In this issue:

Technical Topics
Page 7

FOCUS ON London Branch
Pages 8-9

Technical Article
Page 12
Approved Courses

- Painting Inspector Levels 1, 2 & 3
- Pipeline Coatings Inspector Level 2
- Cathodic protection of re-inforced concrete structures Levels 1 & 2
- Insulation Inspector Level 2
- Hot Dip Galvanising Inspector
- Fire Proofing Inspector Level 2
- Cathodic protection of buried and submerged structures Levels 1 & 2
- Cathodic protection of re-inforced concrete structures Levels 1 & 2
- Pipeline Coatings Inspector Level 2
- Insulation Inspector Level 2
- Hot Dip Galvanising Inspector
- Fire Proofing Inspector Level 2
- Cathodic protection of buried and submerged structures Levels 1 & 2

For further information or administrative details, costs and bookings for courses and examinations or detailed information packages free of charge, please contact:

David Betts or Steve Pilley on:
Tel: +44 (0)1709 560459  Fax: +44 (0)1709 557705
Email: enquiries@ruanetpo.com
Internet: www.argyllruane.com

Technical and eligibility enquiries can be made direct to Dave Griffiths the ICorr Scheme Manager on:
Tel: +44 (0)1709 550999

EMPLOYMENT OPPORTUNITY

ARL are currently seeking a Full Time lecturer to join their team in Rotherham. Please contact Steve Pilley or David Betts for further information.

David Betts or Steve Pilley on:
Tel: +44 (0)1709 560459  Fax: +44 (0)1709 557705

Ruane & T P O’Neill      Argyll-Ruane Ltd.
Meadowbank Road, Rotherham S61 2NE United Kingdom
I hope everyone enjoyed the Christmas and New Year holidays, I know I did. One phenomenon that never takes a break is corrosion; it is insidious and continues to consume our infrastructure at an alarming rate. Wherever I go I cannot but help notice that corrosion is at work. In to the amusement of some, including my wife, I photograph the effects of corrosion at every opportunity and have a good database of images. So, with expansion of the database in mind I spent a few days on the Isle of Wight ferry photographing the car deck area; the operators and crew appear to be unable to keep up with the effects of salt water and the briny atmosphere on painted steel. It was fully painted to begin with but soon becomes damaged allowing corrosion to initiate. We’re met with a similar situation at Freshwater where the ferry docks; the piles above the water line are coated but are suffering corrosion where coating damage has occurred. I'm not sure if CP has been applied in the wetted zone – I draw the line at underwater photography – but if not, it will be vulnerable there too.

The interest I have in corrosion and its impact continues on the many walks taken on the island. I have three dogs who are not the slightest bit interested in corrosion but will put up with my hobbies just to get a good walk. I again cannot but help notice that steel railings are wasting away, gates are hanging from rusty hinges and perfectly good galvanised fencing is secured with rusting bare steel crumbs, all slowly returning to their original state. We all see this, wherever we go.

What is the answer? Well, it’s a question of economics. The capital cost of building a seagoing vessel such as a ferry is but one part of the story, investing more in making it from more exotic alloy, or even carbon steel coated with a state of the art coating is another. It’s easier to do what has always been done – build to a budget and fabricate in steel, paint to whatever standard is specified and maintain the vessel over its lifetime, or until either major repairs are required or a replacement vessel is needed. The same applies to much in our everyday world, steel items will never be fully immune to corrosion but we can improve standards and serviceable life, a good example are motorway crash barriers, which are hot dip galvanised and continue in corrosion-free service almost indefinitely (note almost).

This leads me on to my first presentation as President, this will be at London Branch in March of this year “Corrosion, Friend or Foe”. Well, it depends where you stand. If it means the supplier has to resupply when items fail or the maintenance contractor has to maintain then it’s a friend. The operator who has inherited a structure built with budget in mind and is looking at replacement it’s foe. Perhaps there is a balance to be found here that would improve service life and be more environmentally friendly? It could take a while, however. As Winston Churchill would have it “Never give in, never give in….” (I will spare you the rest), let’s stop looking backwards and trying to improve the practice of corrosion control.

Trevor Osborne, President of the Institute of Corrosion

The subject of corrosion under insulation (CUI), and whether or not to coat insulated pipework at temperatures above 120°C proved an attraction, bringing 55 people to attend the first London Branch meeting of 2013 at The Naval Club. The evening took the form of a panel and open discussion, with the argument in favour of coatings being put forward by Matthew Fletcher and Neil Wills of Akzonobel. They explained that although water boils off at temperatures above 100°C, it could not be guaranteed that plant would maintain constant heat because many processes involved cyclic temperatures and that they would fall below 100°C anyway during shutdowns for maintenance for example. PIPework also needs protection during manufacture and delivery to site, and the accumulation of contaminants during service added further weight to the need for coating. However, a stumbling block in these days of recommended standards is that there is no pre-qualification standard for such coatings under insulation. It should be remembered that remedial work to correct corrosion problems would be more expensive than preventing those problems in the first place.

