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CONTENTS

Institute News
The President Writes 4
Icorr branches out into Middle East 4
Focus On: Mott Macdonald 5
Technical Topic No. 37 6
CED Report 6-7
London Branch News 8
Aberdeen Branch Meeting April 2012 8-9
Interviewing Corrosion Professionals 9-10

Technical Article
Kinetic Studies of Localized Corrosion of 204 Steel in Chloride Solution 11-13

Company News
Ascott Analytical 14-15
BAC 16
Winn & Coales (Denso Ltd) 16

Sustaining Members 17-24
ICATS Registered Companies 25-27

Diary and Branch Contacts 28
The President Writes

I passed! I am now a Chartered Scientist. It didn’t hurt and once I got down to it, it did not take long and was free as I am a Fellow of the Institute. Now what about the rest of you? The key to the process is Continuing Professional Development or CPD for the three letter acronym lovers out there. CPD is set to become an important part of maintaining qualifications in the future especially chartered status and professional membership of bodies such as ICorr. The underlying principle is that we should maintain records of those things we do in our professional and personal lives which demonstrate that we are continuously developing ourselves. This does not just cover attending training courses and conferences but also reading journals, contributing to committee work and doing something worthwhile but different. We should seek to develop ourselves in a number of ways not just a single one. I attended a Midland Branch lecture on the subject by Brenda Peters a Past President of ICorr and a member of the Science Council working party on CPD. The talk was relatively short and easily understandable what was surprising to me was the extent and depth of the subsequent question and answer session demonstrating the need for greater understanding of the subject across the ICorr membership. I know that Brenda will be doing more of these talks and, if you can, I recommend you to attend and participate. You may not think you need CPD now but watch this space.

I recently attended an ICorr Aberdeen Branch meeting which followed on from a Marine Corrosion Forum meeting and was very heartened by the enthusiasm that exists in the Granite City. I was surprised to find that some of the subjects which were being debated in ICorr technical meetings years ago continue to be at the forefront of discussion today; there remains plenty for the inquisitive corrosion engineer/scientist to go at and remember it all counts towards CPD.

I am conscious that I am entering the last 6 months of my Presidency it has been a most interesting and at times challenging experience but the most important thing for me has been the old acquaintances that have been renewed and the new friendships made. The energy displayed by members across the country continues to amaze me and I am very aware that I have not been able to travel abroad to places where small groups of Institute members meet and push forward the boundaries by sharing knowledge and experience.

I remind you of the Institutes LinkedIn group which provides a forum to learn from, share with and make contact with members across the world.

ICorr President, Bob Crundwell

ICORR BRANCHES OUT INTO MIDDLE EAST

Following a number of requests from members ICorr is currently exploring the possibility of setting up a Middle East branch. It is envisaged that the activities the branch will engage in will include Networking Events, Evening Meetings with Topical Lectures, Short Conferences and Training Courses.

Steve Wroe Managing Director of Corrosion Technology Services Middle East LLC has agreed to act as ICorr Champion for this initiative and would appreciate expressions of interest from members in the Middle East area. Steve is also interested in any suggestions of activities and venues for the branch events along with any members who may be willing to contribute to the organisation of the branch. Steve can be contacted by email spwroe@cts-middleeast.com. He will also be setting up a discussion group on the ICorr forum and in ICorr Linkedin group where comments and suggestions can also be posted.

We will keep you posted on the progress of the proposed branch via the usual channels, Corrosion management, www.icorr.org and the Linkedin group.
Mott MacDonald is a leading management, engineering and development consultancy with a wealth of experience established through many years of close teamwork with a wide range of clients including local government, service providers and private enterprise. With over 30 offices throughout the UK, we can mobilise our skills and resources close to our clients, wherever they or their projects are based.

Mott MacDonald is dedicated to bringing clients’ plans and projects to fruition, in whatever sector. Every project, large or small, receives the same attention to detail and commitment to customer care. Through collaboration with our clients we stay attuned to their varying needs, working in partnership to bring concepts to working reality. Drawing upon the strength of our multidisciplinary staff and group-wide resources, we are able to provide efficient, innovative solutions on a wide range of projects.

The Materials and Corrosion team provides specialist engineering support for both in-house projects and individual clients worldwide. This department has an international reputation for the development and application of novel and advanced repair and remediation techniques including cathodic protection, corrosion inhibitors, fibre composite strengthening, electrochemical osmosis and remote corrosion monitoring and has played a major role in the widespread acceptance of many new methods of durability enhancement for reinforced concrete and steel-framed structures.

In addition to being Gold Sustaining Members of the Institute of Corrosion, the team are corporate members of The Corrosion Prevention Association, NACE International and the International Concrete Repair Institute - the first UK-based consultancy to be accepted.

We have been based in the Altrincham office, near Manchester, since 1989. Over the subsequent years the team has become firmly established as a source of information and support on all things material, with the added specialism of corrosion engineering. The current core line-up of Paul Lambert, Chris Atkins, Anthony Foster, Rene Brueckner and Rudi Merola can together cover all aspects of steel, concrete and masonry investigation, remediation and specification covering areas such as:

- Cathodic Protection
- Cement Chemistry
- Concrete Degradation
- Concrete Mix Design
- Concrete Testing
- Corrosion Inhibitors
- Corrosion Science and Engineering
- Failure Analysis
- Fibre Composites
- Forensic Engineering
- Heritage Structures
- Inspection and Surveys
- Masonry – natural, brick & faience
- Nuclear Structures
- Parking Structures
- Protective Coatings
- Remote Monitoring
- Repair and Strengthening
- Tribology, Wear & Lubrication

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Condition surveys and inspections are required on many structures to ensure their continued safe operation. We have been entrusted with numerous commissions to recommend, design and supervise appropriate repair and improvement works. Many such schemes have included structural alterations to allow for changed usage and improved efficiency in existing facilities, plus strengthening works where modern development imposes new looking regimes.

The most common investigation and inspection techniques include:
- Chloride content/depth profiling
- Carbonation testing
- Reinforcement breakout and assessment
- Half-cell potential surveys
- Corrosion rate measurements
- Reinforcement assessment by non-destructive techniques
- Concrete sampling and analysis, for strength, cement content etc
- Petrographic analysis
- Delamination surveys
- Ultrasonic steel section assessment and
- Crack detection and monitoring.

Inspection and investigations in tunnels, storage tanks and other areas classified as confined spaces are all within our remit.

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Technical Topics No.37:
“COST OF CORROSION, EXTENDING PLANT LIFE AND CED DAY ”
by Technical Secretary, Douglas J Mills

