Schaefer and your correspondent!) This time it was presented to A Vimalalanden working at the Max-Planck Institute, the title being “Redox Responsive Coatings for Corrosion Protection”. Apart from Coatings, other working party meetings attended by UK delegates were Oil and Gas (Gareth Hinds), CP (Trevor Osborne), Concrete (Brian Wyatt) and High Temperature Corrosion (Herman Potgeiter). There are iCorr delegates appointed to another five or six WPs. Hopefully they will be able to attend the next EuroCorr in Graz and represent UK at the meetings. On Thursday evening there was the Gala Dinner. Despite its cost (120 euros) this was well attended with over 400 people going and was apparently an enjoyable event. The final half day was more lightly attended. But there was still some good papers including a couple from the Swansea group (Steve Geary and Carol Glover).

The next Eurocorr will take place in Graz, Austria from 6-10th September 2015.

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For further information contact: 4 Westacre Gardens, Ormesby, Great Yarmouth, Norfolk
Telephone 01493 262262 (option 1) Mobile 0044 7867518858 Email: Jduncan@balista.info
October 2014

Dear Member,

The Trustees and Council of the Institute would like to invite you all to the 2014 AGM to be held on 27th November 2014 at the Council Chambers Birmingham in conjunction with a half day Midlands Branch meeting.

**Agenda for the event**

**Corrosion Control by Coatings**

Half day seminar organized by Midland Branch which includes presentations on the galvanizing process, coatings and inspections. A buffet lunch will be available from 12:30 along with the opportunity to network with other corrosion professionals.

12:30 - 13:30 Lunch served
13:30 - 13:40 Welcome and introductions
13:40 – 15:40 Presentations by industry experts
15:40 – 16:30 Coffee Break
16:30 – 17:30 ICorr AGM

**AGM Agenda**

1 Apologies for absence
2 Minutes of the previous AGM January 2013
3 President’s report
4 Treasurer’s report
5 Elections
6 Any other business

The Trustees and members of Council will be available before the meeting to answer any questions you may have regarding the Institute and its future.

Again as in the case of 2013 the Institute’s accounts, and the minutes for the November 2013 AGM, will be available via the ICorr website (www.icorr.org). Please examine them and the website in general as we would appreciate your feedback. The website will continue to be influential in increasing the Professional Membership and the perspective of non members of ICorr and as a major means of communication with membership.

Your confirmation of attendance or apology for absence will be appreciated preferably by e-mail to admin@icorr.org

We look forward to seeing you there.

Yours faithfully,

Dr Jane Lomas
Institute of Corrosion
Honorary Secretary
THE EVALUATION OF STAINLESS STEEL PITTING IN NEAT CORROSION INHIBITOR PRODUCTS

Yolanda M. De-Abreu and Jeremy J. Moloney, NALCO Champion, An Ecolab Company 7705 Highway 90-A Sugar Land, Texas, 77478, USA

ABSTRACT

Electrochemical Impedance Spectroscopy (EIS) is a commonly used tool to assess pitting corrosion due to the detailed information that can be obtained in a relatively short time compared with other approaches. This study examines the feasibility in using EIS in evaluating and monitoring pitting on stainless steel immersed in neat chemical products. In order to accomplish this, one series of experiments was conducted in various neat chemical products using different immersion times to take into account possible incubation periods for pitting initiation on stainless steel. Cyclic polarization scans and electrochemical impedance measurements at different anodic potentials were also performed in order to evaluate the resistive nature of the passive film to various neat products. The entire tests were conducted at 55°C. After exposure, the surfaces of all the coupons were thoroughly appraised using an optical microscope to better assist in interpreting the EIS data.

1. INTRODUCTION

Stainless steel is a commonly employed alloy in many aggressive environments and is widely used as a structural material in the chemical industry, marine environments and oil and gas services. It is generally accepted that the corrosion resistance of stainless steel alloys is due to the formation of a protective chrome oxide layer. Chemical companies have a duty to perform and provide accurate information about the compatibility of materials, including stainless steel, with the products they provide their customers. Several reasons for this have been previously documented, including failures being detected in umbilical tubes carrying neat chemicals to offshore as-sets and adjoining equipment [1, 2], failures of port-a-feeds highly concentrated products, and the emergence of numerous safety and governmental regulations that require guaranteeing safety compliances to deliver a zero-defect program.

