CORROSION MANAGEMENT
A JOURNAL OF THE INSTITUTE OF CORROSION
January/February 2016 No. 129

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Patterson Coatings Ltd is a family run business dedicated to providing its clients with diverse, cost effective solutions in surface preparation and protective coatings for both industrial and marine environments.

At Patterson Coatings we undertake a wide array of abrasive/non-abrasive blasts cleaning methods. Our protective coatings range from single finish coats to complex multi-coat systems by all methods of application. Ideally situated on the southern side of the Humber Bank, close to the Port of Immingham, Patterson Coatings has established a wide and diverse customer base to include but not limited to the following industries:

- Petrochemical
- Marine
- Power Generators
- Engineering & Fabrication
- Automotive & Transport
- Building & Construction
- Agricultural

All services at Patterson Coatings are offered as an onsite and offsite capacity either utilizing dedicated blasting and coating shops or where necessary a fully mobile service is available.

Our dedicated team at Patterson Coatings works continuously with our clients and suppliers to maintain a high level of customer satisfaction, an impeccable safety record whilst having the minimum environmental impact.

For further information contact: Patterson Coatings Ltd, Netherlands Way, Kiln Lane Industrial Estate, Stallingborough, Grimsby, Lincolnshire, DN41 8DF Tel: 01469 575603 Email: info@pattersoncoatings.com Website: www.pattersoncoatings.com
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The President Writes

Please allow me to be, probably, the last person this year to wish you all a happy and successful New Year. 2016 is upon us and it is likely to be a difficult year for UK industry and the world economy. However, I consider that the shortest day on 21st December is in fact the first day of spring, in an effort to reduce the winter period to an acceptable duration. So in my mind we are careering rapidly toward summer and all the pleasures that this means.

Much has happened since my last piece in the magazine before the Christmas break. For example, I was privileged to attend the annual London Branch Christmas Lunch and enjoyed the lively and very friendly event. The after-lunch speaker was very good and told some very entertaining stories about air traffic control and flying in general. I may never climb aboard an aeroplane again.

However, I must point out to the organisers of the lunch that I did not win any raffle prizes this year. I can only assume that this was an oversight or a malfunction in the draw procedure. I have suspicions that my tickets were in fact from last year’s draw. Joking apart, an oversight or a malfunction in the draw this year. I can only assume that this was the lunch that I did not win any raffle prizes aboard an aeroplane again.

As a result of an initiative started in the London Branch Committee, ICorr now has sets of lapel badges that will be distributed to members marking their length of service. More details on these badges and their distribution can be found elsewhere in this issue. However, I wanted to record my thanks to those who have contributed to this idea, as I believe that it will both recognise members contributions to the Institute and gain more awareness for the Institute and our work, as people notice members wearing the badges.

Turning to the next few months, there are several ICorr events planned and I draw your attention to the ICorr website; www.icorr.org for more information which can be found on the conference and events page. Again I would like to encourage all ICorr Branch Chairmen to prepare their events for 2016 and to get them notified in Corrosion Management as soon as possible so that their branch members and others are aware of these events and can plan to get involved. To all ICorr members, please get involved with your local branch or with any of the national events that are being organised for the corrosion community and if there is anything that you would like to see added to these plans please let me know and I will see what we can do.

One event that has just been notified to me but, as I write, is not yet on the website is the 2016 CED Spring Working Day that will be held jointly with the International Biodeterioration and Biodegradation Society on Tuesday 26th April at the Motorcycle Museum Conference Centre near the NEC in Birmingham. For those of you with an interest in “Microbial Corrosion Issues in Heating and Cooling Systems” this is a date for your diary.

The Young Engineers Program Winners are now preparing, or perhaps I should say, are being prepared, for their trip to the NACE 2016 Conference in Vancouver in March. This prize is a result of the BP sponsorship of the event and I am looking forward to the reports that will be prepared by the YEP winning team on their return.

So 2016 gets off to a brisk and demanding start. I am expecting ICorr to have busy year and I am looking forward to meeting more of you at the various ICorr and other corrosion events that are planned to take place at locations around the UK and beyond.

John Fletcher
President of the Institute of Corrosion
In accordance with the winter season tradition, on 10th December 2015, London Branch held their 27th Christmas Luncheon at the prestigious premises of The Royal Overseas League, in the heart of St James’s London.

Over 155 hosts and guests created an excellent attendance and all enjoyed the opportunity to discuss the latest gossip in the corrosion world, in a convivial atmosphere and over a satisfying lunch; the continuing good health of the industry was confirmed in numerous conversations.

After lunch, newly appointed Branch Chairman, Jim Glynn, steadily drove proceedings, beginning with a presentation of an engraved tankard to John O’Shea, for services to the Branch both as Chairman and long term committee member. In his thank you response, John took the opportunity to highlight the recent efforts Jim Glynn had made in creating a series of ICorr long service lapel pins for members with 5 to 30+ years service. These pins have now been approved by Council and should be ready for distribution in the New Year.

Jim’s guests on the Chairman’s table included LMS Chair Priya Kalia and President of the Institute, John Fletcher, who gave a brief address to the gathering on current Institute matters.

The Chairman then invited Past President, David Deacon to give a tribute to another London Branch ICorr ‘heavyweight’, Derek Bayliss, LB Chairman and ICorr President 81-82, who sadly passed away in June this year.

David described first meeting Derek in the 60’s when Derek was the Coatings and Corrosion Specialist for CEGB and David was working as Technical Services Manager for Burmah/ Castrol Group working on CEGB transmission tower and power station projects. In the 70’s, David needed a new Technical Director for his own company, Steel Protection Consultancy and after 25 years at CEGB, Derek joined SPC in 1976 and then worked with David for another 25 years, in which he travelled extensively to North America, the Middle East, the Far East and Australasia, until he retired in 2003.

David explained that when ICorr celebrated its’ 50 year programme in 2009, it was agreed by the Organising Committee that it would be held at the Thames Barrier in London, which was appropriate, since Derek was the Coatings Consultant for that project and he had recommended a single coat of paint to protect the large gates in the immersed position and projected a 25 year life, to first maintenance, the GLC’s target figure, as far back as 1976. David noted that not only did this one coat paint system protect the gates for 25 years, but from the recent 30 year survey, it appears that it will continue to protect the gates for at least 40 years before any major maintenance is required. Sadly Derek could not attend the 50th celebrations, although he was on the VIP list of people who had done most for the Institute over its’ first 50 years. To conclude, David thanked the Chairman for the opportunity for letting him share these memories of Derek and led a toast to Derek’s memory and his input to the corrosion world and in particular the Institute of Corrosion and London Branch.

To bring the event to a finale, the guest speaker, Mr David Gunson, former air traffic controller at Birmingham Airport spoke on the theme ‘What goes up doesn’t necessarily come down’. David’s smooth approach and impeccable timing did nothing to allay the fears of frequent flyers, leaving nagging doubts that what he comically described was too close to the truth; however lasting memories were of a hilarious and brilliant presentation.

London Branch was grateful for the additional sponsorship of the Guest Speaker, provided by Messrs Corrosion Technology Services (Europe), Deepwater Corrosion Services (UK), Spencer Coatings, Steel Protection Consultancy, and Winn & Coales (Denso).

This thoroughly enjoyable event is due for a repeat in December 2016. For early details please contact Branch Treasurer Mike Allen, at mike.allen9@btinternet.com.
**WELCOME...**

To our 145 new members and 9 new Sustaining members who joined in 2015. Together with the congratulations of the Institute to all the following members who have attained Professional Status in 2015.

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**MEMBERSHIP SERVICE LAPEL BADGES NOW AVAILABLE**

Arising from a London Branch initiative to recognise the membership service of our loyal members, the ICorr Office now has a supply of lapel badges showing the length of membership in five year periods. There are badges in recognition of membership of more than 5 years, 10 years, 15 years, 20 years, 25 years and 30+ years, as shown in the photograph below.

It is planned that the notification of these badges to individual members will be made as part of the next subscription renewal in July 2016. Individual members can then request the appropriate badge on receipt of their subscription renewal. However, if there are any members who would like to request their appropriate lapel badge sooner, please send an e-mail to admin@icorr.org and the office will check eligibility and send the relevant complimentary badge in the post.

![The ICorr Membership Lapel Badges.](image)
Technical Topics No.52

TRYING TO MAKE STEEL RUST!

By Douglas J Mills, Technical Secretary

Well it’s the New Year again. Been doing these TTs for over ten years now. Anyway, I thought I would take a somewhat different theme to start 2016. We normally talk about ways of trying to prevent corrosion. But there are times when we want corrosion to happen. To my students I always quote the battery as an example. The faster the corrosion rate and the lower the polarization, the better the battery will be. There is also an example which was being worked on by my one time PhD student Sina where stents in heart surgery are made from magnesium alloys. You want these to dissolve over time inside the body. Hence you try to make them as corrodisible as possible. Why have I become interested in producing rusty steel? Well it is in connection with a project I am doing with National Maritime Museum in Gdansk. My co-worker on this is another old student of mine Katarzyna (Kasia) Schaefer. The work is concerned

with developing a test method for organic conservation coatings applied to metal objects, normally iron/steel, copper/ bronze or pewter. These type of coatings have different properties to normal paints. For a start they should be invisible. Or as near invisible as possible. They should be easy to apply. And also easily removable. This limits what can be used. Some waxes fulfil the role quite well, the simplest being paraffin wax dissolved in benzene. The advantage of developing such a test method (electrochemical) is that it will enable the best coating at optimum thickness to be selected for a particular application. It also affords the possibility of checking to see whether the coating is still maintaining a reasonable level of protection ie objects can be monitored in situ ie in the museum or in the storage environment. The challenge is that many of the objects to which the coatings will be applied, will have residual rust (or corrosion product) on them. Hence we need to do tests with coatings on rusted steel or corroded copper. It is true one can buy rusted steel panels. But there is further complication. We want the panels to be rusted in Baltic sea water (this is an interesting sea because its salinity is significantly lower (about 1.6% salt) than say the Atlantic sea water (3.5% salt)). So how to do this? Well we thought it would be easy. Just immerse the steel panel and leave for a week. I was aware that if we put the panel in vertically it might show an anode and cathode area with the anode at the bottom and the cathode at the top (where oxygen access was easier). So I got the student to lay the panels horizontally in flat dishes with the panel only just covered with the sea water and what happened? Well not much rusting at all. And what there was concentrated at one edge. So next we tried heat. Up to 50°C (not too hot or we would drive out all the oxygen) and agitation. We could not leave this running for a week but for the period we did leave it there was limited rusting and again it was concentrated in one section near the edge of each panel (see picture). It appears that this steel is difficult to rust! Could it be that there is an inhibiting layer on it? So the next thing was to attempt to roughen or activate the surface with emery before rapidly immersing in the sea water. Result: same again - small anode large cathode; most of the surface not rusted. That got me thinking that an electrochemical approach might be good. Take the oxide off by polarising cathodically; then hold at an anodic potential eg +0.25V to the rest potential. See if that created the right conditions. Tried that. Got bubbling (O2 evolution?) on the surface and some ferrous compounds appeared. But the metal itself had nothing that looked like a nice layer of rust on it. So how can we do it?