This TT is going to be shorter than usual and is not going to take a specific theme as the main technical thrust will be MIC which is going to be covered below. The cost of corrosion is always an interesting topic. Recently I received a technical enquiry about this. I replied with the usual statement that it is around 3-3.5 % GDP which, if UK GDP is £1 trillion, would make it about £30 Billion. So I was interested to read that the World Corrosion Organisation (WCO) has produced a similar figure based on 3% of the world’s GDP which runs into many Trillions (a trillion being 1 followed by 12 noughts, when I was at school it was 1 followed by 18 noughts - words change their meaning with time eg marriage!). But how important corrosion is perceived to be as a subject depends on other factors ie how much publicity it gets. We discussed the Hammersmith flyover in the last two TTs which is quite high profile. But on a more subtle point this recession we are in, means that companies are being more careful with their money around my car doesn't get replaced so regularly despite the fact that it is costing me a significant amount in repair. Of course you normally have reasonable warning about when bits in a car wear out or corrode - regular MOT checks and servicing will pick many up. In plant it may be more difficult. There is a big demand right now for what we were talking about last TT ie effective monitoring methods. Slow steady corrosion can be coped with, it is the corrosion processes that start suddenly and cause localised significant loss of strength like pitting and stress corrosion that are more difficult to deal with. So development of effective FORECASTING techniques (rather than life prediction) is needed. Electrochemical techniques can help here, particularly my hobby horse of electrochemical noise measurement. With more thorough development work, particularly on data treatment, this is the technique to watch out for. Now to the CED day, where several talks touched on the subject of detection and monitoring. An excellent report follows by David Nuttall. I will just comment on the other parts. Upwards of 40 delegates enjoyed a day out at what I would say is a very interesting venue (the National Motorcycle Museum at Birmingham), although not totally straightforward to find by either car or train (it IS near the NEC – but having said that not as near as all that!). But if you are a motorcycle enthusiast, even a minor one like me, you will love this place (we had a free tour after the meeting). The original museum was burnt down seven or so years ago causing many bikes to be destroyed. But every bike that was incinerated has been replaced. A bit of an undiscovered treasure in the museum world I would say. Anyway we had a really good set of talks and after a pleasant lunch, the individual CED working groups conducted their annual business meetings. Those that met included nuclear, water treatment, monitoring, oil-field chemicals, concrete/CP and coatings. The coatings one, although few in number, was lively! The minutes of these meetings will be posted on the CED website. This also applies to the talks that were given. Comments on the foregoing to Douglas@harrbridge.freeserve.co.uk. Over now to David Nuttall’s report.

CED WORKING DAY AND SYMPOSIUM ON MICROBIAL CORROSION

By David Nuttall

This one-day Symposium, the fifth in a series of recent working days organised by the Corrosion Engineering Division of the Institute of Corrosion, was held on Thursday, 26th April 2012 at the National Motorcycle Museum, Birmingham. Nick Smart (Serco Ltd) welcomed delegates and explained the mechanism of CED Operations. The plenary lecture was delivered by Jim Stott (CAPCIS – Intertek) and entitled “An overview of microbiologically-influenced corrosion”. He pointed out that MIC is fundamentally no different from other types of corrosion mechanisms and posed the question, “What is a micro-organism?” It transpired that these include: algae (simple plant-like organisms - photosynthetic), fungi (major problem area - biodegradation of polymers) and bacteria (including sulphate reducing bacteria, SRB, and acid-producing bacteria). They can cause corrosion by direct chemical action – spilling out acid(s), generating electro-chemical cells, localised electrochemical action, removal of inhibitor and by direct degradation of protective coatings. About 90% of MIC is seen as local/ pitting corrosion as a result of SRB. The most problematic bacteria are those entrained within a ‘biofilm’. Common problem areas include under deposits and in deaerated waters and areas of stagnation. A range of interesting slides was then shown, including SRB attack on sheet steel piling and shallow pitting that was revealed after cleaning the metal surface. The mechanism of corrosion was then discussed, including the importance of iron sulphide as a conducting cathode. Evidence for MIC of carbon steels includes “high” bacteria counts, the presence of sulphides/corrosion product, a characteristic morphology of corrosion, a suitable temperature and physical conditions, the presence of bacterial nutrients and a lack of any other explanation for corrosion! One way of dealing with MIC is to use inorganic oxidising biocides (including chlorine/hypochlorite), although these treatments may be incompatible with traditional chemicals and it may be difficult to control the dosage properly. An alternative option is to
use organic biocides which are often batch dosed at high dosage rates. Nick Smart (Serco Ltd) then spoke on “Microbiologically influenced corrosion issues in the nuclear industry”. He pointed out that MIC is less easy to predict than other forms of corrosion, a good maxim being “expect the unexpected!” He discussed the corrosion of containers used for the management and disposal of radioactive waste. Internationally, such containers may be made from a wide range of metals, for example carbon steel, stainless steel, copper, nickel alloys and/or titanium. For underground disposal the backfill material around the containers may be bentonite clay or cement, in a geological environment which could be granite or sedimentary rock, such as clay. For above-ground storage of radioactive waste the factors investigated in one set of experiments described included air temperature, relative humidity, the presence of VOCs and microbial activity. “Wetting times” of the surfaces of containers was estimated from measurements of temperature and RH values and it was realised that these periods occurred for only ~5% of the storage time, so limiting the possibility of microbial corrosion. Although organic materials in bentonite may support MIC, it is expected that high density bentonite, as used for geological disposal of radioactive waste, should inhibit MIC. In an in-situ underground experiment, iron and copper corrosion rates were estimated from LPR and impedance measurements and linked with thermodynamic studies of copper, iron and their sulphides. Phil Munn (Midland Corrosion) spoke on, “MIC in water systems in buildings: detection, prevention and cure”. He reiterated the theme of previous speakers that there is no such thing as “microboral corrosion”, rather “microbiologically influenced corrosion”. All aqueous corrosion occurs via an electrochemical mechanism. MIC has been found in domestic central heating systems, copper pipes in hospitals, hotels and large office blocks, LTHW and CHW systems, steel radiators, and pipework made from a range of metals, including copper, copper alloys, mild steel and stainless steels. Factors influencing MIC include water composition (e.g. hardness, pH, and bicarbonate, humic acid and phosphate concentrations), stagnant water (e.g. due to long pipe runs and low or intermittent water flows, with periods of stagnation in dead legs), temperature (22 – 40°C is ideal for microbial activity) and the presence of debris (e.g. flux residue/jointing compounds). The use of the sodium azide/iodine “spot test” for the presence of sulphide produced by SRB was described. Methods for preventing MIC included modifying the design (e.g. to avoid long runs/dead legs), changing the size of pipework to moderate the flow regime, preventing ingress of debris, flushing before first use, thermally lagging pipework and sterilising potable water systems before handover. Peter Allison (OFc Technical Services) spoke on “Monitoring and prediction of microbial corrosion in the oilfield”. Oilfield activities are generally “once through and dirty” – as a result, techniques developed in other areas do not apply. Monitoring methods deal with sessile or planktonic microorganisms. However, there are newer ‘molecular biology’ methods, originating from the food and medical industries. These have the advantage that they are more accurate and can detect GHB and SRB, but the disadvantage is that they require a 28 day incubation period and are bulky to carry. One problem of counting micro-organisms is that actual bacteria exist in “clumps.” He gave details about the RapidChek immunoassay technique, bioprobes, sidestream devices and water chemistry, followed by an outline of prediction techniques for oilfield MIC. Maxwell has developed a qualitative model for MIC in seawater injection systems and pipelines involving the time needed to form sulphide films, etc. Elizabeth Day (Chesterfield WT Consultants Ltd) addressed the meeting on, “MIC in closed water systems used for temperature control in the office environment”. A case history of an LTHW system in an office block in London was described. The main cause of the MIC was a failure to provide acceptable water quality for the system, where it remained for some 18 months until it was handed over to the client. A metallurgist examined the system and decided that there had been historic corrosion associated with SRB, but it was not active at the time of inspection. It was decided to clean the pipework, but retain the ‘risers’ at the side of the building. Pressure testing was then discussed. To minimise MIC problems it is necessary to assess the risk that microbes will develop in the (inevitably) stale water, dose the pressure test water if necessary (with biocide and inhibitor) and minimise the period before cleaning. Other case histories described were failures of aluminium and mild steel radiators, an air handling unit manifold and a “new” Trigen chiller. Scott Betts (Thor UK) then gave a paper on, “Aspects of microbiological degradation of anti-corrosive coatings”. Aspects covered included fungal/algal corrosion, solutions and regulatory issues. Fungi are multi-cellled, with individual cells being very small (about 10 μm diameter). They need nutrients, water of pH 5-7 and temperature 20-35°C; most are oxygen-loving and reproduce by spore production. Algae are plants, 1 μm – 50 m long (kelp), obtain energy by photosynthesis (CO₂ + H₂O) and may be single-cellled (e.g. chlorella) or multi-cellled (e.g. seaweed). Algal growth mainly causes disfigurement of surfaces and can occur in tree-shaded locations (if sunlight-inhibited). A series of slides was shown, illustrating defacement of wind turbine blades. The solution to fungal/ algal growth is the addition of a dry film biocide. The speakers were then brought back as a group and some interesting discussion ensued. The presentations and information from the working group meetings will be made available through the members area of the Institute’s web site. Chris Googan proposed a vote of thanks to Nick Smart and the speakers. So ended a very enjoyable and worthwhile day.
ICorr London Branch are organising an offshore cathodic protection conference, this is scheduled for 13th and 14th of June 2013 and will be held at the Royal Overseas League in London, the organising sub-committee not wishing to waste any time met at the HQ of Deepwater Corrosion Services (UK) Ltd on 23rd May to set the wheels in motion and to discuss arrangements for what will be a successful two day event, not wishing to waste an opportunity to avail themselves of the early summer weather the meeting took place Al Fresco.