There is a large amount of data in the literature related to the compatibility of stainless steel immersed in solutions of NaCl or FeCl3, [3–5]. This data could be used to rank the compatibility of stainless steel with these solutions, but it would be dangerous to extrapolate this compatibility/ranking data with other solutions or products such as corrosion inhibitors, scale inhibitors, or oxygen scavengers, where mixtures of several compounds are likely to change the characteristics of the final solution compared with NaCl or FeCl3. With this in mind, chemical companies often assess the compatibility of their neat products with stainless steel based on long immersion tests at open-circuit potential (OCP). However, there is no standard time duration for these compatibility immersion tests. For example, some companies provide compatibility data based on three weeks of immersion tests, some after three months, whilst other cases may be customer-specific. Empirical results have shown that compatibility of stainless steel based on three weeks of immersion time in neat chemical products might not be sufficient. Three months seems a reasonable time to allow for the chrome oxide film to break down and for pit initiation and propagation to ensue, to increase the confidence of product compatibility should negligible general corrosion or pitting attack occur. These testing-time differences make it difficult to accurately compare and contrast product test data and compatibility.

This work uses a more universal and rapid approach to study the compatibility of stainless steel type 316L (SS316L) with different neat chemicals using electrochemical techniques. Cyclic anodic polarization scans and electrochemical impedance spectroscopy provide important features related to the behavior of the material in a few hours and, thus, could serve as a tool to evaluate the compatibility of stainless steel with chemical products in a much shorter time frame than long-term immersion tests.

2. EXPERIMENTAL

2.1 Electrodes & test solutions

Electrochemical studies (cyclic polarization scans and electrochemical impedance spectroscopy) were carried out using a conventional three-electrode cell, consisting of an SS316L Working Electrode (WE) as the material under evaluation, a graphite Auxiliary Electrode (AE), and a Ag/AgCl Reference Electrode (RE) connected to the cell via a Luggin capillary in order to increase the accuracy of the corrosion data. The chemical composition of the SS316L alloy is given in Table 1. The SS316L WE had an approximate surface area of 4.75 cm². Before the test, the electrode was ground to a 600 grit finish, rinsed, and successively sonicated with xylene, isopropyl alcohol and acetone before being air-dried.

Fifteen neat corrosion-inhibitor products were used as test solutions. The chemicals are all amine based corrosion inhibitor products. All experiments were performed at 55°C under aerated conditions. The solutions were stirred at a rate of 500 rpm to ensure a constant temperature during the test. Six hundred milliliters (600 ml) of solution were used for each test.

2.2 Electrochemical Measurements

The electrochemical tests (cyclic polarization and electrochemical impedance spectroscopy) were performed using a Gamry Model 600 potentiostat.

Cyclic Potentiodynamic curves: The anodic cyclic polarization test was performed at 10 mV/min (0.166 mV/s). The working electrode was exposed to the solution test for 1½ h before starting the test to allow the potential to stabilize at the test temperature. The potential was scanned in the anodic direction starting from the open-circuit potential and reversed in the negative direction when the current density exceeded 0.3 mA/cm² or when the potential reached 650 mV vs Ag/AgCl, whichever came first. The reverse scan was ceased either when the initial open-circuit potential was reached or when the reverse sweep potential intercepted the passivation region. Electrochemical results for samples that presented any evidence of crevice corrosion were disregarded and repeated.

Electrochemical impedance spectroscopy (EIS) measurements: The EIS measurements were performed at different immersion times (1 h, 3 h, 8 h, and 672 h), and different potentials on the passive region scans (including OCP, 50
mV, 100 mV, 150 mV, 200 mV and greater if the material had a large passive region). The frequency analysis for the electrochemical impedance spectroscopy was performed in the range of frequency of 10 mHz to 100 KHz, with a 5 mV amplitude modulation at 8 points per decade.

After the electrochemical measurements were performed, the test coupons were washed with distilled water, cleaned, rinsed, and successively sonicated with different solvents (xylene, isopropyl alcohol, acetone successively) before being air-dried. The electrodes were then assessed under an optical microscope to evaluate the extent of pitting on the metal surface.

2.3 Immersion tests

In order to evaluate the compatibility of the products with SS316L, immersion tests were performed for a period of a month at 55°C. After the test, the exposed coupons were rinsed and cleaned with distilled water before being successively sonicated with xylene, isopropyl alcohol, and acetone. After air-drying, the electrode surface was immediately examined in the microscope for the presence of any pits. The pitting rate was calculated using the maximum pit depth observed on the coupon as follows: \( \text{Pit}_{\text{avg}} = \text{pit depth (mils)} \times 365 / \text{exposure time in days} \).