It seems, in conducting solution in the lab metals, (steel anyway) are very difficult to get to uniformly rust. Atmospheric corrosion particularly the famous Corten steel with 2% copper might do better. But that is not a typical composition for the iron and steel objects that we are trying to use these coatings for! Intermittent dipping might be a good approach. Any suggestions welcome. Before leaving this rust topic I thought I would just include a couple of pictures of the Solidarity Museum in Gdansk which I was lucky enough to visit on a lovely day during a recent work trip. This museum is housed in a building that is not only full of rust on the outside, but also on the inside! Note even with this (presumably Corten), it is not uniform rusting with some places hardly rusted at all. But the cladding plates are definitely showing better rusting than the samples did in our lab experiments! Finally, I would like to draw attention to the upcoming (Tuesday 26th April, Birmingham Motorcycle Museum) one day CED meeting organised between ourselves and the Biodegradation society. The theme is Microbial Corrosion in Heating and Cooling Systems. Note six working parties will meet on that day. To see the list of WPs and get more details please see Nick Smart’s article and also the enclosed leaflet. Now back to trying get those samples to rust!
ABERDEEN BRANCH NOVEMBER MEETING

CORROSION ENGINEERING – ADDING VALUE?

The guest speaker for the November 2015 meeting was Billy Morrison of Wood Group Kenny.

He set the scene by giving an overview of corrosion engineering, what a corrosion engineer should know and emphasised the importance of a wide breath of practical experience especially in related fields such as inspection and integrity. He made reference to the falling oil prices highlighted the challenges that came with this loss of oil revenue. He gave an overview of the integrity management process highlighting the specific roles of the corrosion engineer. With illustrative flowcharts he explained the Risk Based Inspection (RBI) methodology for topside equipment, structures, caissons etc. He stated that data collation, corrosion loops/systems definition, risk assessment, selecting inspection techniques and defining intervals were all important aspects of the RBI process.

He discussed the development of equipment Written Scheme of Examinations (WSEs) and Inspection and Maintenance Routines (IMR) highlighting that codes such as API 570 (piping) and API 1160 (pipelines) could be used as guides to define intervals using a risk based decision making approach. He touched pipelines stating that the cost of activities such as corrosion inhibition, pigging and inline inspections should be considered during design to make the decision to use carbon steel or corrosion resistant alloys.

Billy presented two case studies. The first was related to deposits found in a section of manifold pipework. Chemical analysis showed deposits were iron sulphide scales. Analysis of corrosion products showed that there was also oxygen in the system even if this was supposed to be a deoxygenated system. Further investigation revealed that damaged gas compressor seals was the likely source. The lesson here was that system parameters do not always remain as they are designed to be. The second case was pressure swing adsorbers that suffered from solids accumulating at the walls. The problem was solved by increased gas purity without need for an extensive NDT programme or pipework replacement.

He concluded by encouraging corrosion engineers to be adaptable to learning new skills and always look for ways to improve processes. There were questions from various areas of corrosion management at the end of the meeting.

For information about the Aberdeen branch activities please contact our branch secretary, Frances Chalmers, ICorrABZ@gmail.com. Alternatively a calendar of local events of interest to corrosion professionals in the Aberdeen area and the opportunity to sign up to the branch mailing list is available at https://sites.google.com/site/icorrabz/home.
A joint meeting was held by the Institute of Corrosion Aberdeen branch and the Institute of Materials, Minerals and Mining (IOM3). The guest speaker was Javad Safari of Technip. The presentation covered the crack failure effects of fluids containing H₂S and CO₂ on reeled pipelines. He explained the various methods for sour qualification testing - Crack Tip Opening Displacement (CTOD) tests, Fatigue Crack Growth Rate tests and Corrosion Fatigue Testing (S-N Curve). Javad explained the results of various sour qualification tests carried out and used these to illustrate the effect of different concentration of H₂S on the fracture specimens. With illustrative diagrams, he compared the results of a series of fracture toughness tests on single edge notched bend (SENB) samples within different hydrogen charged conditions and provided details procedures for choosing the optimum test variables, which include the effect of hydrogen charging period, loading condition and stress intensity factor rate (K-rate). The results of tests which were performed in air (with and without hydrogen pre-charging) and tests in a sour environment (with hydrogen pre-charging) were presented and compared. Samples were also strained and aged to simulate reeling installation strains and the effect this had on the fracture toughness was measured.

Following the presentation, questions were asked on how fatigue tests were performed and verified, how the industry can come up with guidelines document and hydrogen content in air relating to a single side exposure in the K-rate measurement experiment.

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On Thursday 3 December ICorr Midlands Branch has held an afternoon meeting at the impressive and historic Council Chambers in Birmingham. The event was followed by the ICorr AGM.

Three interesting talks were presented on the topic of Education and Training, in relation to corrosion. Dr Paul Lambert of Mott McDonald kept delegates entertained explaining his colourful and winding path into the field of corrosion, and highlighting the difficulty, despite its importance, in finding a corrosion related course for those new into the field. He compared undergraduate and postgraduate courses worldwide. The conclusion was that more should be done to make any corrosion related education known, as prospective students are unlikely to apply for courses if they are not aware of them or they are difficult to find.

Mark Dowell of the Institution of Mechanical Engineers explained how IMechE are providing engineering training and supporting ICorr to expand overseas and in the UK. He also discussed how this was being achieved by adopting blended learning.

Sarah Vasey of Sherwin Williams explained the success and growth of the Young Engineers programme and discussed how young engineers had been given materials or corrosion related case studies to investigate in groups and how the programme had, through mentoring and sponsorship encouraged graduates and young engineers, and could continue to stimulate the entrance of young people into the Institute of Corrosion and the corrosion industry. There was discussion about whether the Midlands Branch would like to organise future events for the Young Engineers Programme.

Bob Crundwell also explained by way of example how he had ended up working in the corrosion industry.

Ali Sharifi, ICorr Midlands Branch Chairman had thanked all speakers for their presentations. He also thanked the audience for attending and participating in this informative and interesting event.

The AGM followed the meeting and the treasurer outlined the financial performance and John Fletcher explained future plans to buy offices in Northamptonshire.
Dear Sir/Madam,

We would like to invite you to participate in the International Conference and Exhibition in the Field of Corrosion and Cathodic Protection 2016. The event will take place at the Grand Hotel Union Ljubljana, from 17 – 20 May 2016.

All those willing to contribute to the conference programme are welcome to submit abstracts for their presentations.

The deadline for submission of abstracts is February 16 2016.

Titles and abstracts should be submitted to the Presidents of Commission 1 and Commission 2, with a copy to the Secretariat of CEOCOR.

cceocor@synergrid.be

To see the conference programme, registration form and information about the exhibition please visit our website.

The CeoCor International Conference is a traditional event – this will be the 60th conference of the European Committee for the Study of Corrosion and Protection of Pipes and Pipeline Systems – Drinking Water, Waste Water, Gas and Oil.

The conference is a meeting place for hundreds of experts from all over Europe. It will be held in Slovenia for the first time, bringing many experts as well as potential business partners to the country, thus offering your company the opportunity to make a powerful entry into the international markets. To facilitate this we have prepared several sponsorship packages which will enable you to deliver a convincing presentation of your company at this three-day conference organised by Energetika.NET, Slovenia’s leading on-line provider of energy industry news as well as a vast database of energy information.

Conference registration

All information on registration, the event, and sponsorship, can be found on our website www.ceocor-slovenia.si. Registrations can be submitted via the online APPLICATION FORM. Upon registration, we will send you a pre-invoice, as well as all the necessary logistical details.

Sponsorship

The International Conference and Exhibition in the Field of Corrosion and Cathodic Protection 2016 offers companies a great opportunity to promote their activities. For additional information please contact: Mateja Kegel Kozlevčar (+386 1 40 12 872) or info@ceocor-slovenia.si.
It was with great sadness that we heard of the passing of Ken Berkeley.

He had been ill for some time but passed away peacefully in his sleep on the 26th November 2015.

He is survived by his devoted wife Elizabeth, his son Grant and grandchildren Zoe & Maddie.

Ken was a very private man but dedicated to his work in the corrosion industry. He and John Morgan formed Morgan Berkeley and Company Ltd., which became well regarded in the 1960’s for successfully designing and applying cathodic protection systems on land and marine based plant throughout the UK.

Amongst the most memorable and successful projects were;

Internal protection of the fire water tanks on the Chivas Regal whisky distillery at Dalmuir Scotland. This was pre-drink drive and in happy times where all was shared; so leaving the site was difficult without partaking in the rather large dram in the security office when signing out for the day. Watching the launching of the QE2 down the Clyde being rather blurred.