The conference will concentrate on offshore cathodic protection over a two day period, presentations will be provided by twelve industry leaders and will coupled with the opportunity discuss each group of papers during a sector specific four panel sessions; in addition there will opportunities to network with one’s peers at the coffee and lunch breaks, all of which are included in the conference delegate fee, there will also be a sponsored bar at the end of the first days proceedings. For further early information go to the ICorr website and register your interest.

ICorr London Branch Sub-Committee chaired by Mash Biagioli and supported by Paul Brooks, Brian Goldie and Trevor Osborne meet for the first their detailed deliberations.

ABERDEEN BRANCH MEETING APRIL 2012:
AL-ZN-IN SACRIFICIAL ANODE MANUFACTURE AND SPECIFICATION

The joint meeting with the Marine Corrosion Forum (MCF) was held at the Palm Court hotel on the 17th April 2012. The national president Dr Bob Crundwell attended the meeting and addressed members. He recommended that attendees read the Corrosion Management magazine and get more involved in institute activities. Before handing over to the guest speaker, he reminded the audience about the benefits of the institute noting continuous professional development, networking, relationships with other institutions, training and accreditation among others.

Following the president’s address, Nigel Owen of Aberdeen Foundries gave a presentation on Al-Zn-In sacrificial anodes outlining their application, composition, manufacture, design, and testing. His presentation focused on sacrificial anodes for offshore applications.

Nigel Owen started by explaining the fundamental principles of cathodic protection noting that the composition of anodes could be manipulated to place them more favourably in the electrochemical series by inclusion of various elemental additions. Nigel mentioned the three main materials used in anode manufacture as Magnesium, Zinc and Aluminium. He listed the key parameters that affected anode material selection such as temperature, salinity, high electrical output per kilogram etc. He explained how imperities could also affect the properties of sacrificial anodes noting elements that they could either raise or lower potentials. He urged the audience to work with guidance from recognised standards such as BS EN, NACE, ISO, DNV and other international standards emphasising that proliferation of various client specifications made things complicated and difficult.

He went on to describe various stages of anode manufacture explaining with illustrative photographs activities such as melting, preparation & manufacturing inserts, selection of casting mould, testing, top-up, fettle, anode marking and identification. He explained various anode tests performed including the optical emission spectroscopy (OES) and various other additional tests for integrity, cracks, shape, dimension, electrochemical tests and electric continuity. He explained the importance of various design parameters such as anode mass, current output, mounting position, utilisation etc and important design standards. Questions from the audience were on improvement of anode utilisation, surface preparation of inserts, use of galvanised steel as inserts, effects of various anode compositions and iron solubility levels.

Afterwards, the ICorr branch chairman thanked the president and the guest speaker and urged new/intending members to contact the committee members for more information on ICorr. PET booklets and continuous professional development certificates were distributed to members immediately after the meeting.

More information about the Aberdeen branch activities can be got from the ICorr Aberdeen branch Secretary, Frances Blackburn, 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.
Dr Steve Paterson is the Head of Materials and Corrosion Department of Shell Upstream International Europe. He is a graduate of Imperial College London with a PhD in Metallurgy. With over thirty (30) years working experience in various material, corrosion and integrity management roles within a leading oil and gas company, Steve has an excellent knowledge of materials and corrosion practices in the oil and gas industry and is well placed to provide a candid perspective on the history and future of materials and corrosion as a technical discipline.

In the second of our series of interviews with corrosion professionals, Aberdeen branch committee members Dr Muhammad Ejaz and Mr Eugene Ogosi speak with Dr Steve Paterson about Materials & Corrosion as a profession and get some valuable tips for young materials & corrosion professionals on career progression.

Q. Please could you tell us about your career so far?
A: I graduated from the Imperial College London with BSc and PhD in Metallurgy. After completing my studies in 1981, I joined Shell and worked in the research laboratory in Amsterdam where I performed various Materials and Failure analysis projects. Afterwards, I worked as a Materials & Corrosion Engineer at the Shell refinery in Rotterdam for 4 years and then took up material, corrosion and quality management roles in Shell Malaysia and Norway until 1996 when I moved to the Netherlands to work as an asset materials and corrosion engineer in the east of the country. In 1999 I moved back to Aberdeen

INTERVIEWING CORROSION PROFESSIONALS
THEME: MATERIALS & CORROSION AS A PROFESSION - PAST PRESENT & FUTURE

Q. People find inspiration through various experiences and sometimes it could be a single experience that defines a professional’s career path. Do you recall any such experience(s) in your career? Why did you choose materials and corrosion as a profession?
A. After I finished my studies in Metallurgy, I had an opportunity with Shell to apply my knowledge practically and this was very attractive. For me, the technical challenges which I envisaged and the opportunity for professional development were key factors in my decision to go into materials and corrosion as a profession.

“Materials & Corrosion professionals must be proactive in their search for information and interaction with other disciplines”

Q. Do you think that materials and corrosion as a profession has improved over the years or has receded?
A. Overall the standards and understanding of corrosion have improved with time. I think we are only beginning to see the importance and value of materials & corrosion especially within the oil and gas industry. With many facilities in the North Sea approaching the end of their service lives and with an increase in emphasis on safety and integrity it is difficult to ignore the obvious relevance of materials and corrosion as a discipline.

Q. It is said that materials and corrosion as a discipline has been very slow to embrace computing and modern technology when compared with other fields of engineering/science. In your experience, what areas of corrosion engineering/science have embraced technology?
A. Materials & Corrosion science and engineering should not be considered in isolation. It is important to stop corrosion from occurring in the first instance, once the corrosion mechanism is present it becomes increasingly difficult to mitigate. There are a lot of areas in materials & corrosion where there has been application of software and modern technology especially in the areas of corrosion prediction and corrosion monitoring. The Materials & Corrosion discipline is one that has embraced technology to a large extent and it has certainly evolved with the time. In my experience, materials and corrosion engineers have always been keen to apply new technology whenever possible. As a simple example we have CO2–corrosion modelling software for corrosion rate prediction and a corrosion management concept for managing the threats of corrosion. These are tools that we have developed to help understand and mitigate corrosion threats. An area where some further improvement can be made in the industry is the handling of data and information that help in analysis and the decision making process. At the continued
heart of corrosion control is the gathering, managing and sharing of information with other professionals.