Note: 1 mil = 1/1000 inch = 0.0254 mm

3 Results

Whilst many tests were performed, due to the space constraints of this article it is only possible to present and discuss a select few. With this in mind, only four sets of results, representative of four different categories observed, are discussed herein. The first section on cyclic polarization, which forms the guidance for the electrochemical impedance spectroscopy work, is a high-level overview of a portion of previous, more detailed work by Moloney and DeAbreu [6], which is due to be published shortly.

3.1 Cyclic polarization anodic scans

Figure 1 shows the 4 representative polarization curves generated during the cyclic anodic polarization scans with SS316L immersed in four different neat products at 55°C. The first type of behaviour (category A) corresponds to the products which show low current density (about 7 µA/cm²) throughout the majority of the scan, the largest passivation region during the scans (>800 mV), and might or might not exhibit a pitting potential value (\( E_{\text{pit}} \)). A negative hysteresis could also be observed during the reverse scans. The second and third types of curve (categories B and C) were similar: a low current density up until the pitting potential and the presence of a distinct passivation region. The difference between scans B and C is the extent of the passivation plateau and, consequently, the \( E_{\text{pit}} \) value. For B category scans, the passivation plateau is larger (ca. 400 to 600 mV) than C category scans (ca. 200 mV). The \( E_{\text{pit}} \) is about 500 mV and 180 mV vs OCP for category B and C scans, respectively. As is well known, \( E_{\text{pit}} \) is a measurement of the tendency to form pits: a higher value of \( E_{\text{pit}} \) indicates a metal’s greater resistance to pitting attack in that environment (i.e. a higher compatibility with the solution). In the last group, category D scans, the dominant characteristic is the presence of a pseudo passivation plateau; the current density increases relatively quickly from the OCP (0 µA/cm²) to quite high current densities (e.g. ca. 10 µA/cm² at 100 mV). This behaviour is different than category A-, B-, and C-type scans, in which the current densities are low and stable until approximately 200 mV (between 0.5 to 7 µA/cm²).

3.2 Electrochemical impedance spectroscopy

3.2.1 Influence of the immersion time

Electrochemical impedance measurements were taken for SS316L immersed in neat products (A, B, C, and D) at 55°C for different immersion times: 1h, 2h, 4h, 6h, and 672 h (28 days). All the measurements were taken at OCP. Figure 2 shows the impedance results represented in the Nyquist diagram. The overall results show constant impedance values for products A, B, and D for all the times evaluated. These results suggest that, after a month long test, the passive layer present on the SS316L has the same resistance as passive layers tested after 1 h in their respective solutions. For product C, the result is relatively different: the impedance increases with the immersion time in the initial stages (1–2 hours) and becomes constant from 4 hours onward in contact with the solution. It is also important to note that the resistance of the oxide film is different, depending on the product tested. The values of polarization resistance significantly decrease for product D (6 KΩ cm²), compared with the other products tested. The values of the polarization resistance are 67, 107 and 30 KΩ cm² for products A, B, and C, respectively. The high values of resistance of SS316L in the presence of products A, B, and C suggest the oxide chrome passive film formed on the surface is not degraded with time. Figure 3 shows the surface morphology of SS316L coupons after immersion tests. Surface analyses found no deterioration on the SS316L surface for products A, B and C, while deterioration is evident for product D—a general corrosion attack with the presence of important number of pits (4 µm depth). This result is consistent with the low resistance polarization values obtained for product D.

3.2.2 Influence of the polarization

The effect of applying anodic potential on the passivation of SS316L immersed in products A, B, C, and D at 55°C is presented in Figure 4. The goal in this section is to study the corrosion resistance of the passive film with application of the potential and to try to relate the reduction of the polarization resistance (\( R_p \)) with the rupture of the passive film, in other words, with pit formation. The entire
The impedance spectra presented were obtained below and close to the pitting potential ($E_{p}$).

The impedance data for all the products show one capacitive semicircle for the entire set of potentials, with some deviations in behaviour for products C and D at high frequencies that will be described below. The values of $R_p$ of SS316L obtained at different anodic polarization in presence of products A, B, C, and D, are plotted in Figure 5. The largest $R_p$ values were obtained for products A and B. The SS316L was subjected to much higher polarization in products A and B (from OCP to 550 and 600 mV for A and B, respectively), compared with products C and D (from OCP to 600 mV for A and B). The maximum potential applied in the EIS work was based upon the previous work by Moloney and De-Abreu [6] and the cyclic anodic polarization passivation regions in Figure 1.