Distributive groundbeds serving protection to the M8 flyover at Abbotsynch - with again easy access to the nice facilities offered by the Glasgow airport.

The Protection of the Stanlow to Heysham pipeline where commissioning revealed serious stray current effects on the Post Office telephone lead sheathed cabling near to Runcorn. The authorities insisted immediate de-commissioning. Naturally the situation was attended to by the Morgan Berkeley team. Ken felt that he needed to move on. He won the Eastern Gas Blanket Contract and set up the controlling office in the old gas works site along the Exning Road, Newmarket. With that running smoothly with a team of technicians in place he resigned from Morgan Berkeley and Company Ltd and later set up his own company PI Corrosion Ltd.

He travelled the world flying the CP flag and Elizabeth chuckles even now when remembering a meeting Ken had in America with an eminent Japanese engineer. The man introduced himself with great bows and held Ken in such awe and said “You very famous man in Japan”

Ken had a great passion for vintage cars and owned a nice collection. Sadly a serious fire destroyed so much of his home, his possessions and his collection it took Ken and his family a long time to recover from the losses.

Fortunately his second passion was France where he and Elizabeth drove the long journey down to the Pyrenees annually - though not restricted to once per annum.

As Ken was such a private man and no-one plans a lifetime diary - unless you are a teenage pop star needing a biography released through each two years of fame – it is very difficult to accurately document his life. Any inaccuracies are apologised for as they rely upon an aging memory.

However he does leave us with the book he co-wrote with his friend S. Pathmanaban: Cathodic protection of reinforcement steel in Concrete – first published in 1990.

As his first trainee on the Eastern Gas Blanket contract he never forgot me and gave me a signed copy which is shared with you below.

To finalise by quoting from the back cover;

‘The authors of CATHODIC PROTECTION OF REINFORCEMENT STEEL IN CONCRETE have over 50 years combined experience in the engineering industry. K.G.C. Berkeley was a member of the concrete Society’s Cathodic Protection Committee and Dr .S. Pathmanaban was a corresponding member. Together they have produced a valuable source of guidance for practising civil and structural engineers, surveyors and architects, as well as for students of those disciplines.’

With the end of this quote the contribution to cathodic protection by Ken is duly acknowledged.

A TRIBUTE TO KEN BERKELEY

Born in UK: 30th July 1929
Deceased Age: 86 years

Additional Note by Brian Wyatt: Ken was one of the gentlemen of our Industry. His company, PI Corrosion was one of the more successful in providing competent cathodic protection into the UK Water Industry......something that has become much more difficult in recent years with the changes in corporate objectives within this industry. He also strove to ‘put back’ for the future of corrosion and cathodic protection personnel; for many years he taught cathodic protection to short courses at his alma mater, the University of Surrey. He was always a generous and courteous host, with a fine choice of food and wine. He will be missed.
Institute of Corrosion’s Corrosion Engineering Division is holding a one day symposium on ‘Microbial Corrosion Issues in Heating and Cooling Systems’. This subject is important; for example, pre-commission cleaning of closed circuit pipework systems and the subsequent monitoring of water quality are essential in any building. The implications of getting these wrong can be catastrophic. The resulting problems include disruption to occupants whilst systems are re-cleaned or, in the worst cases, complete closure of buildings whilst entire systems are ripped out and replaced due to early failure.

This meeting will be the latest in a series of annual working days of the Institute of Corrosion’s Corrosion Engineering Division, which this year is being organised jointly with the International Biodeterioration and Biodegradation Society. The meeting will be held at the National Motorcycle Museum, Birmingham on Tuesday, April 26th.

After a series of talks by invited expert speakers, the meeting will break up into the individual CED working groups. The current working groups are as follows:

- Nuclear (chair Nick Smart)
- Coatings (chair David Horrocks)
- Oil-field chemicals and corrosion (chair Alistair Seton)
- Water treatment (chair Pam Simpson)
- Cathodic protection (chair Ross Fielding)
- Corrosion in concrete (chair Chris Atkins)

Note that the previous Monitoring and Oil-field Chemicals working groups have now been incorporated into a single working group under the chairmanship of Alistair Seton, who is based in Aberdeen and is a member of the Aberdeen Branch. Chris Atkins has replaced Ali Sharifi as chair of the Corrosion in Concrete working group.

Where possible, agendas for the working group meetings will be published separately in advance on the CED section of the ICorr website. In parallel there will be an exhibition and demonstration of equipment to visit.

This meeting will be a good opportunity to network with other corrosion professionals from different industry sectors, to learn about some of the latest developments in the field of microbial corrosion control, and to work with like-minded colleagues in the industry to develop useful documents of practical use in your areas of endeavour. For information on becoming involved with CED working parties please see the CED web site or contact the Chair of CED, Nick Smart (nick.smart@amecw.com). For registration to attend the meeting, or to apply for exhibition stand space, please see the enclosed leaflet. The registration fee includes refreshments during the day and free access to the motorcycle museum until 5:30 pm.
THE EVALUATION OF STAINLESS STEEL PITTING IN NEAT CORROSION INHIBITOR PRODUCTS – PART II

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SUMMARY

The resistance of the chromium oxide layer on stainless steel 316L (SS316L) to localized film breakdown and pitting when immersed in various neat chemical products at 55°C was previously evaluated using anodic cyclic polarization and electrochemical impedance spectroscopy (EIS) [1-3]. The focus of the previous research was to predict the compatibility of neat chemical products with SS316L, a commonly employed metallurgy for storage tanks and umbilical tubing. The investigation was aimed at assessing the influence of the immersion time and the applied anodic potential on pitting resistance [2]. Based on the results, a small or non-existent passivation region and low polarization resistance values indicated that the SS316L material was susceptible to pit initiation and propagation in the neat chemical product in which it was immersed. The results demonstrated that EIS could be used as a quick tool to investigate the compatibility of neat chemical products with SS316L metallurgy. Nevertheless, some storage tanks are also made with a lower grade stainless steel 304 material (SS304). There is an interest for both chemical manufacturers and operators alike to determine if existing storage tanks made of SS304 are compatible and thus suitable for use with both current and potentially new products considering that the lower molybdenum content of SS304 lowers its pitting resistance in comparison with SS316L. This article presents the results from accelerated SS304 compatibility tests of neat chemical products using the same techniques: anodic cyclic polarization and EIS at 55°C. The objective is to corroborate that the criteria used to determine the compatibility for SS316L could be also implemented to evaluate the chemical compatibility with SS304.

1. INTRODUCTION

This work of compatibility using electrochemical techniques started in 2010 when a production company found that the chemicals injected in the super duplex stainless steel (SDS2507) umbilical tubes inside three subsea umbilicals were incompatible with various corrosion resistant alloys [4]. The root cause failure analysis (RCFA) determined that a particular type of low dosage hydrate inhibitor chemical (LDHI) being used during normal service conditions in the western equatorial coast of Africa caused internal pitting corrosion that resulted in numerous leaks, necessitating the replacement of all three umbilicals. Additionally, the LDHI injection system (the top sides tanks and piping), which were made of SS316L, were found to be severely pitted during this timeframe. The RCFA concluded that both the SS316L chemical injection system and the SDSS2507 umbilical tubes were properly manufactured and the root cause of failure was internal pitting corrosion from exposure to a particular LDHI in its pure state. The repair costs were more than $50 million (US Dollars). An alert was sent to the rest of the operators reporting the failure found. The typical method of evaluating such compatibility – often conducted in accordance with ASTM G31-12a (NACE TM-01-69) [5] – involves the natural exposure of the metal alloy of interest to the chemical product, under the expected field conditions at a specified temperature for a particular duration of time. The examination of these tests commonly comprises the evaluation of corrosion rates based upon weight loss, coupled with pit density and maximum pit depth measurements. However, the use of immersion testing is not recommended for pitting evaluation because there is no standard test time and the overall weight loss of the metal species may be too small to measure accurately even if severe pits have developed. This procedure is also lengthy, sometimes greater than two months. This has led to interest from the production company affected, for the need for a more sophisticated method of evaluating the compatibility in terms of pitting resistance. The cyclic anodic polarization scans [6] are based on the determination of the pitting potential and pitting protection, which provide information on the susceptibility of a material in a given environment. The critical pitting temperature (CPT) is based on the lowest temperature where the material starts to generate stable pits [7]. Both cyclic anodic polarization scans and CPT testing provide important information related to the behavior of the material within a few hours and thus could serve as a tool to evaluate the compatibility of stainless steel with chemical products in a much shorter timeframe.

Since the production company initially made the request, the interest to explore more accurate and efficient techniques to complete the evaluation has continued. The final goal is to confidently assure clients that the products supplied in the field are not going to form pits on the specific metallurgy used in the field. Additionally, in some cases, there is only a short notice from the client to the supplier to develop a new product. In order to give a prompt response to the client, an accelerated technique of evaluating stainless steel compatibility with new chemical products would be highly beneficial [8, 9]. This is the reason that impedance studies were performed along with cyclic polarization and CPT testing. The resistance of the chromium oxide layer on stainless steel 316L (SS316L) to localized film breakdown and pitting when immersed in various neat chemical products at 55°C was previously evaluated using anodic cyclic polarization and electrochemical impedance spectroscopy (EIS) [2,3]. The results demonstrated that EIS could be used as a quick tool to investigate the compatibility of neat chemical products with SS316L metallurgy. Nevertheless, some storage tanks are also made with a lower grade stainless SS304 material.