Q. It is sometimes said that corrosion as a problem has been ignored for years and is still being ignored in some instances. There is the apothegm that “the corrosion engineer is always the last to be told”. What is your view on this?

A. This has not been the case in my experience. I think it is important for Materials & Corrosion professionals to be proactive in the search for information and in their interaction with others. Addressing the problem of corrosion early and engaging with other professionals at all levels is very important. It is also essential to keep all communication channels open. For example, I have found that face to face meetings are sometimes more effective than emails or other written communication. A good working environment that encourages communication and interaction between professionals is also very important for good interfacing across disciplines.

Q. Employers say there is a lack of expertise or a skill gap in corrosion engineering/science. Why do you think fewer people choosing a career in materials and corrosion when compared with other disciplines? How do you think this problem can be addressed in the medium and long term?

A. One of the main reasons is the tendency to follow other professions, often non-technical that appear to be more attractive. In my opinion the professional institutes and associations are doing a lot these days to encourage young graduates to follow more technical career routes so this is changing. Professional institutes and employers should engage with young people at schools and universities to promote interest in materials. This should not be restricted to making presentations and organising talks but should also include providing teaching aids and support to encourage awareness of the opportunities in materials and corrosion.

Q. What have you done during the course of your career to continuously keep yourself up-to-date in your discipline and improve your skills in materials & corrosion?

A. Primarily I have always been involved in professional institute activities as often as I can. Also I have kept in touch with developments in materials and corrosion by attending conferences regularly. There is also an enormous amount of information that can be found online, in electronic libraries and resources from professional institute websites and magazines that cover various aspects of materials and corrosion. You may not have the time to read all the information that is available but at least when you have a problem you have a good idea of where to look. Also, I find that talking to other materials & corrosion professionals and building a good professional network within the industry has also been helpful to me.

Q. What would be your advice to a professional just starting out in the field of materials and corrosion?

A. I think young professionals should place more emphasis on individual development plans and take continuous professional development seriously. This may not necessarily be very formal but the young professional should develop a clear aspiration of how he/she wants his/her career to develop and build a plan for achieving their goals. Most young professionals these days usually have a clear idea of where they want to go in terms of their career and that is very encouraging. Young professionals should also attend conferences, seminars, technical presentations organised by the professional institutes and engage in association activities. The Institute of Corrosion (ICorr), the Welding and Joining Society (WJS), the Institute of Materials, Minerals and Mining (IOM3) are examples of organisations that help professionals in their career development, provide networking opportunities and keep them updated with recent developments in materials and corrosion.

Q. Is there a future for the materials & corrosion professional?

A. I would say “Yes”. For me there is a very clear and attractive future for materials & corrosion professionals especially in the UK oil and gas sector. Oil and gas companies now often have to drill deeper and use highly alloyed materials to deal with the demands of higher pressures and temperatures. Materials and corrosion professionals will be required to address these and other new challenges.

The members of the Aberdeen branch committee would like to thank Dr Steve Paterson for his contribution to our interview series and commend him for his continued commitment to development of materials and corrosion science/engineering. This interview has been conducted by the Institute of Corrosion (ICorr) Aberdeen branch committee and more information about the branch activities can be obtained from the ICorr Aberdeen branch Secretary, Frances Blackburn, 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.

visit the new Icorr website

www.icorr.org

Dr Steve Paterson
ABSTRACT

The present work deals with the method of finding a rate equation and possible kinetic mechanism for passivity breakdown of austenitic steel due to pitting in chloride solution. It is seen that the rate is dependent on temperature, chloride content of the solution, passivity curve etc. The order of reaction with respect to chloride ion is found out. The rate can be expressed as an equation, Rate = A K (Cl^-)^1/3. Where K is the rate constant and Cl is the concentration of Cl ion. The activation energy for pit initiation process has also been found. It comes out to be around 90 kJ/m. Studies of kinetic data by Reduced Time plot indicate that initiation of pitting follows a mixed mechanism of diffusion and chemical controlled reaction.

INTRODUCTION

It is well known that austenitic stainless steels have excellent corrosion resistance in aqueous solution due to a protective surface passive film. However stainless steel is prone to localized corrosion, in the form of pitting, in presence of chloride ions due to breakdown of this passive film.

Numerous studies have been carried out on various aspects of pitting, viz. Pitting mechanisms etc, but limited literature is available on the kinetic aspects of pitting. Nisancioglu et al. studied the relation between incubation time, pitting potential and rate constant on pitting of aluminum in chloride solution. Engell and Stolica determined the order of reaction with respect to chloride ion for aluminum, Beccaria and Poggi worked on the kinetics of aluminum corrosion in NaCl solution with some surface treatments.

In the present work it has been conducted to find the factors influencing the rate of passivity breakdown on stainless steel from the concept of induction time. An equation expressing the rate has been established. It is also attempted here to find a rate controlled mechanism through the concept of a Reduced Time Plot.

THEORY AND EXPERIMENTAL SET UP

The steel sample is potentiostatically polarized into the passive region, a known concentration of chloride ion is injected into the solution. The current starts increasing due to the generation of pits and then a steady state value is reached. The induction time (t) is taken as the time required for the current to attain the steady state value. If t is the induction time, then 1/t is taken as the rate of pitting that is the number of events per unit time. So the rate equation for initiation of pitting is given by

\[ \frac{1}{t} = K (Fe^{++}) (Cl^-)^{1/3} \]

Where K is the rate constant and m & n are orders of reaction with respect to Fe^{++} and Cl^- ions respectively.

Thus \[ \log \left( \frac{1}{t} \right) = \log K + m \log (Fe^{++}) + n \log (Cl^-) \]  

Taking K, m and (Fe^{++}) as constants, plot of \[ \log \left( \frac{1}{t} \right) \] Vs \[ \log (Cl^-) \] gives the order of reaction with respect to concentration of chloride ion.

Again \[ K = k_0 e^{-6.9R} \]

So from equations (2) and (3), keeping chloride concentrations fixed and varying temperature, activation energy can be found out.

REDUCED TIME PLOTS

Identification of rate controlled mechanism is possible by "Reduced Time Plots, first introduced by Sharp et al" and Giess. Here kinetic relationships are first expressed in the form

\[ g(t) = k t \]

Where f is the fraction corroded in t time and k is the rate constant. If \[ t_{0.5} \] be the time for 0.50 fraction reacted then

\[ g(t)/g(t=0.5) = t/t_{0.5} = t_R \]

where \( t_R \) is the dimensionless time scale, reduced time. The above expression is independent of the rate constant k and is dimensionless. It only depends on the form of g(t) (Table 1). Plotting f vs. \( t_R \) for all possible reaction mechanisms from Table 1, a master chart can be obtained. Thus if a reaction is controlled by a particular reaction mechanism, all the data points would fit into the curve for that mechanism, irrespective of nature of the system, temperature or any other factors that influence the rate.