When the anodic potential is applied for product A, the value of $R_p$ slowly decreases from 67 KΩ.cm$^2$ to 12 KΩ.cm$^2$. For product B, the response is the same as A, except that the decrease rate is greater (from 124 to 10 KΩ.cm$^2$). For products C and D, the initial $R_p$ is lower than 8.5 KΩ.cm$^2$. A notable feature that was observed for some of the anodic potentials applied is that the Nyquist semicircle appears to “turn-back” on itself when the system is polarized at higher potentials (e.g. 150 mV/OCP and above for product C). The magnitude of impedance decreased significantly during the application of the lower frequency values. This “turn-back” response was also observed for all anodic polarized potentials of SS316L in product D. The values of $R_p$ calculated at the very low frequencies were extremely small, indicating a very high current density.

All the electrodes were observed under the microscope (Figure 6) after the anodic polarization scans. Products A and B, having $R_p$ values greater than 10 KΩ.cm$^2$, did not reveal any localized attack. However, products D and C, with much lower $R_p$ values (< 10 KΩ.cm$^2$), showed a relatively large amount of pitting, some of which was quite deep (12 and 42 µm for product C and D, respectively).

Pit rates were calculated for samples A, B, C, and D after immersion time of 28 days. The values are: 0 mpy for products A, B, and C, and 3.59 mpy (0.091 mm/y) for product D. It is important to note that during the immersion test the samples kept at the OCP (i.e. no external potential was applied). The results were largely consistent with the surface morphologies after the electrochemical tests. No pits were observed on the SS316L surfaces after exposure in products A and B after polarization. The presence of pits for
product C is attributed to the application of the potential, since the pitting potential (150 mV/OCP) was exceeded (but no pits were detected after 672 h at OCP). For product D, the situation is different: pits were formed at OCP and continued to grow at higher potentials (compare surface for product D in Fig. 3 with product D in Fig. 6).

Based on the overall results (electrochemical analysis, immersion test, and surface observations) the pitting formation was found to be related to the low polarization resistance found in the impedance scans.

4. Conclusions

The results obtained from EIS combined with cyclic polarization scans confirm the techniques may be used as short-term methods to evaluate the compatibility of neat products with SS316L. Low or no presence of passivation region and low polarization resistance values at OCP indicate the SS316L material has more potential to form pits in the neat solution. The results were consistent with the surface morphologies after the electrochemical and immersion tests. The application of potential may change the resistive nature of the initial film oxide by the formation or growing of pits or partial dissolution of the passive film. The high resistance polarization values obtained in large ranges of applied potential for some of the neat products suggest a better resistance of the passive film formed on the SS316L. Future work needs to be completed with surface analysis to identify which part of the mixture product is acting as an activator of the pit initiation in stainless steel.

5. References


Dairyland Electrical Industries recently announced that both its Zone 1 product lines (PCRH and OVP) and Zone 2 product lines (SSD, PCR, OVP2) have achieved IECEx certification after an extensive review of applicable standards and a comprehensive project with Underwriters Laboratories (UL). IECEx certification assures the broadest acceptance of Dairyland products world-wide.

Dairyland’s solid-state decoupling devices are used to isolate cathodically protected structures from grounding systems and other equipment, and mitigating induced AC voltage. These maintenance-free devices provide over-voltage protection and are rated for very high values of lightning and AC fault current. Dairyland products are extensively used worldwide for insulated joint protection, induced AC mitigation, and decoupling electrical equipment and facilities from grounding systems.

IECEx operates under the objective of establishing safety requirements for products intended for use in hazardous atmospheres. Dairyland’s achievement provides assurance to customers around the world that the highest standards have been met for hazardous location products. Dairyland’s Zone 1 products are the only decoupling devices in the world that have achieved this certification.

Dairyland products have also been certified as meeting the Zone 2 requirements of the ATEX Directive for Europe since 2003, and now certified Zone 1 products per the EN60079 standards are available. Further, the existing Zone 2 products now meet the most current standards. This updated certification affirms Dairyland’s commitment to product designs that comply with the latest quality and technical standards.

About Dairyland Electrical Industries

Over a range of industries and applications, Dairyland has applied the concepts of isolation, grounding, and over-voltage protection to standard and custom products since 1983. Dairyland deals with a wide variety of applications including AC voltage mitigation, insulated joint protection, gradient control mats and other applications where it is necessary to isolate cathodically protected structures from other equipment or grounding systems. Dairyland products isolate DC current, ground AC fault current and lightning, and protect equipment and personnel. Offering the first solid-state solutions to each of these markets, Dairyland remains the leader in the industry, with popular products such as the PCR, SSD, OVP and OVP2 as well as a full line of accessories to make installation quick and easy.