This paper presents the results from accelerated SS304 compatibility tests of neat chemical products using the same techniques for SS316L [2,3]: anodic cyclic polarization and EIS at 55°C. Historically, EIS has been used to investigate the dissolution and passivation of metal. In the literature there are many papers suggesting that impedance is a powerful tool for interpreting the formation of pits in passive materials and various electrochemistry models have been proposed to interpret the impedance data [10-14]. The main goal of this study is to identify the transition from the passive to active range in the impedance diagram and correlate the results with the compatibility of the chemicals. The intention is to corroborate that the criteria used to determine compatibility for SS316L can be also implemented to evaluate compatibility.
The composition of the SS304 alloy is given in Table 1. The SS304 cylindrical WE had an approximate surface area of 4.75 cm². Before the test, the electrode was ground to 600-grit finish, sonicated in the presence of xylene, isopropyl alcohol, and acetone successively, and then dried with compressed air. Experiments were conducted using fifteen neat chemical products (i.e., corrosion inhibitors, biocides, scale inhibitors - see Table 2). 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 and were naturally aerated. Six hundred millilitres (600 ml) of solution was used for each test.

2. EXPERIMENTAL

2.1 ELECTRODES & TEST SOLUTIONS

Electrochemical studies (cyclic polarization scans and EIS) were carried out using a standard three electrode electrochemical cell consisting of a 304 grade stainless steel (SS304) 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. The composition of the SS304 alloy is given in Table 1. The SS304 cylindrical WE had an approximate surface area of 4.75 cm². Before the test, the electrode was ground to 600-grit finish, sonicated in the presence of xylene, isopropyl alcohol, and acetone successively, and then dried with compressed air. Experiments were conducted using fifteen neat chemical products (i.e., corrosion inhibitors, biocides, scale inhibitors - see Table 2). 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 and were naturally aerated. Six hundred millilitres (600 ml) of solution was used for each test.

2.2 EIS MEASUREMENTS

The EIS measurements were performed at different immersion times at the open circuit potential (OCP) (1 h, 2 h, 4 h, and 6 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 impedance was performed using a sinusoidal input potential with an amplitude of 10 mV at 8 points per decade in the frequency range of 10 mHz to 100 KHz.

2.3 IMMERSION TESTS

In order to evaluate the compatibility of the products with SS304, immersion tests were performed for a period of one month at 55°C. After the test, the coupons were rinsed and cleaned with distilled water before being successively sonicated with xylene, isopropyl alcohol and acetone. The coupons were weighed before and after the immersion test. The amount of metal loss and the time of exposure were used to calculate the corrosion rate following Equation 1 (below).

\[
\text{corrosion rate} = \frac{\Delta W (g) \cdot 22300}{D (\text{g/cm}^3) \cdot A (\text{m}^2) \cdot t (\text{days})}
\]

Where
- Corrosion rate is in mpy
- Weight loss (\(\Delta W\)) is in grams
- Alloy density (\(D\)) is in g/cm³
- Area is in square inches
- Time is in days
- 22300 is a conversion factor

The electrodes were then assessed using optical microscope to evaluate the extent of pitting on the metal surface. In addition, the electrodes were also submitted for white light interferometer (WLI) analysis to determine the extent of localized attack.

3. RESULTS

3.1 CYCLIC POLARIZATION ANODIC SCAN

Figure 1 show the sixteen anodic polarization scans performed for SS304 in neat chemical products at 55°C. Arrows denote the potential sweep direction of the potential applied. These polarization scans were generated on a 600-grit finish surface. To simplify the discussion, four different categories of the anodic polarization were identified: A, B, C, and D. The classification of the four different categories observed was based on the following electrochemical parameters estimated from the curves:

- Current density (\(i_{corr}\)) at a specific potential: The magnitude of the \(i_{corr}\) is a function of the potential applied. In the literature, the value of \(i_{corr}\) reported is typically averaged over the entire passivation domain. The current density at 150 mV above the OCP \(E_{\text{corr}}\) (in g/cm²) greater than 5 µA/cm² is taken to indicate a low likelihood of neat chemical compatibility with stainless steel based on previous work [3].
• Presence of the hysteresis loop in the polarization graph: the positive hysteresis loop generated between the forward and reverse potential scans is indicative of pitting corrosion. In the case of the positive hysteresis, the curve reverses with a higher current density indicating the formation and growth of pits. When the scan has a negative hysteresis, the curve reverses with a lower current density implying that pitting corrosion is not occurring.

• A pitting potential ($E_{p,i}$) of 200 mV (vs. OCP) or greater is taken to indicate a high likelihood of neat chemical compatibility with stainless steel [3].

It is important to mention that the classification of the four different categories was based on previous in-house work correlating long term (90 days) material compatibility testing of SS316L with short-term polarization tests in neat corrosion inhibitor products [2, 3]. To date, these criteria have been giving excellent correlation to long-term materials compatibility immersion tests for SS316L and other passive alloys.

The first type of behavior (category A) corresponds to product 1, showing the largest passivation region (>800 mV) and low current density (<5 µA cm$^{-2}$) throughout the majority of the scan. This product may or may not exhibit a pitting potential value ($E_{p,i}$) (see Figure 1a and Table 3). In addition, negative hysteresis was observed in which the current density on the reverse potential sweep is less than that of the forward potential scan. In this case, the hysteresis during the anodization of the working electrode is ascribed to the growth or thickening of the oxide film on the steel surface [3]. This would provide greater resistance to the ionic species diffusing to and from the metal surface, resulting in a lower current density on the reverse sweep [3]. The neat product found in category A was product 1. Previous work with SS316L has found the same behavior [3]. The current density at 150 mV above the OCP, $E_{p,i}$, was 2.7 µA cm$^{-2}$ (lower than 5 µA cm$^{-2}$).

The anodic polarization curves of SS304 in categories B and C were very similar (see Figure 1b and 1c). Products in both categories have a distinctive passive region (pitting and repassivation potential), a positive hysteresis during the reverse potential sweep, and a low current density (< 5 µm/cm²) until the pitting potential. The differences between scans B and C are the extent of the passivation plateau and consequently the $E_{p,i}$ value. Scans in category B presented larger passivation plateau (ca. 203 to 456 mV) than category C scans (ca. 65 to 175 mV). As it is well known, $E_{p,i}$ is a measure of the tendency to form pits. Higher value of $E_{p,i}$ indicates greater resistance to pitting attack in the tested environment (i.e. a higher compatibility with the solution). Chemicals in category B with larger passivation plateau include products 2, 3, 4, and 5. For the smaller passivation plateau another 4 chemicals were found in category C, which are products 6, 7, 8, and 9.

Products 10, 11, 12, 13, 14, and 15 were placed in the last group (category D). The dominant characteristic is the presence of a pseudo passivation plateau as the current density increased relatively fast from zero to quite high values (e.g. ca. 16 µA cm$^{-2}$ or more at 100 mV). This behavior is different from scans in categories A, B, and C, for which stable current densities were observed within the potential range of 65-800 mV (Table 3). The pseudo passivation suggests that the passive film becomes unstable, thus the material is exhibiting active-passive behavior (the metal starts to corrode rapidly when the slope is lower). When pits start to occur in the entire surface, general corrosion is likely to happen.

**Figure 1**: Anodic Cyclic Polarization scans obtained for SS304 immersed in 15 different neat products at 55°C (scan rate 10 mV/min).

**3.2 IMMERSION TEST RESULTS**

Surface observations: The photographs in Figure 2 show the surface morphology of SS304 coupons after the immersion test (a picture before immersion was also included for reference purposes - Figure 2a). Microscopic examination indicated that pitting didn’t occur on the coupons immersed in the neat products in categories A and B. Representative photographs for product 1 from category A and product 3 from category B are shown in Figures 2b and 2c, respectively. In contrast, pits were observed for products in categories C and D. Figures 2d and 2e show representative photographs for product 8 from category C as well as product 11 and product 14 from category D. For the products in category D, beside the significant number of deep pits (Figure 2e), a large amount of shallow localized corrosion was found across the entire surface of the coupon, which may be.

**Figure 2**: Morphology of the surface of SS304: (a) before and after immersion testing, (b) in Category A, (c) in Category B, (d) in Category C, (e) and (f) in Category D.
related to general corrosion instead of pitting corrosion (Figure 2e bottom).

Figure 3 shows the photograph and white light interferometry (WLI) image of the fully scanned electrode surface of each category, along with the histogram of pits on the metal after a three-month immersion test of SS304. As it can be seen in Figure 3a from the photograph and WLI image of the fully scanned surface electrode immersed in Product 11 (Category D), as well as the pit histogram data, extensive localized corrosion attack on the SS04 surface with more than 280 pits, the deepest of which was 672 μm, correlating to an average pitting corrosion rate of about 16 mpy (0.41 mm/y”), was detected on the metal. The photograph and WLI image in Figure 3b show that there is a substantial amount of general corrosion attack that has taken place on SS304 after three month immersion testing in Product 11 at 55°C. Additionally, from the pit histogram in Figure 3, it is evident that there were more than 12,500 pits detected on the SS304 metal surface after immersion testing.

Table 3 shows the corrosion rates and pitting results for each category. For products in categories A and B, low values of general corrosion rates (less than 2 mpy) and negligible pitting (i.e., no features greater than those already present on the surface before exposure) were observed on SS304 coupons after the three-month immersion test (Table 3). For products in category C, the general corrosion rate was less than 4 mpy, however pits were observed on the surface after three months. In contrast, for products in category D, general corrosion was detected (16-155 mpy), associated with the formation of a significant number of pits.

### 3.2 Electrochemical Impedance Spectroscopy

#### 3.2.1 Influence of the Immersion Time

The effect of the immersion time on OCP was traced over 6 hours for the SS304 electrodes immersed in 15 neat products. Nyquist diagrams for one of the most representative products in each category are represented in Figure 4. The analyses carried out monitored the polarization resistance ($R_p$) over time. A decrease of the polarization resistance would be indicative of the passive film dissolution. For the products in categories A and B, only one time constant was observed and the overall impedance did not change with time. These phenomena suggest that the passive film is a continuous and stable barrier between the metal and the solution. Classic Randle circuit with the constant phase element (CPE) representing the capacitance of the metal and the solution. Classic Randle circuit with the constant phase element (CPE) representing the capacitance of the passive film was therefore used to model the impedance diagram for SS304 over time at OCP [11,14]. Since only one semicircle was observed in the Nyquist plots, the same Randle circuit with CPE was used to model the impedance curves. The polarization resistance is in range of $21200 \Omega \cdot \text{cm}^2$ – $98650 \Omega \cdot \text{cm}^2$ as shown in Table 3.