The experiments were conducted with variation of chloride concentrations (0.1N,0.2N & 0.3N KCl) in 1N H_2SO_4 solutions and temperatures maintained at 303 K, 313 K and 323 K. AISI 304 stainless sample (Table – 1) about 1 cm diameter. One of the circular faces of the sample was polished with 00,1/0,2/0,3/0 emery papers and finally on wet cloth, until a mirror finished surface was obtained. The sample was then observed under optical microscope at 50X magnification to ensure that no pits, scratch or cracks were present. The sample was tightly covered with Teflon around its round surface up to the edges so that no crevice could form. About 200ml of each batch above solution was taken in a glass reactor with arrangement for thermometer, salt bridge, electrodes etc. The temperature of solution was maintained within+ -1 deg. C, using Remi heater stirrer. The sample was then introduced into the solution through one of the holes in the top of the vessel. It was then polarized, with scan rate of 50mV per 5 minute interval, using a Wenking standard Potentostat model ST-72, according to methodology of ASTM G5 – 72. The sample was anodically polarized to different starting potentials (0.30v, 0.35v, 0.40v vs. SCE) within the passive region, when a fixed concentration of chloride ion was injected.
RESULTS AND DISCUSSIONS

Fig. 1 shows the anodic polarization curve of 304 steel in 1N H₂SO₄ from this curve three potentials were chosen, within the passive range were taken for determination of induction time, notably, 0.30v, 0.35v and 0.40v. It is seen at a passive potential of 0.30v (Fig.2) that for each of the curves the current increases immediately the Cl ion is injected due to pit initiation and reaches a steady state within few seconds depending on factors such as Cl concentration, starting potential, temperature etc. this time is taken as induction time and determined from the graph. Figs. 3 and 4 illustrate similar curves with 0.35v and 0.40v passive potentials respectively. It is seen from Table 2, that induction time decreases with increase in chloride concentration. This indicates that the rate of pit initiation (1/t) is accelerated with Cl ion concentration. It is also seen from Table 3 induction time decreases with increase in passive potential. This explains that the rate of initiation of pitting increases as the applied potential is closer to pitting potential, which in accordance with the relation

\[
\frac{1}{t} = K(E - E_p), \text{ where } E \text{ is the pitting potential and } E_p \text{ is any potential from within the passive region.}
\]

With the data of induction time at various Cl concentrations the order of reaction is calculated, using equation (2) a plot of log(1/t) vs. log (Cl) is derived and given in fig 5. This shows straight lines with slopes equal to 0.353, 0.368 and 0.346 for three different curves. These values may be assumed to be approximately the same and equal to 1/3. This means that the electrochemical reaction between Fe⁺⁺ and Cl⁻ at the time of pitting is of 1/3 order with respect to chloride ion. Therefore the rate equation for initiation of pitting can be written as Rate = A K (Cl) 1/3.

Where k is the rate constant and is dependent on temperature. A is another constant which is a function of several parameters such as type of alloy, its composition, surface finish, other ions present in the solution, agitation of solution etc. The activation energy involved in the process is calculated to be of the order of 90 kJ/m, using equation Arrhenius equation (fig 6). The higher value seems in agreement with the fact that both diffusion of cations Fe and anions Cl and their chemical reaction are involved during the initiation of pitting.

<table>
<thead>
<tr>
<th>Composition of steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
</tr>
<tr>
<td>0.67</td>
</tr>
</tbody>
</table>

Table -2
Induction Time with Cl concentration
At passive potential 0.30v and temperature 303K

<table>
<thead>
<tr>
<th>Chloride concentration (N)</th>
<th>Induction Time in Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>720</td>
</tr>
<tr>
<td>0.2</td>
<td>600</td>
</tr>
<tr>
<td>0.3</td>
<td>510</td>
</tr>
</tbody>
</table>

Table -3
Induction Time with various passive potential
At fixed chloride concentration 0.2N and 303K

<table>
<thead>
<tr>
<th>Passive Potential (V) Vs SCE</th>
<th>Induction Time in Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30</td>
<td>600</td>
</tr>
<tr>
<td>0.35</td>
<td>510</td>
</tr>
<tr>
<td>0.40</td>
<td>330</td>
</tr>
</tbody>
</table>

Table -4
Induction Time with temperature
At fixed Cl concentration 0.2N and passive potential 0.30

<table>
<thead>
<tr>
<th>Temperature in deg. K</th>
<th>Induction Time in Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>303</td>
<td>600</td>
</tr>
<tr>
<td>313</td>
<td>110</td>
</tr>
<tr>
<td>323</td>
<td>48</td>
</tr>
</tbody>
</table>

With the data of induction time at various Cl concentrations the order of reaction is calculated, using equation (2) a plot of log(1/t) vs. log (Cl) is derived and given in fig 5. This shows straight lines with slopes equal to 0.353, 0.368 and 0.346 for three different curves. These values may be assumed to be approximately the same and equal to 1/3. This means that the electrochemical reaction between Fe⁺⁺ and Cl⁻ at the time of pitting is of 1/3 order with respect to chloride ion. Therefore the rate equation for initiation of pitting can be written as Rate = A K (Cl) 1/3.

Where k is the rate constant and is dependent on temperature. A is another constant which is a function of several parameters such as type of alloy, its composition, surface finish, other ions present in the solution, agitation of solution etc. The activation energy involved in the process is calculated to be of the order of 90 kJ/m, using equation Arrhenius equation (fig 6). The higher value seems in agreement with the fact that both diffusion of cations Fe and anions Cl and their chemical reaction are involved during the initiation of pitting.

Figure 1. Polarisation Curve in 1 N acid

Figure 2. Determination of induction time at E=0.30V

Figure 3. Determination of induction time at E=0.35V

Figure 4. Determination of induction time at E=0.40V

Figure 5. Determination of order of reaction

Figure 6. Determination of activation energy
The rate controlled mechanism is found using the reduced time plot. For this the fraction of pits generated f, with the time t has been calculated from the data of current variation with time as given in figs 2, 3, 4, based on following assumption.

For any of the curves in these figures, at zero time, the current is the sum of applied polarized passive current and electrochemical current for any electrochemical reaction occurring at the electrode. On the injection of chloride ions the increase in current is solely due to initiation of pits formation. With progress of time more and more pits are initiated and hence the current increases further until a steady state is reached when initiation of pitting may be assumed to be complete. It is worth noting that it has been found in several studies [8,9] that current reaches a steady state value when initiation of pits formation is complete. So the difference between the current at any time I_0 and I is the current, purely due to pit formation and is thus proportional to the amount of pits formed. So the amount of pits formed and hence fraction of pits formed f at any time t can be obtained from the equation.

\[
f = \frac{I_0 - I}{I_{st} - I_0}
\]

(6)

Where I_0 is the steady state current. Using the above equation (6) f vs. t curves are plotted in figs 7, 8, 9.

From any of these figs, say fig 5, t_0.5 can be found out at f=0.5 for any curve. Knowing t_0.5, t/t_0.5 values can be calculated at different f values. Each of these data points is superimposed on Reduced time plot as shown in fig. 10. Thus series of data points for 0.1NaCl, 0.2Nacl and 0.3NaCl are plotted on a master chart, where curves for only two reaction mechanisms have been shown. Since the curves for other mechanisms are far away from the experimental results.

It is interesting to note here that all the data points irrespective of Cl concentration or polarized potentials lie within a domain of chemical controlled and diffusion controlled mechanisms. A few points which are outside the domain may be due to experimental error. This may be reasonably true because when a Cl^- ion gets adsorbed on passive film, it starts penetrating the film through diffusion. This picture may be visualized as equivalent to an electrical double layer with Cl^- ions at the oxide/solution interface and +ve Fe^{++} ions at metal/oxide interface. Although the potential drop between the layers of positive and negative charge is small, the thickness of this oxide is very narrow of the order of a few Armstongs. So the voltage gradient is high and under such a strong electrical field Cl^- ions would try to diffuse towards Fe^{++} ions. Thus the kinetics of passivity breakdown is controlled by mixed mechanism of diffusion and chemical reaction.