About DC Materials

DC Materials has more than 20 years of experience providing advanced corrosion mitigation materials and services. Specializing in AC mitigation engineering design services using the Safe Engineering Services software Right of Way (ROW), DC Materials is able to expertly address even the most complicated applications. DC Materials has over 20 years of experience specifying and providing technical assistance for Dairyland decoupling devices.
DENSO TAPE PROTECTION AT CAMBRIDGE PUMPING STATION

The pumping station at Kennet on the Cambridge/Suffolk border performs a key function on the Environmental Agency’s major Ely Ouse to Essex Water Transfer system which takes raw water from Blackdyke in Norfolk to Great Sampford in Essex. Design consultants for a project to refurbish the pipeline part of the system were Black & Veatch Ltd.

The construction of this project was carried out by main contractors Jackson Civil Engineering for refurbishment of the anode bed of the cathodic protection system for the main pipework, with specialist sub-contractor Cathodic Protection Co Ltd of Grantham. During works at Kennett PS it was observed that two VJ couplings and associated pipework within a chamber were suffering from surface corrosion due to deterioration of the original protection system.

Sub-contractors Jack Tighe Ltd wire brushed all chamber pipe and coupling surfaces and ensured they were dry and free from contaminants. In this project, after stabilising the surface with a paint primer, Winn & Coales (Denso) Ltd’s conventional protection system was then applied, starting with Denso Paste and then application of Denso Mastic on bolt heads, nuts, flanges and other projections to give an overall smooth external profile. This was then wrapped with Denso Tape in a spiral wrap using 55% overlap. The tape extended along 150mm of the protected barrel of the pipe on each side of the joint and fittings.

In a report to the Environment Agency Black & Veatch stated: “The works were carried out to a high standard.”

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(Pictured right) Application of Denso Mastic to give a smooth profile. Followed by spiral wrap of Denso Tape.

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Tel: 0191 469 6111 Fax: 0191 496 0676 Email: sarah.vasey@akzonobel.com Website: www.international-pc.com

JOTUN PAINTS (EUROPE) LTD.
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Tel: 01724 400 125 Fax: 01724 400 100 Email: decpaints@jotun.co.uk www.jotun.co.uk

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SPECIALTY POLYMER COATINGS INC
64 Tudor Avenue
Worcester Park
Surrey KT4 8TX
Tel: 020 8337 4953 Fax: 020 8337 4953 Website: www.spc-net.com

STORK TECHNICAL SERVICES (RGB) LIMITED
Norfolk House, Pitmedden Road, Aberdeen AB21 0DP
Tel: 01224 722888 Fax: 01224 723406 Email: robert.grainger@stork.com Website: www.storktechnicalservices.com