The behavior for products in Category D is different. Figure 4d shows the variation of the impedance diagram for SS304 over time for one of the representative products in this category. A particular behavior was observed for the entire list of products in Category D: a capacitive semicircle at high frequencies and an inductive loop at low frequencies in the Nyquist diagram. This inductive loop was ascribed in the literature to localized corrosion [10]. Category D had the lowest $R_p$ values: 0.2 $\Omega \cdot \text{cm}^2$ - 5129 $\Omega \cdot \text{cm}^2$. In future work, equivalent circuit models used for each product with the values of the parameters will be discussed in detail.

#### 3.2.2 Influence of the Polarization

The effect of applied anodic potential on the passivation of SS304 immersed in different categories of products (A, B, C, and D) at 55°C is presented in Figure 5. It was found that the Nyquist diagram followed the changes in the $R_p$ of the passive layer and therefore changes in the circuit to be used, depending on the applied potential [2]. The goal in this section is to study the corrosion resistance of the passive film with the application of the potential and...
to try to relate the reduction of the $R_p$ with the rupture or dissolution of the passive film (pit formation). The anodic potential was maintained for 6 minutes at each potential applied before the impedance test in order to minimize the possible perturbation in the interface. The model most used is the classic Randle circuit described previously. The impedance of some products in Categories A and B were affected by diffusion behavior during the initial potentials. However, after polarization was applied in the anodic passive region, one semicircle in the complex plane of the Nyquist plot fits the impedance spectrum satisfactorily [11-14]. For products in Categories A and B, the largest $R_p$ were gained in the spectrum with anodic potential applied. This is due to the fact that these products presented a much higher passivation region compared to products in Categories C and D (Figure 5). The overall impedance does not change much with the polarization, suggesting that there was no significant change in the passive film with polarization and the values were among the highest from the list of products tested.

Previous work by Moloney and De-Abreu [2, 3], a pitting potential, $E_{pit}$ of more than 200 mV (OCP) from anodic potentiodynamic polarization for SS316L was found to be an indication of the compatibility. For comparative reasons, the $R_p$ reported was obtained from impedance polarized at 200 mV vs. OCP and the values are in the range of 8500 $\Omega$ cm$^2$ -175000 $\Omega$ cm$^2$ (Table 3) for products in Categories A and B.

The model used to fit the experimental impedance data for products in Category C varies. The simulation was conducted using different equivalent circuits due to the fact that the solutions studied were different in nature. Some products showed a capacitive behavior, defined by the semicircle with large diameters around OCP. The diameter of these capacitive loops decreased significantly when the applied potential was equal or higher than $E_{pit}$ ($E_{pit}$ < 200 mV for Category C).

When anodic potential was applied to products in Categories C and D, $R_p$ decreased with potential. Notice the inductive behaviour for products in Category D. The magnitude of the impedance decreased significantly during the application of the potential at lower frequency values. Conversely to Categories A and B, the passivation region in the cyclic polarization is lower for Categories C and D (Figure 1). In some cases, when the products showed an $E_{pit}$ lower than 200 mV (Figure 1c) or pseudo-passivation (Figure 1d), it was not possible to get an impedance spectrum. Consequently, the $R_p$ reported in those cases came from the impedance plot for the maximum potential available. The values of $R_p$ for both Categories C and D after polarization were low. For Category C $R_p$ values are between 890 $\Omega$ cm$^2$ -5778 $\Omega$ cm$^2$ and for Category D between 0.2* $\Omega$ cm$^2$-2635* $\Omega$ cm$^2$ (the * indicates that the values reported were taken at the maximum potential available).

### 3. CONCLUSIONS

The use of cyclic polarization and EIS as accurate techniques for evaluating the pit formation have been demonstrated. Both techniques provide a powerful tool to classify chemical products in terms of their potential for pitting corrosion in stainless steel 304.

It was corroborated that the criteria used to determine the chemical compatibility for SS316L [3] could also be implemented to evaluate the compatibility with SS304: A pitting potential greater than 200 mV (OCP), and current density less than 5 $\mu$A cm$^{-2}$ at 150 mV both need to be met in order to deem a chemical product as compatible with the metallurgy [3].

A polarization resistance determined from the impedance diagram higher than 8500 $\Omega$ cm$^2$, obtained at 200 mV in anodic polarization, suggests high resistance of the passive film. Flags about the presence of pits at 200 mV will be suggested by a polarization resistance value lower than 8500 $\Omega$ cm$^2$. No conclusive results could be obtained from $R_p$ at different immersion test at the OCP.
COMPOSITE WRAP TACKLES COMPLEX PIPE GEOMETRIES

In April 2015, a Norwegian Floating Production, Storage and Offloading vessel (FPSO) requested a solution to rebuild, strengthen and protect corroded gas pipes. A series of pipes on board the North Sea FPSO were displaying signs of corrosion between both the pipe and support, in some areas registering thin wall defects with up to 35% wall loss. Not only did this represent a severe containment issue, but it also threatened the vessel’s operation.

Impressively, FPSOs combine facilities for production, processing and storage all in the same place. Often viewed as a safer and more economical solution, with the ability to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another development, these vessels have become the foremost system to relocate to another 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the application of Belzona SuperWrap II. As a part of the designated plan, the installation team assembled tarpaulin housing around the specific pipe defect, for grit blasting and climate control purposes. Each wrap application followed the same procedures, by initially grit blasting in accordance with Standard SA2.5, removing any foreign corrosive matter. Ultimately this provided an optimum substrate surface profile of 75µm, ideal for successful application. Once achieved, corrosion resistant Belzona 1111 (Super Metal) was used to rebuild the metal substrate. The versatile adhesive properties of the resurfacing epoxy-based composite, particularly on carbon steel substrates, created a level surface for the next stage of repair.

As highlighted, the complex pipe geometries included bends, straights and tees, necessitating a tailored design for the Belzona SuperWrap II application. The two-part, fluid grade resin system works in conjunction with a bespoke hybrid reinforcement sheet based on fibre glass and carbon fibre. The fibre glass offers flexibility, in addition to serving as a wet-out indicator, which ensures effective application of the reinforcement sheet. Interwoven with carbon fibres, the reinforcement sheet provides the composite wrap with the strength it needs to retain high pressures and loads. Belzona were able to cut the reinforcement sheets to match the unique pipe dimensions in the form of a reinforcement jackets for the tees, whilst utilising specifically measured strips for the bends. Before each application, the substrate was wetted with the fluid grade resin system, maximising the bond between the carbon steel and Belzona SuperWrap II. Covering lengths of 690mm, applicators used seven spirals of reinforcement around each defect, creating a tapered profile of 14mm at the densest section. Finally, this was consolidated by tightly wrapping release film around the composite wrap, which was later removed after the cure process was complete, allowing the repair to securely adhere.

Following completion of the Belzona SuperWrap II installation, a new solution was implemented to place the pipes into position, fit for purpose. Belzona 1311 (Ceramic R-Metal) was adapted by applicators to create irregular loading bearing shims between the pipeline and support. Often used for metal repair and protection against the effects of erosion and corrosion, these reinforced plates were installed to transfer the load of the pipe, demonstrating the material’s excellent compressive strength.

Inclusive of grit blasting the defected areas, each Belzona SuperWrap II installation was finished within 6 hours, leaving sufficient cure time for each application. Once the entirety of the repair was completed, it was necessary for pressure testing to be carried out. After successful assessment indicated that the pipe pressure had been restored to its original levels, without any irregularities, the pipe system was set back into production. Due to the initial planning, combined with the correct equipment and application management, there were no issues during the timeline of the project, consistent with the customer’s specified shutdown period.

Primarily, all phases of the project were handled by one contractor, allowing for a consistent approach that ensured the application was successfully achieved within the allotted schedule. Furthermore, this was significantly aided by the ease and speed in which Belzona’s versatile composite wrap system could be applied. Since installation, the customer has indicated that the application is functioning well and is set for periodic inspection, in line with the specified design life of 20 years. Between 2010 and 2015, a total of 48 Belzona SuperWrap applications have been commissioned by the customer, across various offshore oil and gas platforms. This figure has subsequently risen, after three repairs executed in August 2015 were completed, serving as an indication of the product’s strength and the customer relationship developed.
Belzona’s Technical Service Engineer, Henry Smith, who assisted with the application said, “Located on a dredger, the boiler was situated just next to the engine room. Due to this proximity, the operator required the chocking system to exhibit exceptional impact resistance in order to withstand constant vibration attack caused by the engine machinery. A further requirement was for the application to be carried out as quickly as possible, ensuring minimal downtime was incurred and therefore minimal profit loss.”

Bad Vibrations

The long-term success of any chocking installation is determined by how well the machinery system is joined to the foundation. The base plate of the machinery system must become a monolithic member of the foundation system in order to ensure minimal vibration activity is achieved. If this system is insufficient, excessive vibration can lead to machinery failure; bolts can become slack, and in more severe cases, equipment can become misaligned.

A conventional chocking solution commonly employed to combat vibrations is metal shimming. However this technique can often be difficult to install and can loosen over time. Another option involves cement grouting, but not only does cement have poor mechanical properties, this method can incur significant cure time and will therefore require longer downtime.

Belzona Specification

Following a Belzona inspection, the operator decided to chock the boiler into place using Belzona 7111 (Marine Grade). This two-component material is specially designed for use as a chocking or grouting compound to endure the physical and thermal shock common to marine environments. DNV GL approved and certified by major classification bodies including Lloyd’s Register Marine and the American Bureau of Shipping, Belzona 7111 is the ideal solution to withstand the damaging vibrations on the dredger.