**CONCLUSION**

From foregoing results and discussion, it is seen that the kinetics of pitting can be studied from the determination of induction time. The electrochemical reaction between Fe^{++} and Cl^- during pit initiation is of one-third order with respect to chloride ion. The rate of pitting is faster with higher chloride ion, temperature, and passive potential closer to pitting potential. The Activation energy calculated is of the order of 90 kJ/m. The kinetic of passivity breakdown seems to be a mixed mechanism of diffusion and chemical reaction.

**REFERENCES**


Figure 7. Fraction of pits formed Vs time at E=0.30V

Figure 8. Fraction of pits formed Vs time at E=0.35V

Figure 9. Fraction of pits formed Vs time at E=0.40V

Figure 10. Reduced time plots
Corrosion test chamber specialist, Ascott Analytical Equipment Ltd. is introducing a new, self-contained unit that is designed to remove highly corrosive salt from the chamber exhaust without the need to vent to atmosphere outside the building. The new Exhaust Salt Scrubber can be easily located alongside any Ascott salt spray chamber and only requires a connection to the chamber exhaust outlet, a floor level drain, a single-phase electricity and a pressurised water supply.

“We believe this is an important addition to our range because it enables users to benefit from salt spray and cyclic corrosion test chambers virtually irrespective of their location in a factory premises,” comments Chris Gates, Managing Director of Ascott Analytical. “This clearly allows corrosion analysis to be undertaken at the most convenient location and minimises the need for ducting or ventilation installation work to be undertaken.”

The unit operates by condensing the salt-water droplets present in the exhaust from the chamber, and then washing out by combining this with liquid that is retained in the base of the unit. This can then be either re-circulated to the spray system via an integral water pump – minimising water wastage – or safely drained via the waste at the base.

“The mobile design has a footprint of less than 35 cm x 35 cm and a height of less than 64 cm so can be positioned in the most convenient location,” continues Chris Gates.

“Until now, the single biggest determinant of where a corrosion test chamber is installed has been the need for close proximity to a building’s external wall, so that the highly corrosive exhaust can vent safely to atmosphere. The introduction of this accessory largely liberates the user from this constraint and provides both performance and environmental benefits,” Chris Gates concludes.

For further information contact: Ascott Analytical Equipment Ltd. Unit 6, Gerard Lichfield Road Industrial Estate, Tamworth, Staffordshire, B79 7UW Tel: 01827 318041. Fax: 01827 318049 e-mail: info@ascott-analytical.com Web: www.ascott-analytical.com
ADVANCED CORROSION TESTING TO ELECTRICAL PROCESS MANUFACTURER

Rotork Controls, one of the world’s leading manufacturers of electrical process and actuation equipment, has enhanced its acclaimed design and testing capability with the installation of the latest generation corrosion testing system from specialist manufacturer, Ascott Analytical Equipment Ltd. The facility, now operational at the Bath premises of Rotork Controls, builds on its long standing use of Ascott Analytical equipment and provides an invaluable means of assessing corrosion performance during the development phase of a wide range of electrically and hydraulically operated actuators. The move reflects the company’s commitment to quality and the critical role played by its equipment in some of industry’s most challenging environments.

Rotork has been at the forefront of cyclic corrosion testing since purchasing an Ascott Analytical chamber in 1996. The upgrade now to a new Ascott CC450iP cyclic corrosion test chamber enhances this capability and adds a number of key features to the testing process.

Providing a capacity of some 450 litres, the unit has been developed by Ascott Analytical to recreate wetting, salt spray, drying and humidity conditions in a highly controlled environment, enabling Rotork Controls to assess key components of its control system range. A choice of operating programmes and an ergonomic design enhance the suitability of the system for this type of operation, as Geoff Beeho, Chief Development Engineer at Rotork Controls explains –

“Our product range comprises designs destined for installation in industries ranging from petro-chemical to water-works and from the marine to power generation sectors,” he says. “The long term performance and quality of our equipment is fundamental – not least because it often performs critical functions that can protect against the risk of extremely expensive down time. This means that we focus heavily on testing procedures – with an Ascott Analytical test chamber at the heart of our corrosion analysis for many years.”

For reasons of both performance and appearance, it is vital Rotork Controls tests all external components and structures for corrosion resistance, both in terms of the substrate – typically high pressure die-cast aluminium – and the powder coating that is then applied. The company is able to pre-programme the humidity, temperature and time parameters into the Ascott Analytical machine to replicate all relevant conditions. “The cyclic capability has been of particular importance because this allows us to get closer to real environments,” adds Geoff Beeho. By way of example, he highlights testing that can assess site performance across two and a half years in just 1000 hours – or six weeks – in the laboratory.

The Ascott Analytical chamber used in Bath requires a footprint of only 1660 mm x 840 mm with a height of just 1510 mm and can accommodate products up to 48 kgs in weight. Access to the test chamber is provided by an easy to open, pneumatically operated canopy and can contain a range of fixing and mounting solutions to suit the components under test. With the latest design benefiting from a full colour touch screen user-controlled interface, test parameters can be established, whilst a visual check can be obtained through a large viewing window. The latest generation of chambers allow monitoring and recording of the process in greater detail.

“Installation at the site only requires connection to deionised mains water, an electrical supply and a compressed air source,” comments Ascott Analytical’s Managing Director, Chris Gates. “All climatic cycles are undertaken in accordance with the programmes selected, with the chamber designed to ensure even distribution and circulation. Importantly, the installation at Rotork Controls accommodates components of varying sizes – from complete units to smaller representative samples – and includes both metal elements and some sub-assemblies.”

The reputation that Rotork Controls has in marine to power generation sectors,” he says. “The ability to test product designs and developments, often in response to changing regulations and customer requirements, is therefore clearly a central element in our ongoing success.”

“We are delighted that Rotork Controls, which has a long standing commitment to our equipment, has now committed to the latest generation of our cyclic corrosion test chambers and is gaining from the additional features and capability they now offer,” concludes Chris Gates. “It represents an installation which, we believe, demonstrates clear advantages and benefits of the technology and methods that we use, and that reflects on the focus on testing and quality that underpins the worldwide success of Rotork Controls.”

Ease of loading is a key feature of the Ascott Analytical CC450iP cyclic corrosion test chamber now operational at Rotork Controls in Bath where a new CC450iP cabinet is now operational.

Views of the new Ascott Analytical CC450iP cyclic corrosion test chamber now operational at Rotork Controls. The design features a large viewing window set into the pneumatically operated canopy.
Cathodic Protection (CP) market leaders, BAC Corrosion Control Ltd of Telford, in the UK, is pleased to announce that they have bought Rose Corrosion Services Ltd (RCSL), a world class company specialising in corrosion monitoring and inhibition.

BAC and RCSL have had a working relationship for a number of years, exchanging relevant enquiries to each other where it was felt the other company could better deal with the client. Each company has supplied the other with products when needed to bolster their own technical submittal.

RCSL design, manufacture & supply the following:
- comprehensive range of DNV certified access fittings
- corrosion monitoring systems for all environments as well as microbiologically induced corrosion monitoring systems
- chemical injection systems including fixed on-line, retrievable on-line and skid mounted dosing systems.

BAC now aims to develop their activities within the internal corrosion monitoring market using existing contacts and also penetrate the market of corrosion inhibiting using the past experiences and contacts of RCSL.

Managing Director of BAC, Tony Gerrard said “The acquisition of RCSL by BAC proves more than ever that BAC is a progressive company, looking to the future and aiming to develop our product portfolio. The last year has been challenging with the company having to re-focus efforts and activities but we came through it as a stronger overall business however we still aim to progress yet further and we are now in a position to do so more than ever”.