The opposite view, put forward by George Winning and Trevor Osborne claimed that many coatings break down at high temperatures in wet service and that the coating should be suitable for hot water immersion, this being an arduous and demanding environment, with temperature cycling being particularly telling. It was advocated that insulation should start as the primary defence to CUI, and if used, coatings seen as a secondary defence, and even then their performance should be continuously monitored to ensure compliance, and that insulation should be made water-tight from the outset, and if temperatures are constant, there should be no problem with corrosion.

There was much discussion about all three factors and challenges, and it should not be overlooked that many deluge systems use sea water, thus increasing the chances of the build-up of corrosion. This point was made by Trevor Osborne but was soon rebutted by the view that if the top sides of plant are deluged with sea water, then CUI becomes a secondary concern; deluge water isn’t corrosive in its own right. It’s a myriad of issues. At least its impact on CRA materials and plant in general. There was an extended debate about the pros and cons of TSA, and it was suggested that a serious question to be asked at the design stage would be: is insulation really necessary in all areas, i.e. do process engineers look closely at the need for insulation in all cases, and can some areas be omitted to reduce the possibility of CUI?

The Midlands Branch half-day meeting in November 2012 was entitled “The Future of Galvanic Anodes”. A good turn-out of over 50 ICorr members and guests attended the afternoon. The Council Chamber of Birmingham Council House; the Victorian panelled debating chamber is now an attraction, bringing 55 people to attend the meeting. The meeting was held in the Council Chamber of Birmingham Council House; the Victorian panelled debating chamber is now an attraction, bringing 55 people to attend the meeting. The evening took the form of a panel and open discussion, with the argument in favour of coatings being put forward by Matthew Fletcher and Neil Wills of Akzonobel. They explained that although water boils off at temperatures above 100°C, it could not be guaranteed that plant would maintain constant heat because many processes involved cyclic temperatures and that they would fall below 100°C anyway during shutdowns for maintenance for example. PIPework also needs protection during manufacture and delivery to site, and the accumulation of contaminants during service added further weight to the need for coating. However, a stumbling block in these days of recommended standards is that there is no pre-qualification standard for such coatings under insulation. It should be remembered that remedial work to correct corrosion problems would be more expensive than preventing those problems in the first place.

The opposite view, put forward by George Winning and Trevor Osborne claimed that many coatings break down at high temperatures in wet service and that the coating should be suitable for hot water immersion, this being an arduous and demanding environment, with temperature cycling being particularly telling. It was advocated that insulation should start as the primary defence to CUI, and if used, coatings seen as a secondary defence, and even then their performance should be continuously monitored to ensure compliance, and that insulation should be made water-tight from the outset, and if temperatures are constant, there should be no problem with corrosion.

Trevor Osborne, President of the Institute of Corrosion

Bob Crudwell, outgoing ICorr President started off with a paper “The Future of Sacrificial Anodes”. Bob explained the history of the technology, the development of different alloys and the use of different alloy types for protection of different types of structures in different environments. Bob also described methods of anode attachments and production. The importance of QA and QC being put in place as a secondary defence, and even then their performance should be continuously monitored to ensure compliance, and that insulation should be made water-tight from the outset, and if temperatures are constant, there should be no problem with corrosion.

George Sergi of Vector Corrosion Technologies told of their recent projects on the use and development of galvanic anodes to prevent corrosion of reinforcement in concrete, with a paper entitled “The development and use of galvanic anodes for the protection of atmospherically exposed steel reinforced concrete”. George started by explaining the corrosion processes at work in reinforced concrete, a topic of interest to many members of Midlands Branch involved in keeping the UK motorway network in safe and operational condition. George explained the current requirements to provide corrosion protection and also the development of galvanic anodes for use in concrete since the late 1990s. The development of these anodes for protection against incipient anodes around patch repairs through to other applications for contaminated concrete, expansion joints and submerged columns were described.

Winston Shepherd of Impalloy Limited then took on the mantle with a paper “Galvanic Anodes: Challenges and Opportunities”. This very much complimented Bob’s earlier paper but Bob also noted that many thousands of electrochemical test are undertaken, often for no real benefit.

There was much discussion about all three factors and challenges, and it should not be overlooked that many deluge systems use sea water, thus increasing the chances of the build-up of corrosion. This point was made by Trevor Osborne but was soon rebutted by the view that if the top sides of plant are deluged with sea water, then CUI becomes a secondary concern; deluge water isn’t corrosive in its own right. It’s a myriad of issues. At least its impact on CRA materials and plant in general. There was an extended debate about the pros and cons of TSA, and it was suggested that a serious question to be asked at the design stage would be: is insulation really necessary in all areas, i.e. do process engineers look closely at the need for insulation in all cases, and can some areas be omitted to reduce the possibility of CUI?"
Ali Morshed of the Atkins Subsea Division was the guest speaker at the November branch meeting. Dr. Morshed covered the concept of corrosion management, the importance of the integrity review process and some cases of recurring corrosion management failure as part of the presentation.