Simple Application Method

The boiler was set into place using jacking bolts, and dams were built around each of the individual bolts in order to ensure a restricted chocking area. Belzona 7111 was then poured into the prepared areas.

Due to the way in which the boiler sat inside the engine room, there was limited access underneath which made it difficult to pour the product directly from the mixed unit into the chock area. A small curved steel section was therefore used as a channel to funnel the product, with a thickness of just over 2 inches, application to be carried out with minimal downtime, while the high impact properties of the material will ensure the boiler will remain secure for the long term. In fact, when the impact resistance was tested using Izod Pendulum impact testing in accordance with ASTM D256, Belzona 7111 achieved 0.75 J/cm (un-notched). This indicates that when the chocking material is subjected to impact forces, the material will successfully absorb the shock, thus minimising the impact damage.

Fast Application and Cure Ensures Minimal Downtime

Dredgers are an important part of the world’s commerce system as much of the world’s goods travel by ship, and therefore need to access harbours or seas via channels. Thus the requirement of a fast-curing chocking material that incurs minimal downtime is critical in insuring this transport method does not become impaired or hindered. In this situation, as Belzona 7111 took just two hours to apply and only 48 hours to cure, this enabled the dredger to successfully continue its operation with minimum downtime and disruption. Furthermore, as Belzona had fully trained the operator and their application team on Belzona chocking applications, this enabled the application to be carried out on site without the need for an external representative; saving the operator unnecessary capital expenditure.

For further information contact: Belzona Polymerics Ltd., Claro Road, Harrogate, HG1 4DS Tel: 01423 567641 Fax: 01423 505967 Email: sales@belzona.co.uk Website: www.belzona.co.uk

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SEASHIELD PROTECTION AT CROMER PIER

As part of a recent project for repairing RNLI Cromer’s supporting structure, Edwards Diving Services Ltd of Caerphilly has installed Winn & Coales SeaShield 100 System on nine of the tubular piles to the Lifeboat Station.

Cromer Lifeboat Station is located at the end of Cromer Pier on the North Norfolk Coast in a very exposed location and is manned by volunteers. The location can be subject to severe wave action and fast flowing tidal currents. Sections of some of the previously installed protective wrapping system on the piles had deteriorated and needed replacement. The RNLI, the charity that saves lives at sea, commissioned Edwards Diving to undertake repairs during a period of relatively calm conditions.

After removing the previous protective wrapping and marine growth Edwards Diving Services applied sections of SeaShield 100 protection to piles in the intertidal zones, one of the most aggressive environmental areas. As a system SeaShield 100 consists of Denso Paste S105, Marine Piling Tape, all then encased by SeaShield jackets which are held in place by Smartbands wrapped and tensioned around the piles at close interval.

Access to the site area beneath the Lifeboat Station was gained via Edwards Diving Services Aquadoc flexible pontoon system, configured to fit around individual piles requiring repair. Careful planning allowed the work to be undertaken over a number of days during a period of suitable Spring Tides coupled with calm weather conditions.

Bagnalls are once again stepping onto the podium after being awarded Silver at this year’s National Considerate Constructors Scheme awards.

The accolade was awarded after an audit of works and site conduct on the historic residential property on King William Walk, Greenwich.

The Considerate Constructors Scheme only honours the top twenty per cent of contractors that score highly when audited on five main categories; Appearance, Community, Environment, Safety and Workforce.

Having only been a member of the Considerate Constructors Scheme since 2010 Bagnalls have now picked up awards in consecutive years having won their first Bronze award last year.

Bagnalls is a national painting, decorating and specialist coatings contractor with a specialist concrete repair and refurbishment division servicing London and the South East.
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Successful completion of the ICATS course by operatives leads to certification by Correx. Trainers and operatives will require re-certification after 3 years and renewal after 9 years.

ICATS REGISTERED COMPANIES

A & R Painting Services Ltd
Marwood House, Riverside Park, Bromborough, Wirral, CH62 3QX
Tel: 0151 445 3589

Abbey Gritblasting Services
Unit 13, Clotpon Commercial Park, Clotpon, Woodbridge, Suffolk, IP12 3TP
T: 0191 262 0510

Access & Coatings
Nigg Energy Park, Nigg, Ross-shire Scotland, IV19 1QU
T: 01862 852960

AIc Steel Ltd
1 Neptune Works, Newport NP20 2SS
T: 01633 528400

Alfred Bagnall & Sons
6 Manor Lane, Shipley, West Yorkshire, BD18 3RD
T: 01302 853259

Alpa ccess s.r.l.
I.L. Caragiale, 21 Ploiesti, 100015, P.H. Romania
T: +44 (0) 722140858

a McKie Building & Engineering Ltd
19 Kyle Road, Irvine, Ayrshire, KA12 8JX
T: 01294 279586

aMiTeC UK Ltd
Riverside Farm Estate, Back Lane, Kingston Seymour Nr Clevedon, North Somerset, BS21 6UZ
T: 01275 342236

APB Construction (UK)
First Floor Offices, Grange Business Centre, River Works, Grange Lane, Sheffield, S5 ODP
T: 0114 261 0000

APB Group Limited
Roundhead House, Roundhead Business Park, Brookhouse Way, Cheadle, ST10 1SR
T: 01538 755377

Appius UK Ltd
Block 2, Units C & D West Mains Industrial Estate, Grangemouth, Stirlingshire FK3 8YE
T: 01324 489785

Armourcote Surface Technology Plc
15/17 Colvilles Place, Kelvin Industrial Estate, East Kilbride, Scotland, G75 OPZ
T: 01355 248223

Austin Hayes Ltd
Carlton Works, Cemetry Road, Yeadon, Leeds, LS19 7BD, UK
T: 0113 250 2255

Aveon Offshore Ltd
Aveon Offshore Facility, Rumulmeni, Port Harcourt, River State, Nigeria
E: dpetillion@aveonoffshore.com

B&A Contracts Ltd
Dale Road, Hubberston, Milford Haven, Pembrokeshire SA73 3PR
T: 01646 693489

BAE Systems Surface Ships Support Ltd
Room 213, Naval Base Headquarters, Building 1/100, PP127, Portsmouth, PO1 3LS
T: 023 92857279

BAM Nuttall Ltd
St James House, Knoll Road, Camberley GU11 3XW
T: 0782 5798440

Beever Limited
Little Coldharbour farm, Tong Lane, Lamberhurst, Kent, TN3 8AD, UK
T: 01892 890045

Blifinger Salamis UK Ltd
4 Greenhole Place, Bridge on Don, Aberdeen, AB23 8EU
T: 01224 246499

Bluhull Marine Ltd
Orange Grove Birbal Street Bazard, BN1 903 MALTA
T: +356 21445807

Border Coatings (Scotland) Ltd
Unit 7, Station Road Industrial Estate, Earliston, Berwickshire TD4 6BZ
T: 01896 848919

Briton Fabricators Ltd
Watnall Road, Hucknall, Notts, NG15 6EP
T: 0115 963 2901

BSM Consulting
11 Kingsmead, Nailsea BS48 2XH
T: 01275 854708

CAN Structures Ltd
Smeckley Wood Close, Chesterfield Trading Estate, Chesterfield, S41 9PZ
T: 01246 261111

C E Pittaway & Son Ltd
106 – 114 Flinton Street Hull HU3 4NA
Tel: 01482 329007

Celtic Specialist Treatments Ltd
Enterprise House, Herbert Road, Newport, South Wales, NP19 7BH
T: 01633 267007 (office)
01633 215900 (workshop)

Centregreat Engineering Ltd
11/12 Wyndham Close, Brackla, Brackla Industrial Estate, Bridgend, CF31 2AD
T: 01656 650481

Chencem Scotland Ltd
Wester Crosshill, Avonbridge Road, Falkirk FK1 3DF
T: 01324 851987

Cleveland Bridge UK Ltd
Cleveland House, Yarm Road, Darlington, DL1 1DE
T: 01325 502345

Coastground Ltd
Morton Peto Road, Gabpton Hall Industrial, Great Yarmouth, Norfolk, NR31 0LT
T: 01493 650455

Coating Services Ltd
Parlton Street, Mumps Bridge, Oldham, OL1 3RU, UK
T: 0161 665 1998

Collins Engineering Railway Contracts
Salcombe Road, Meadow Lane Industrial Estate, Alfredton, Derbyshire, DE55 7RG
T: 01773 833255

Community Clean
11 Old Forge Road, Fenndown Industrial Estate, Ferndown, Wimborne, Dorset, BH21 7RR, UK
T: 0845 6850133
Corrocoat
Forster Street, Leeds, LS10 1PW
T: 01132760760

Corroless Eastern Ltd
Greens Road, Greens Industrial Estate, Dereham, Norfolk NR20 5TG
T: 01362 691484

County Building Services Ltd
Unit D3, Spectrum Business Estate, Anthony’s Way, Medway City Estate, Rochester, Kent, ME2 4NP
T: 01604 711507

Darcy Spillcare Manufacture
Brook House, Larkfield Trading Estate, New Hythe Lane, Larkfield, Kent ME20 6GN
T: 01622 715100

d&d rail Ltd
Time House, Time Square, Basildon Essex SS14 1DJ
T: 01268 520000

denholm industrial Services
200 Carmichael Street, Glasgow, G51 2QU
T: 0141 445 3939

d F Coatings Ltd
Unit 17, Willments Ind. Estate, Hazel Road, Woolston, Southampton, SO19 7HS
T: 0238 044 5634

donyal engineering Ltd
Hobson Industrial Estate, Burnopfield, Newcastle Upon Tyne, NE16 6EA
T: 01207 270909

Donyal Engineering Ltd
Hobson Industrial Estate, Burnopfield, Newcastle Upon Tyne, NE16 6EA
T: 01207 270909