Until further notice, BAC and RCSL will remain separate trading companies, and customers/prospective clients are asked to send enquiries as before the acquisition. If any overlap should occur, these will be communicated as needed between BAC and RCSL.

Further information can be obtained from BAC Corrosion Control on tel: +44 (0) 1952 290321 fax: +44 (0) 1952 290325 email: sales@bacgroup.com or Rose Corrosion Services Ltd on tel: +44 (0) 01635 552225 fax: +44 (0) 01635 568690 email: rcsl@rosecorrosionservices.co.uk

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Premier Coatings Ltd are delighted to announce that they are celebrating 30 years of business in 2012.

Founded in 1982, the company specialises in the manufacture and supply of a wide range of cost effective, corrosion prevention and waterproofing systems to the utilities, civil engineering and construction industries.

Based just outside Headcorn in Kent, the company’s products are manufactured to meet the requirements of National & International Standards and Commercial Specifications and have gained a well earned reputation for consistent high quality.

In 1997 Premier Coatings Ltd was acquired by anti-corrosion and sealing specialist Winn & Coales International Ltd, who realised the advantage of being able to offer an alternative range of products for their global markets.

The resulting increase in the demand for these products has prompted the establishment of many regional offices and recruitment of agents across the world, dedicated to the supply of Premier Coatings products along with any associated technical advice that may be required.

A history of manufacturing and supplying, effective, affordable corrosion prevention, sealing and waterproofing solutions has resulted in a long list of satisfied customers - a successful formula that has worked exceptionally well for the company over the past 30 years and will continue to do so in the future.

For further information contact:
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Shinfield Park, Reading, Berkshire, RG2 9FL
www.erimustech.com

Reader Enquiry: CM013
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Unit 3 Maises Way, The Village, Carter Lane, South Normanton, Derbyshire DE55 2DS
Tel: +44 (0) 1773 814520  Fax: +44 (0) 1773 814521
Web: www.ppgpmc.com

SPENCER COATINGS LTD

Froghall Terrace, Aberdeen, AB24 3JN
Tel: 01224 788400  Fax: 01224 648116
Website: www.spencercoatings.co.uk

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 LTD)

Norfolk House, Pitmedden Road,
Dyce, Aberdeen AB21 0EW
Tel: 01224 722888  Fax: 01224 723406
Email: Fraser.coull@rgb.com  Website: www.rgbltd.com

TINSLEY SPECIAL COATINGS

Enterprise House, Durham Lane,
Eaglescliffe TS16 0PS
Tel: 01642 784279  Fax: 01642 782891
Email: enquiries@tinsleyspecialproducts.com

TORISHIMA SERVICE SOLUTIONS

Sunnyside Works, Gartsherrie Road, Coatbridge ML5 2DJ
Tel: 01236 442391  Fax: 01236 702875
Website: www.torishima.eu
ICATS REGISTERED COMPANIES WITH QUALIFIED APPLICATORS

Access Integrated Services Ltd
Unit 3, Waterton Buildings, Moor Road, Waterton Industrial Estate, Bridgend, CF31 3TR
T: 01646 654054

Alltask Limited
Alltask House, Commissioners Road, Strood, Kent, ME2 4EJ
T: 01634 298000

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

APB Construction (UK)
Unit 3, Bramley Way, Hellaby Industrial Estate, Hellaby, Rotherham, S. Yorkshire, S66 8QB
T: 01709 541000

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

Armourcote Surface Technology Plc
15/17 Colvilles Place, Kelvin Industrial Estate, East Kilbride, Scotland, G75 0PZ
T: 01355 248223

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

Beever Limited
Little Coldharbour farm, Tong Lane, Lamberhurst, Kent, TN3 4AD, UK
T: 01892 890045

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

Cape Industrial Services
Cape House, 3 Red Hall Avenue, Paragon Business Village, Wakefield, WF1 2UL
T: 01224 215800

Cleveland Bridge UK Ltd
Cleveland House, Yarm Road, Darlington, DL1 4DE
T: 01325 502345

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

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

Community Clean
11 Old Forge Road, Ferndown Industrial Estate, Ferndown, Wimborne, Dorset, BH21 7RR, UK
T: 0845 6850133

Corrocoat
Forster Street, Leeds, LS10 1PW
T: 01132760760

Denholm Industrial
21 Boden Street, Glasgow, G40 3PU
T: 0141 445 3939

Dyer & Butler Ltd (Rail)
Mead House, Station Road, Nursling, Southampton, SO16 0AH, UK
T: 02380 667549

ENC (Yorkshire) Ltd
Unit 3B Rotherham Road, Dinnington, Sheffield, S25 3RF
T: 01909 567860

E & P Painting Contractors
Rossfield Road, Rossmore Trading Estate, Ellesmere Port, Cheshire, CH65 3AW
T: 0151 9558141

F A Clover & Son Ltd
Bardolph Road, Richmond, Surrey, TW9 2LH
T: 0208 948 6321

Finclean SKJ Ltd
Waterloo Industrial Estate, Pembroke Dock, Pembrokeshire, SA72 4RR
T: 01646 622407

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

GABRE (UK) LTD
9 Holme Road, Dromore, Omagh
Co Tyrone, BT78 3BX
T: 02882 897950

H&H Painting Contractors Ltd
4 Hamilton Gardens, Mutley, Plymouth, PL4 6PQ
T: 07837 382619

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

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

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

Herrington Industrial Services Ltd
Crown Works, Crown Road, Low Southwick, Sunderland S52 5BS
T: 0191 5160634

Hi-Tech Surface Treatment Ltd
Unit B, Deacon Trading Estate, Chickenhall Lane, Eastleigh, Hants SO5 6RP
T: 023 80611789

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

Industrial Coating Services
5 Danesbury Crescent, Kingstanding, Birmingham, B44 0QQ
T: 0121 384 2266

Industrial Painting
48–49 RCM Business Centres, Sandbeds Trading Estate, Dewsbury Road, Ossett, WF5 9ND
T: 01924 272606

International Energy Services Ltd
94 Awoyoyo, Ikoyi, Lagos State, Nigeria
T: 014615636

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

Jack Tighe Coatings
Sandall Lane, Kirk Sandall, Doncaster, DN3 1QR
T: 01302 880360
ICATS REGISTERED COMPANIES

ICATS REGISTERED COMPANIES WITH APPLICATORS IN TRAINING

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

E G Lewis & Company Ltd
Suite 5, Shawcross Industrial Estate, Ackworth Road, Portsmouth PO3 5JP
T: 01792 323288

Gemini Corrosion Services
Brent Avenue, Forties Road, Montrose, Angus, DD10 9PB
T: 01674 672 678