TINSLEY SPECIAL COATINGS
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<tr>
<th>Company Name</th>
<th>Address</th>
<th>Telephone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMC Technologies NIGERIA</td>
<td>No. 22, Cerrard Road, Ikoyi, NIGERIA</td>
<td>+234 (0) 8039740023</td>
</tr>
<tr>
<td>Focus Scaffolding Ltd</td>
<td>Meadow Road Compound, Meadow Road, Whitehaven, Cumbria, CA28 9HY</td>
<td>01946 552338</td>
</tr>
<tr>
<td>Forth Eustay Transport Authority</td>
<td>Forth Road Bridge, Administration Office South Queensferry, EH30 9SF</td>
<td>0131 319 1699</td>
</tr>
<tr>
<td>Forward Protective</td>
<td>Vernon Street, Shenbrook, Mansfield</td>
<td>01623 748323</td>
</tr>
<tr>
<td>Galdris Construction Ltd</td>
<td>Galdris House, Pavilions Business Centre, Kinnetic Crecent, Innova Science Park, Infield BN3 7FJ</td>
<td>01992 763000</td>
</tr>
<tr>
<td>Galdris Construction Ltd</td>
<td>Brent Avenue, Forties Road, Montrose, Angli, DD10 9PB</td>
<td>01674 672 678</td>
</tr>
<tr>
<td>Gemini Corrosion Services</td>
<td>Brent Avenue, Forties Road, Montrose</td>
<td>013648 855123</td>
</tr>
<tr>
<td>Global Energy Group (Access Coatings)</td>
<td>Unit 5, Service Base, Shore Road, Invergororda, IV18 0EX</td>
<td>01924 272750</td>
</tr>
<tr>
<td>CPL Civil Engineering Ltd (Special Projects Division)</td>
<td>Kennedy House, Chellenden Street, Safford, M6 6WY</td>
<td>0161 745 7888</td>
</tr>
<tr>
<td>Hayes Engineering Services Ltd</td>
<td>Bridlely Road, Off Hadfield Road, Cardiff CF11 8TL</td>
<td>029 2022 6088</td>
</tr>
<tr>
<td>Harsoo Infrastructure UK Ltd</td>
<td>Unit 3, Manby Road, South Killingholme, Immingham, North Lincolnshire, DN40 3DX</td>
<td>01469 553800</td>
</tr>
<tr>
<td>Harrisons Engineering Lancashire Ltd</td>
<td>Judge Wilmy Mill, Longworth Road, Billington, Clitheroe, Lancashire, BB7 9TP</td>
<td>017524 823993</td>
</tr>
<tr>
<td>HBS Protective Coatings Ltd</td>
<td>40 Marsee Road, Belfast BT8 6SA</td>
<td>028 90708280</td>
</tr>
<tr>
<td>Hempel UK Ltd</td>
<td>LlanTRANe Park, Cwmbran, Gwent, NP4 3XF</td>
<td>01633 874024</td>
</tr>
<tr>
<td>Harrington Industrial Services Ltd</td>
<td>Crown Works, Crown Road, Low Southwick, Sunderland S3 28S</td>
<td>0191 5160634</td>
</tr>
<tr>
<td>Hi-Tech Surface Treatment Ltd</td>
<td>Unit B, Deacon Trading Estate, Chickenhall Lane, Eastleigh, Hants SO50 6JP</td>
<td>023 80611789</td>
</tr>
<tr>
<td>Hypprec Services Ltd</td>
<td>Unit 3, Meadowfield Industrial Estate, Cowdenbeath Road, Buntingstlan, Fife, KY3 0LY</td>
<td>01392 874661</td>
</tr>
<tr>
<td>Industrial Coating Services A1 House</td>
<td>Rolling Mill Street, Norton Canes, Cannock WS11 9UH</td>
<td>0845 474 0007</td>
</tr>
<tr>
<td>Industrial Painting</td>
<td>Azzam House, Rolleston Mill Street, Ossett, WFS 9U8</td>
<td>01924 272750</td>
</tr>
<tr>
<td>International Energy Services Ltd</td>
<td>94 Awolowo, Ikoyi, Lagos State, Nigeria</td>
<td>014615636</td>
</tr>
<tr>
<td>Interserve International</td>
<td>Unit 2, Olympic Park, Pool Hall Road, Ellesmere Port, Cheshire, CH66 1ST</td>
<td>0151 3737660</td>
</tr>
<tr>
<td>Jack Tighe Coatings</td>
<td>Sandall Lane, Kirk Sandall, Doncaster, DN21 4NR</td>
<td>01302 880360</td>
</tr>
<tr>
<td>Jack Tighe Ltd</td>
<td>Redbourne Mere, Kirtin Lindsey, Gainsborough, Lincoln, DN21 4NW, UK</td>
<td>01652 640003</td>
</tr>
<tr>
<td>J Murphy &amp; Sons Ltd</td>
<td>Highview House, Highgate Road, London NW5 1TN</td>
<td>020 7267 4366</td>
</tr>
<tr>
<td>J MW Industrial Services Ltd</td>
<td>47 Barton Road, Stretford, Manchester, M32 9FA</td>