DRH Coatings Ltd
Suite 5, 3 Shawcross Industrial Estate, Ackworth Road, Portsmouth PO3 5JQ
T: 023 9266 6165

Dyer & Butler Ltd (Rail)
Mead House, Station Road, Nursling, Southampton, SO16 4AH, UK
T: 02380 667549

E G Lewis & Company Ltd
Suite 5, 3 Shawcross Industrial Estate, Ackworth Road, Portsmouth, PO3 5JQ
T: 01970 732350

ENC Industrial Ltd
Houghton Road, North Anston Trading Estate, Ovington, Sheffield, S25 4JY
T: 01909 567860

Enzo South West Ltd
Unit 3, City Business Park, Somerset Place, Plymouth, Devon, PL3 4BB
E: enzoswltld@gmail.com

ESB Surface Engineering
203 Westgate Street, Gloucester, GL1 2RN
T: 01452 306272

F A Clover & Son
Bardolph Road, Richmond, Surrey, TW9 3LH
T: 0208 948 6321

Farbuild Ltd
Trelawn Lodge, Vicarage Road, Wingfield, Diss, Norfolk IP21 1SR
T: 01379 640670

Ferrous Protection Ltd
Units 27-29 Saddlesworth Business Centre, Huddersfield Road, Delph, OL3 5DF
T: 01457 87419

Forth Estuary Transport Authority
Forth Road Bridge, Administration Office South Queensferry, EH30 9SF
T: 0131 319 1699

Forth Protective
Vernon Street, Shirebrook, Mansfield Notts, NG20 8SS
T: 01623 748323

Fountains part of OCS
Group of Companies UK Ltd
Blenheim Court, George Street Banbury, OX16 5BH
T: 01295 750000

Gabre (UK) Ltd
12 Church Street, Omagh, Co Tyrone, BT78 3BX
T: 028 8240391

GPL Civil Engineering Ltd
(Special Projects Division)
Kennedy House, Cheltenham Street, Salford, M6 6YW
T: 0161 745 7888

Harsco Infrastructure UK Ltd
Unit 3 Manby Road, South Killingholme, Immingham, North Lincolnshire, DN40 3DX
T: 01469 553800

Harrisons Engineering Lancashire Ltd
Judge Wilmet Mill, Longworth Road, Billington, Clitheroe, Lancashire, BB7 9TP
T: 01254 823993

HBS Protective Coatings Ltd
40 Manse Road, Belfast BT8 6SA
T: 028 90708280

Hempel UK Ltd
Llantarnam Park, Cwmbran, Gwent, NP44 3XF
T: 01633 874024

Herrington Industrial Services Ltd
Crown Works, Crown Road, Low Southwick, Sunderland SR8 2BS
T: 0191 5160634

Hi-Tech Surface Treatment Ltd
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T: 023 80611789

Hyspec Services Ltd
Unit 3 Meadowfield Industrial Estate, Cowdenbeath Road, Burntisland, Fife, KY3 0HL
T: 01592 874661

Industrial Coating Services
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T: 0845 474 0007

International Energy Services Ltd
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T: 014615636

Interserve Industrial
Unit 2, Olympic Park, Poole Hall Road Ellesmere Port, Cheshire, CH66 1ST
T: 0151 3737660

Jack Tighe Coatings
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T: 01302 880360

Jack Tighe Ltd
Redbourne Mere, Kirton Lindsey, Gainsborough, Lincs, DN21 4NW, UK
T: 01652 640003

JWM Industrial Services Ltd
47 Barton Road, Stretford, Manchester, M32 9FA
T: 0161 2825329

JTL Fire Ltd
24 Cove Road, Farnborough, Hants, GU14 0EN
T: 01252 545741

J W Coatings Ltd
9 Prospect Road, Ossett West Yorks, WF5 8AE
T: 01924 270122

Kaefer C&D Ltd
Riverside House, Rolling Mill Road, Viking Industrial Estate, Jarrow, Tyne & Wear NE32 3DP
T: 0191 428700

K & N Finishers (Southern) Ltd
Castle Trading Estate, Porchester, Fareham, PO16 9SF
T: 02380 869700
Kilnbridge Construction Services Ltd
McDermott House, South Crescent, Cody Road Business Park, London E16 4TL
T: 0207 511 1888

K P Coatings Ltd
Unit 4, James Park, Mahon Road, Portadown, Co Armagh, BT62 3EH
T: 02838 338151

Lanarkshire Welding Co.
82 John Street, Wishaw, Lanarkshire, ML2 7TQ
T: 01698 264271

Ledwood Protective Coatings Ltd
Waterloo Industrial Estate, Pembroke Dock, Pembrokeshire, SA72 4RR
T: 01646 623600

Livingstone Surface Treatments Ltd
Unit 4, The Energy Coast Business Park, Haile, Egremont, Cumbria, CA22 2NH
T: 01946 841191

Mabey Bridge Ltd
Station Road, Chepstow, Monmouthshire NP16 5YL
T: 01291 623801

Maclean & Spiers Blasting Ltd
Unit D, East Fulton Farm, Darlurh Road, Linwood, Cumbria, CA22 2NH
T: 01505 324777

Magain Painters
14 West Stevenson Street, South Shields, Tyne & Wear, NE33 4AG
T: 01914385555

Maldon Painting Company Ltd
2 Spital Road, Maldon, Essex CM9 6EB
T: 07956597392

Megarme Qatar LLC
Al Rayyan Al Qadeem Street, Doha PO Box 200547, Qatar
E: eustart.trainer@megarme.com

C MCL Coatings Group Ltd
Pickering’s Road, Halebank Industrial Estate, Widnes, Cheshire, WA8 8XW
T: 0151 423 6166

Miller Fabrications Ltd
Baronhall Works, Overtown Road, Wishaw, Lanarkshire, ML2 8EW
T: 01698 373770

MIS North East Ltd
Units 2, S/Sa Mill Hill, North West Ind Estate, Peterlee, SR8 2HR
T: 0191 514 2804

Moore Steel Developments Ltd
Station Road, Thornley, Peterborough PE6 OQE
T: 01733 270729

Murvic Contracts Ltd
Askern House, High Street, Askern, Doncaster, DN6 0AA
T: 01302 701122

New Image Contracts Ltd
Askern House, High Street, Askern, Doncaster, DN6 0AA
T: 01302 708070

Northern Protective
T: 0191 438 5555

NSG UK Ltd
Fourth Avenue, Deeside Industrial Park, Deeside, Flintshire CH5 2NR
T: 01244 833138

Nusteel Structures
Lyme Industrial Estate, Lyme, Hythe, Kent, CT2 4LX
T: 01305 268112

Offshore Marine Services Ltd
Bramley House, Jalan Bahasa, PO Box 80148, 87011 Rubiah F.T. Malaysia
T: +356 2142 44410

Orrmac Coatings Ltd
Newton Chambers Road, Thorncliffe Park Estate, Chapel town, Sheffield, S35 2PH
T: 0114 246 1237

Over Rail Services Ltd
Unit 10 Mill Head Way, Purdys Industrial Estate, Rochford, Essex, SS4 1ND
T: 01752 719 701

Paintel Ltd
Trianon, Westover, Ivybridge, Devon, PL21 9JR
T: 01469 578105

Painting & Labour Services Ltd
Unit 1, Queens Road, Immingham DN40 1QR
T: 01469 578105

P H Shotblasting & Spraying Services
43a Drunmack Road, Castletalfield, Dunganon, Co Tyrone, BT70 3NY
T: 028 8776 7722

Pipeline Induction Heating
The Pipeline Centre, Farrington Road, Rosendale Rd Industrial Estate, Burnley BB11 5SW
T: 01254 415323

Port Painters Limited
Unit 3, Ringside Business, Hoel-Y-Rhosog
Cardiff, CF3 2EW
T: 02920 777070

Possilpark Shotblasting Co Ltd
Dalmarnock Works, 73 Dunn Street, Glasgow, G40 3PE
T: 0141 556 6221

Prestec UK Ltd
168 Birmingham Road, Shenstone Wood End
Staffs, WS14 2NX
T: 0121 308 8001

Radleigh Metal Coatings Ltd
Unit 30, Centre Trading Estate, Cable Street, Wolverhampton, WV2 2HX
T: 01902 870606

Randell Industrial Services Ltd
Factory 2, Hardyfield Industrial Estate, Holbury, Southampton, SO45 3NQ
T: 02380 983999

Riplast & Co Ltd
Oakwood Industrial Estate, Harling Road, Snetterton, Norfolk, NR16 2JU
T: 01953 888260

RJC (UK) Ltd
Mews Place, The Street, Hatfield Peverel, Essex, CM3 2JX
T: 01245 380870

R.L.P. Painting Contractors Ltd
Unit 1 Grange Lane, Balby, Doncaster DN4 9BB
T: 01302 853077

RMF Construction Services Ltd
Unit 2, Oughton Road
Birmingham, B12 0DF
T: 0121 440 7970

SCA Group Ltd
Woollbridge Ind. Park, Three Legged Cross, Dorchester, DT1 2FA
T: 01202 820829

Severn River Crossing Plc
Bridge Access Road, Aust, South Gloucestershire, BS35 4BD
T: 01454 633351

Sherwin-Williams Protective & Marine Coatings
Tower Works, Kestor Street, Bolton, Lancs, BL2 2AL
T: +44 (0) 1204 521777