PCM Nigeria Plc
99 Rivoc Road Trans Amadi, Port Harcourt, Rivers State, Nigeria
T: +2348055297828
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Address</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severn River Crossing Plc</td>
<td>Bridge Access Road, Aust, South Gloucestershire, BS35 4BD</td>
<td>01454 633351</td>
</tr>
<tr>
<td>Specialist Blasting Services Ltd</td>
<td>Smiths Quay, Hazel Road, Woolston, SO19 7GB</td>
<td>023 80438901</td>
</tr>
<tr>
<td>Sussex Blast Cleaning</td>
<td>Unit 35-37 Station Road, Hailsham, East Sussex, BN27 2ER</td>
<td>01323 849229</td>
</tr>
<tr>
<td>Tees Valley Coatings</td>
<td>Riverside Park Road, Middlesborough, Cleveland TS2 1UT</td>
<td>01642 228141</td>
</tr>
<tr>
<td>DRH Coatings Ltd</td>
<td>Suite 5, 3 Shawcross Industrial Estate, Ackworth Road, Portsmouth PO3 5JP</td>
<td>023 9266 6165</td>
</tr>
<tr>
<td>EMS Services Ltd</td>
<td>Tank Farm Road, Llandarcy, SA10 6EN</td>
<td>0800 8400564</td>
</tr>
<tr>
<td>Excel Contractors Ltd</td>
<td>11a West End Road, Bitterne, Southampton SO18 6TE</td>
<td>02380 444420</td>
</tr>
<tr>
<td>Ferrous Protection Ltd</td>
<td>Hanson House, Grains Road, Delph, Oldham OL3 5RN</td>
<td>01457 873419</td>
</tr>
<tr>
<td>Forward Protective</td>
<td>Vernon Street, Shirebrook, Mansfield Notts, NG20 8SS</td>
<td>01623 748323</td>
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<tr>
<td>Galldriss Construction Ltd</td>
<td>Galldriss House, Pavilion Business Centre, Kinetic Crescent, Innova Science Park, Enfield BN3 7FJ</td>
<td>01992 763000</td>
</tr>
<tr>
<td>GPL Special Projects Ltd</td>
<td>PO Box 516, Salford, M5 0BJ</td>
<td>0161 7457888</td>
</tr>
<tr>
<td>G W Burton Ltd</td>
<td>New Court, Wooddalling, Norwich, Norfolk, NR11 6SA</td>
<td>01263 584203</td>
</tr>
<tr>
<td>Hempel UK Ltd</td>
<td>Llantarnam Park, Cwmbran, Gwent, NP44 3XF</td>
<td>01633 874024</td>
</tr>
<tr>
<td>IDL Fabrications Limited</td>
<td>Crabtree Lane, Clayton, Manchester, M11 4GU</td>
<td>0161 2306666</td>
</tr>
<tr>
<td>Interkey Services Ltd</td>
<td>2 Princenwood Road, Corby, Northamptonshire, NN17 4AP</td>
<td>01536 266607</td>
</tr>
<tr>
<td>Leighs Paints</td>
<td>Tower Works, Kestor Street, Bolton, Lancs. BL2 2AL</td>
<td>01612306666</td>
</tr>
<tr>
<td>Malakoff Limited</td>
<td>North Ness, Lerwick, Shetland, ZE1 0LZ, UK</td>
<td>01595 695544</td>
</tr>
<tr>
<td>Matthew James Services</td>
<td>Unit 4, Shibdon Business, Cowen Road Blaydon, Newcastle-Upon-Tyne, NE21 STX</td>
<td>0191 414 5700</td>
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<tr>
<td>Moorle Steel Developments Ltd</td>
<td>Station Road, Thorne, Peterborough PE6 0QE</td>
<td>01733 270729</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>Over Rail Services Ltd</td>
<td>Unit 10 Millhead Way, Purdys Industrial Estate, Rochford, Essex, SS4 1ND</td>
<td>07976372866</td>
</tr>
<tr>
<td>Paint Inspection Ltd</td>
<td>Trafalgar House, 223 Southampton Road, Portchester, PO6 4PY</td>
<td>0845 4638680</td>
</tr>
<tr>
<td>Possilpark Shotblasting Co Ltd</td>
<td>Dalmarrock Works, 73 Dunn Street, Glasgow, G40 3PE</td>
<td>0141 556 6221</td>
</tr>
<tr>
<td>Radleigh Metal Coatings Ltd</td>
<td>Unit 30 Central Trading Estate, Cable Street, Wolverhampton, WV2 2HX</td>
<td>01902 870606</td>
</tr>
<tr>
<td>R.L.P. Painting</td>
<td>Heathfield House, Old Bawtry Road, Finningley, Doncaster, DN9 3DD, UK</td>
<td>01302 772222</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>Tinsley Special Products</td>
<td>Enterprise House, Durham Lane, Eaglescliffe, Stockton-on-Tees TS16 0PS</td>
<td>01642 784279</td>
</tr>
</tbody>
</table>
DIARY DATES 2012/2013

19th June 2012
London Branch Golf Day
Silvermere Golf Club, Surrey
Contact Derek Hoskins at: dhoskins@waitrose.com

TBC – November 2012
Corrosion of Infrastructure ‘Present Knowledge and Future Solutions’.
Venue: Institute of Materials, Minerals and Mining1 Carlton House Terrace, London SW1Y 5DB
Further information along with a registration form is available to download at www.icorr.org in the conferences and events section. You can also contact Prof. Robert Akid robert.akid@manchester.ac.uk or Prof. Paul Lambert paul.lambert@mottmac.com

22nd - 26th October 2012
Basic Corrosion Course, Aberdeen
The course provides a basic but thorough review of causes of corrosion and the methods by which it can be identified, monitored, and controlled. Active participation is encouraged through hands-on experiments and case studies, as well as an open discussion format. 4 -Day Classroom Course plus half-day examination
Parallel Path to certification for Corrosion Technician (when you pass the Basic Corrosion course examination and if you have two years corrosion experience or alternatively if you subsequently acquire two years corrosion experience, you can apply to become a Corrosion Technician).
All enquiries to Dr Paulette Sidky, CMC Ltd, p.sidky@cmc.ltd.uk Tel 020-7460 9408

5th -9th November 2012
Designing for Corrosion Control, London
Parallel Path to certification for senior corrosion Technologist – The Designing for Corrosion Control course reviews the principles of corrosion and corrosion control and provides a systematic method for applying the technology of corrosion prevention to the design process. It offers an overview of the steps involved in materials selection common to many industries. It also covers corrosion control in system design and the financial principles used in evaluating alternative materials and designs.
All enquiries to Dr Paulette Sidky, CMC Ltd, p.sidky@cmc.ltd.uk Tel 020-7460 9408

5th -9th November 2012
Corrosion Control in the Refining Industry Course
Four and a half day Classroom Course including quizzes and discussion.
The purpose of Corrosion Control in the Refining Industry is to provide you with an overview of refinery process units, specific process descriptions, and the opportunity to identify and examine corrosion and metallurgical problems that may occur in process units. You will also examine techniques and practices that may be used to control corrosion in refineries. No examination.
All enquiries to Dr Paulette Sidky, CMC Ltd, p.sidky@cmc.ltd.uk Tel 020-7460 9408

24th October –3rd November 2012
Cathodic Protection CP3
The CP 3-Cathodic Protection Technologist Course is an intensive 6-day course that presents CP technology to prepare students for the NACE Cathodic Protection Technologist Certification Examination.
The CP 3-Cathodic Protection Technologist Course builds on the technology presented in the CP 2-Cathodic Protection Technician Course covering both theoretical concepts and practical application of cathodic protection with a strong focus on interpretation of CP data, CP troubleshooting and mitigation of problems that might arise in both galvanic and impressed current systems. The course is presented in a format of lecture, discussion and hands-on, in-class experiments and group exercises. There is a written examination at the conclusion of the course.
All enquiries to Dr Paulette Sidky, CMC Ltd, p.sidky@cmc.ltd.uk Tel 020-7460 9408

13–14th June 2013
London Branch Offshore Cathodic Protection Conference
At the Royal Overseas League in London there will be a two day Offshore Cathodic Protection conference, at this conference industry leaders will present papers on leading edge issues in this important area of corrosion control technology; this will be a must attended event. Please register your interest and to receive the early conference program at: admin@icorr.org

London Branch publish a monthly Newsletter
Details of all Branch activities, dates and venues can be found at www.icorr.org

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