<td>0161 2825329</td>
</tr>
<tr>
<td>JPV (Painters) Ltd</td>
<td>Unit B, Prospect Way, Hutton Industrial Estate, Brentwood, Essex, CM13 1YA, UK</td>
<td>01277 201515</td>
</tr>
<tr>
<td>JTL Fire Ltd</td>
<td>24 Cove Road, Farnborough, Hants, GU14 0EN</td>
<td>01252 545741</td>
</tr>
<tr>
<td>Kafco &amp; Co Ltd</td>
<td>Riverside House, Rollling Mill Road, Viking Industrial Estate, Jarrow, Tyne &amp; Wear NE32 3DP</td>
<td>0191 428700</td>
</tr>
<tr>
<td>KAEFER Opus Ltd</td>
<td>Ethan House, Royce Avenue, Cowpen Industrial Estate, Billingham, TS23 4AX, UK</td>
<td>01642 371850</td>
</tr>
<tr>
<td>Keep Protective Coatings Ltd</td>
<td>Unit 4, James Park, Mahon Road, Portadown, County Armagh BT62 6EH</td>
<td>02893 38151</td>
</tr>
<tr>
<td>Lanarkshire Welding Co</td>
<td>82 John Street, Wishaw, Lanarkshire, ML2 7TQ</td>
<td>01698 264271</td>
</tr>
<tr>
<td>Livingstone Surface Treatments Ltd</td>
<td>Unit 4, The Energy Coast Business Park, Haile, Egremont, Cumbria, CA22 4XN</td>
<td>0946 841191</td>
</tr>
<tr>
<td>Livis Ltd</td>
<td>LLivis House, Springhead Enterprise Park, Springhead Road, Northfleet, Kent, DA11 8BU</td>
<td>01322 220058</td>
</tr>
<tr>
<td>Malby Bridge Ltd</td>
<td>Station Road, Chesterfield, Monmouthshire NP16 5YL</td>
<td>01291 623801</td>
</tr>
<tr>
<td>Maclean &amp; Spiers Blasting Ltd</td>
<td>Unit D, East Fulton Farm, Darluth Road, Linwood, Parsley PA3 3TP</td>
<td>01505 324777</td>
</tr>
<tr>
<td>Malakoff Limited</td>
<td>North Ness, Lerwick, Shetland, ZE1 0LZ, UK</td>
<td>01505 695544</td>
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<tr>
<td>Matthew James Services</td>
<td>Unit 4, Shobdon Business, Cowen Road, Blaydon, Newcastle-Upon-Tyne, NE21 5TX</td>
<td>0191 414 5700</td>
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<tr>
<td>Mark Smith Inspection Services Ltd</td>
<td>14 Statham Close, South Shields, Tyne &amp; Wear, NE34 7ER</td>
<td>0191 456 9925</td>
</tr>
<tr>
<td>MCL Coatings Ltd</td>
<td>Pickering Road, Hallbank Industrial Estate, Widnes, Cheshire, WA8 6XW</td>
<td>0151 423 6166</td>
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<tr>
<td>Miller Fabrications Ltd</td>
<td>Barbonhall Works, Overtown Road, Wishaw, Lanarkshire, ML2 8EW</td>
<td>01698 373770</td>
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<tr>
<td>Moore Steel Developments Ltd</td>
<td>Station Road, Thorney, Peterborough-P66 0QE</td>
<td>01733 270729</td>
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<tr>
<td>N L Williams Group Ltd</td>
<td>Westside Industrial Estate, Jackson Street, St. Helens, Merseyside WA8 3AT</td>
<td>01744 26526</td>
</tr>
<tr>
<td>Northern Protective</td>
<td>16 High Reach, Fairfield Industrial Estate, Bill Quay, Gateshead, Tyne &amp; Wear, NE10 0OE</td>
<td>0191 438 5555</td>
</tr>
<tr>
<td>NSG UK Ltd</td>
<td>Fourth Avenue, Deeside Industrial Park, Deeside, Flintshire CH5 2NR</td>
<td>01244 833138</td>
</tr>
<tr>
<td>Nusteel Structures</td>
<td>Lympne Industrial Estate, Lympne, Hythe, Kent, CT21 4LR</td>
<td>01303 268112</td>
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<tr>
<td>Offshore Marine Services Ltd</td>
<td>Brunby House, Jalan Bahasa, PO Box 80148, 87011 Litus bun F.T. Malaysia</td>
<td>+60352464440</td>
</tr>
<tr>
<td>Optimal Rail Ltd</td>
<td>Unit 5, Moor Gate Crofts Business Centre, Alma Road, Rotherham, S60 2DH</td>
<td>01709 331153</td>
</tr>
</tbody>
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Ormac Coatings Ltd
Newton Chambers Road, Thorncliffe Park Estate, Chapeltown, Sheffield, S35 2PH
T: 0114 246 1237