TO ADVERTISE CONTACT SQUARE ONE
Tel: +44 (0) 114 273 0132
Email: jonathan@squareone.co.uk
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Address</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shirley Industrial Painters &amp; Decorators Ltd</td>
<td>Grand Union House, Bridge Walk, Acock’s Green, Birmingham, B27 6SN</td>
<td>0121 706 4000</td>
</tr>
<tr>
<td>Shutdown Maintenance Services Ltd</td>
<td>Kingsnorth Industrial, Hoo, Rochester, Kent, ME3 9ND</td>
<td>01634 256969</td>
</tr>
<tr>
<td>Sitecote Ltd</td>
<td>33 Kielder Close, Ashton in Makerfield, Wigna, WN4 0JF</td>
<td>07714678719</td>
</tr>
<tr>
<td>Solvent Protective Coatings Ltd</td>
<td>Tredgar Wharf, Marine Parade Southampton, Hants, SO14 5JF</td>
<td>02380 221480</td>
</tr>
<tr>
<td>South Staffs Protective Coatings Ltd</td>
<td>Bloomfield Road, Tipton, West Midlands, DY4 9EE</td>
<td>0121 522 2373</td>
</tr>
<tr>
<td>Southern Coating Contractors Ltd</td>
<td>Malmesbury House, 227 Shirley Road, Shirley, Southampton, SO15 3HT</td>
<td>0238 0702276</td>
</tr>
<tr>
<td>Specialist Blasting Services Ltd</td>
<td>Smiths Quay, Hazel Road, Woolston, SO19 7GB</td>
<td>023 8043901</td>
</tr>
<tr>
<td>Specialist Painting Group Ltd</td>
<td>Unit 3 Propser House, Actone Park, Padholme Road East, Pengeborough, PE1 5XL</td>
<td>01773 309500</td>
</tr>
<tr>
<td>Stainless Restoration Ltd</td>
<td>Unit M1, Adamson Industrial Estate, Croft Street Hyde, Cheshire, SK14 1EE</td>
<td>0161 3686191</td>
</tr>
<tr>
<td>Stamford Construction Limited</td>
<td>Unit 9 The Joiners Shop, The Historic Dockyard, Chatham, Kent, ME4 4TZ</td>
<td>01634 816126</td>
</tr>
<tr>
<td>Standish Metal Treatment Ltd</td>
<td>Potter Place, West Pimbo, Skelmersdale, Lancs, WNW 8PW, UK</td>
<td>01695 455977</td>
</tr>
<tr>
<td>Stobbarts Ltd</td>
<td>Tarn Howe, Lakes Road, Derwent Howe Industrial Estate, Workington, Cumbria CA14 3YP</td>
<td>01900 870780</td>
</tr>
<tr>
<td>Story Contracting Ltd</td>
<td>Burgh Road Industrial Estate, Carlisle, Cumbria CA2 7NA</td>
<td>07730 764414</td>
</tr>
<tr>
<td>Stream Marine Training Ltd</td>
<td>Kintyre House, St Andrews Crescent, West Campus, Glasgow International Airport, Paisley, PA3 2TQ</td>
<td>0141 212 8777</td>
</tr>
<tr>
<td>Tees Valley Coatings</td>
<td>Riverside Park Road, Middlesborough, Cleveland TS2 1UT</td>
<td>01642 228141</td>
</tr>
<tr>
<td>Surface Engineers (Manchester) Ltd</td>
<td>Globe Industrial Park, Off Astley Street, Dukinfield, Cheshire, SK16 4QZ</td>
<td>0161 330 9224</td>
</tr>
<tr>
<td>Surface Technik (Oldhill) Ltd</td>
<td>Roversign Works, Deepdale Lane, Lower Comal, Dudley, DY3 2AF</td>
<td>01384 457610</td>
</tr>
<tr>
<td>TEMA Engineering Ltd</td>
<td>5-6 Curran Road, Cardiff, CF10 5DF, UK</td>
<td>020920 344556</td>
</tr>
<tr>
<td>Thompson Project Management Ltd</td>
<td>Newacres, Athey Road, Carlow, Republic Of Ireland</td>
<td>0353 599131624</td>
</tr>
<tr>
<td>Tinsley Special Products</td>
<td>Enterprise House, Durham Lane, Eaglescliffe, Stockton-on-Tees TS16 0PS</td>
<td>01642 784279</td>
</tr>
<tr>
<td>T I Protective Coatings</td>
<td>Unit 6, Lodge Bank, Crown Lane, Honwich, Bolton, Lancs, BL6 5HU</td>
<td>01204 468080</td>
</tr>
<tr>
<td>Torishima Service Solutions Europe Ltd</td>
<td>Sunnyside Works Garnethill Road Coatbridge MSL 2D</td>
<td>0123642390</td>
</tr>
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<td>Transvac Systems Ltd</td>
<td>Monsal House, 1 Bramble way, Alfreton, Derbyshire, DE55 4RH</td>
<td>01773 831100</td>
</tr>
<tr>
<td>Underhill Engineering Ltd</td>
<td>Plymbridge Road, Estover, Plymouth, PL6 7LX</td>
<td>01752 752480</td>
</tr>
<tr>
<td>Vale Protective Coatings Ltd</td>
<td>Building 152 - Langar North Industrial Estate, Harby Road, Langar, NG13 9HY</td>
<td>01949 869784</td>
</tr>
<tr>
<td>Walker Construction (UK) Ltd</td>
<td>Park Farm Road, Folkestone, Kent, CT19 5DY</td>
<td>01303 851111</td>
</tr>
<tr>
<td>Warde Painters Ltd</td>
<td>Unit 5, Wimborne Building, Atlantic Way, Barry Docks, Glamorgan, CF63 3RA, UK</td>
<td>01446 748620</td>
</tr>
<tr>
<td>Wescott Coatings &amp; Training Services Ltd</td>
<td>9b/9c Tyne Point, Shaftsbury Avenue, Simonside Industrial Estate, Jarrow, Tyne &amp; Wear, NE32 3UP</td>
<td>0191 497 5550</td>
</tr>
<tr>
<td>W G Beaumont &amp; Son</td>
<td>Beaumont House, 8 Bernard Road, Romford RM7 0HX</td>
<td>01708 749202</td>
</tr>
<tr>
<td>William Hare Ltd</td>
<td>Brandsholme House, Brandsholme Road, Burys, Lancs, BL8 1JJ, UK</td>
<td>0161 609 0000</td>
</tr>
<tr>
<td>Wood Group Industrial Services Limited</td>
<td>Kirkstone House, St Osmer’s Road, Western Riverside Route, Gateshead, Wear, NE11 9EZ</td>
<td>0191 4932600</td>
</tr>
<tr>
<td>Xervon Palmers Ltd</td>
<td>331 Charles Street, Royston, Glasgow G21 2QA</td>
<td>0141 5534040</td>
</tr>
</tbody>
</table>

Visit the ICATS website [www.icats-training.org](http://www.icats-training.org)

For all the latest news, events and debates join us on LinkedIn.
**DIARY DATES 2015**

**Thursday 11th February 2016**  
London Branch Event: Jozef Soltis, Macaw Engineering  
To be held at Imperial College, London, SW7 2AZ.

**Tuesday 23rd February 2016**  
ICorr Aberdeen Branch Meeting  
Venue: Palm Court Hotel, 81 Seafield Road, Aberdeen AB15 7YX, United Kingdom, 18:00 – 19:30  
Presenter: JD Demore (Corpro)  
Topic: Field Joint Coating Process - Providing Sustainable Coating Solutions.

**Monday 7th - Friday 11th March 2016**  
Advanced Cathodic Protection  
Venue: London  
For details of courses, please see information below:  
Mobility Oil & Gas Petroleum Engineering  
Consultancy & Technical Training Services  
Upcoming Course.  
Contact: +442030867082 or training@mobilityoilandgas.com

**Thursday 15th - Friday 18th March 2016**  
Corrosion Control in the Oil and Gas Industry  
Venue: Aberdeen  
For details of courses, please see information below:  
Mobility Oil & Gas Petroleum Engineering  
Consultancy & Technical Training Services  
Upcoming Course.  
Contact: +442030867082 or training@mobilityoilandgas.com

**Tuesday 19th April 2016**  
Aberdeen Branch Meeting  
Venue: Palm Court Hotel, 81 Seafield Road, Aberdeen AB15 7YX, United Kingdom, 18:00 – 19:30  
Speaker: Raouf Kattan (Safinah)  
Topic: The challenges of designing and complying with a ship’s coating specification.

**Tuesday 26th April 2016**  
CED Working Day and Symposium on Microbial Corrosion in Heating and Cooling Systems  
Venue: National Motorcycle Museum Conference Centre Coventry Road, Bickenhill Soihull, West Midlands, B92 0EJ  
T: 01675 444 148  
E: sales@nationalconferencacentre.co.uk  
A One Day Symposium organised by the Corrosion Engineering Division and the International Biodeterioration and Biodegradation Society. Directions and details of local accommodation are at: www.nationalmotorcyclemuseum.co.uk/museum/

**Tuesday 17th - Friday 20th May 2016**  
CECOR 2016 Congress  
The CECOR 2016 Congress takes place in Ljubljana, Slovenia. Contact Brian Wyatt for more information: brianwyatt@controlcorrosion.co.uk or visit http://cecor.eu and the Marine Corrosion Forum at www.marinecorrosionforum.org

**Tuesday 31st May 2016**  
Aberdeen Branch Meeting  
Venue: Palm Court Hotel, 81 Seafield Road, Aberdeen AB15 7YX, United Kingdom, 18:00 – 19:30  
Speaker: TBC  
Topic: TBC

**Monday 5th - Tuesday 6th September 2016**  
57th Corrosion Science Symposium (organised by CSD)  
Venue: University of Swansea  
Description: Further details including abstract submission will appear here in due course.

**Wednesday 30th November 2016**  
Anticorrosive Coatings  
Venue: Amsterdam, the Netherlands  
Topics:  
• How does corrosion occur?  
• What surface preparation is necessary for an endurable coating?  
• Which ingredients does a coating comprise and what are their roles?  
• What are the current trends in corrosion protection coatings?  
• What distinguishes water-borne from solvent-borne systems?  
• How do self-healing coatings work?  
Website: www.european-coatings.com/Events/European-Coatings-

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Nick Stevens  
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London Branch publish a monthly Newsletter; to be included on the circulation list please contact Sarah Vasey sarah.vasey@sherwin.com