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Unit 10 Millhead Way, Purdys Industrial Estate, Rochford, Essex, SS4 1ND
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Paintel Ltd
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Painting & Labour Services Ltd
Unit 1, Queens Road, Immingham DN40 1QR
T: 01469 578100

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99 Rvic Road Trans Amadi, Port Harcourt, Rivers State, Nigeria
T: +2348055297828

P H Shotblasting & Springing Services
43a Drumraine Road, Castlescaulfield, Dungannon, Co Tyrone, BT70 3NY
T: 028 8776 7722

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SCA Group Ltd
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Severn River Crossing Plc
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Sherwin-Williams Protective & Marine Coatings Tower Works, Kester Street, Bolton, Lancs, BL2 5AL
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T: 07714678719

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Smiths Quay, Hazel Road, Woolston, S019 7GB
T: 023 80438900

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Unit M1, Adamson Industrial Estate, Croft Street, Hyde, Cheshire, SK14 1EE
T: 0161 3686191

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T: 0141 212 8777

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T: 02380 221480

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T: 01204 468080

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T: 07730 764414

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Riverside Park Road, Middlesborough, Cleveland TS2 1UT
T: 01642 229141

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T: 020920 344556

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T: 01642 784279

T I Protective Coatings
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T: 01204 468080

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Sunnyside Works, Carrshere Road, Coatbridge ML5 2DJ
T: 0123642390

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T: 01773 831100

Vale Protective Coatings Ltd
Building 152 - Langar North Industrial Estate, Harby Road, Langar, NG13 9HY
T: 01949 869784

Walker Construction (UK) Ltd
Park Farm Road, Folkestone, Kent, CT19 5DY
T: 01303 851111

Wardle Painters Ltd
Unit 5, Wimborne Building, Atlantic Way, Barry Docks, Glamorgan, CF63 3RA, UK
T: 01446 748620

Wescott Coatings & Training Services Ltd
The Qudras Centre, Woodstock Way, Boldon Business Park, Boldon NE35 9PF
T: 0191 5197380

W G Beaumont & Son
Beaumont House, II Bernard Road, Romsford RM7 0HX
T: 01708 749202

William Hare Ltd
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**DIARY DATES 2014/2015**

**Thursday 9th October 2014**
**London Branch joint meeting with LMS**
Speaker: Dr Fred Parrett FRSC; ‘Dead and alive – what’s in the air we breathe’.  
Venue: Naval Club, 38 Hill Street, London  
17.45 for 18.15 start

**Dubai**
**Sunday 12th - Thursday 16th October 2014**
**Advanced Cathodic Protection**
http://mobilityoilandgas.com/advanced-cathodic-protection

**London**
**Tuesday 21st - Friday 24th October 2014**
**Corrosion Control in the Oil and Gas Industry**

**London**
**Monday 3rd - Friday 7th November 2014**
**Advanced Cathodic Protection**
http://mobilityoilandgas.com/advanced-cathodic-protection

**Sunday 2nd - Thursday 6th November 2014**
**Call For Papers - 19th International Corrosion Congress**
Venue: Jeju Island, Korea
For more information visit:  
http://www.19thicc.com

**Kuala Lumpur**
**Monday 10th - Friday 14th November 2014**
**Advanced Cathodic Protection**
http://mobilityoilandgas.com/advanced-cathodic-protection

**Thursday 13th November 2014**
**London Branch joint meeting with W&JS**
Speaker: Hesham Mahmoud; ‘Top of line corrosion and mitigation.’  
Venue: Naval Club, 38 Hill Street, London  
17.45 for 18.15 start.

**Dubai**
**Monday 17th - Thursday 20th November 2014**
**Corrosion Control in the Oil and Gas Industry**

**Thursday 27th November 2014**
**Corrosion Control by Coatings**
Half day seminar organised by Midland Branch which includes presentations on the galvanising process, coatings and inspections.  
Venue: Birmingham Council Chambers – Main Chamber  
12:30 – 16:30 followed by ICORR AGM

**Thursday 11th December 2014**
**26th London Branch Christmas Luncheon**
Venue: Royal Over-Seas League, Park Place, St James Street, London, SW1A  
Contact: Mike Allen  
mike.allen9@btinternet.com

**Monday 8th - Wednesday 10th December 2014**
**Corrosion Control in the Oil & Gas Industry**
Learn to Anticipate and Control Corrosion Problems in a Regulatory Environment.  
Venue: Houston, USA  
For further details contact: Colin Britton, cbrit79727@aol.com, Tel:+44 (0)1480-860943

**Thursday 8th January 2015**
**London Branch meeting**
Speaker: David Dore; ‘17th Century murder in the church – a forensic examination of an English Civil War crime’.  
Venue: Naval Club, 38 Hill Street, London  
17.45 for 18.15 start

**Thursday 9th April 2015**
**London Branch meeting with NACE (GB)**
Speaker: Geoff White; ‘Case study – measurement of line current as an aid to solving cathodic protection problems’.  
Venue: Naval Club, 38 Hill Street, London  
17.45 for 18.15 start

**Thursday 12th March 2015**
**London Branch meeting and AGM**
Speaker: John Fletcher, ICORR President’s, ‘All in a day’s work’  
Venue: Naval Club, 38 Hill Street, London  
17.45 for 18.15 start

**Thursday 9th April 2015**
**London Branch meeting with NACE (GB)**
Speaker: Geoff White; ‘Case study – measurement of line current as an aid to solving cathodic protection problems’.  
Venue: Naval Club, 38 Hill Street, London  
17.45 for 18.15 start

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