He started his talk by defining the concept of corrosion management. Improving the system and adequate training/mentoring were also made as the part of the presentation. Morshed gave an explanation of the integrity assessment. He observed that despite significant technological advances, recurring corrosion failures still posed a major problem noting that there was a need for the industry to focus on non-corrosion aspects. Dr. Morshed gave an explanation of the integrity review process outlining ‘corrosion’ and ‘non-corrosion’ aspects of corrosion management.

‘The importance of personnel competency attained through training and experience can not be overemphasised,’ Ali Morshed noted as he went through the key components of effective corrosion management. Improving competency was one of the benefits mentioned along with the more obvious benefits such as improved health, safety and environment protection.

The next part of the presentation covered case studies that highlighted various components of corrosion management. Cases included examples of (1) Unnecessarily high spend on inspections due to poor practices (2) Poor team communication (3) Inappropriate chemical spend (4) Poor competency management. Throughout this part of his presentation, he provided an overview of the observations made, identified the problems and explained the outcomes with solutions to prevent similar issues in future.

He concluded his talk by identifying incompetence, ignorance, complacency and negligence as the key vices plaguing good competency management. He started his talk by defining the concept of recurring corrosion management failure as he went through the key components of corrosion management underlining the importance of review, monitoring and negligence as the key vices plaguing good competency management. He concluded his talk by identifying incompetence, ignorance, complacency and negligence as the key vices plaguing good competency management.

Questions on the use of databases, number of inspections performed and competency management followed immediately after the presentation. Comments and suggestions from the audience on themes such as personnel training, mentorship and tracking staff competency were also made as the session wound up.

Frances Chalmers thanked the speaker for his presentation and members for attending. Corrosion Management magazines and continuous professional development certificates were distributed to members immediately after the meeting. For information about the Aberdeen branch activities please contact our branch Secretary, Muhammad Ejaz, ICorrABZ@gmail.com. Alternatively a calendar of local events of interest to the 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.

Technical Topics No.40:
LONG TERM CORROSION e.g. ARCHAEOLOGICAL AND CONSERVATION

By Douglas J Mills, Technical Secretary

Last month I talked about the EFC needing UK Working party delegates. I have had some response to this (thanks to those who contributed). But we still need delegates for (WP number in brackets) high temperature(3), environmental fracture (5), corrosion mechanisms (6), electrochemical methods (8), marine (10), microbial (11), refinery (15), automotive (17), trib (19), polymers (19), drinking water (20) and archaeological (21). So, as before, if you are interested in representing UK on any of these Working parties please let me know.

Anyway this month I would like to talk about the area covered by the most recently formed of these working parties i.e. archaeological corrosion. When one of my ex-students, Kasia, recently took a job at the Maritime Museum in Gdansk as their “corrosion” expert I have visited this and it is a first class example of a small museum. I was reminded of work I did many years ago at the BNF Metals Technology Centre in Wantage. That send me off looking for the report I co-authored on an examination of artefacts brought up from the seabed after 260 years.

In 1707 several ships of the line from a fleet of twenty one, under the command of Sir Cloudesley Shovell, hit the rocks of the Scilly Isles during a storm and sank. This included the flagship HMS Association. In 1969 a team of divers under the overall control of Roland Morris recovered many artefacts. The BNF was given a Royal Society grant to examine these and the lot fell to me to carry out much of the work.

By doing a lot of analysis and metallography, this enabled us to comment on the types of corrosion, the nature of the corrosion products, the extent of corrosion and also the composition and metallurgical structure of the metal/ alloys. The items included lead pipe, lead musket balls, silver pieces of eight, pewter platters, bronze cannon, brass dividers, a copper spike, and (bronze) ship’s bells. I did this work under the direction of Hector Campbell who, I was very pleased to find out, is still going strong.

Hector, a time editor of the British Corrosion Journal, lives not too far away from where I live in Nottingham. So I went to see him and got hold of the report which was written (some 70 pages long). I was able to pass this over to Kasia (the museum in Gdansk has bits from two ships, Solen and Copper ship, which sank in the Baltic a similar length of time ago). I cannot cover all the things contained in the report here. But I will comment on four interesting corrosion aspects (on the metallurgical side). I will just say that the composition of many of the alloys used was surprisingly close to what might be used today and many alloys were also reasonably pure. The lead musket balls afforded an interesting comparison with musket balls from the Swedish warship Wasa (visible in its entirety in museum in Stockholm) which sank some 60 years earlier in the Harbour there. This was possible because original size and weight of musket balls was known and hence (assuming linear) we could work out the corrosion rate and compare them. What was found was that the musket balls from the Swedish warship had corroded less in an aggressive environment than Stockholm harbour (about half the rate of corrosion).

Then there were the brass dividers. These had undergone hardly any corrosion (the points made of iron had rusted away and maybe they providing galvanic protection in the early stages). But it was the fact that the brass was single phase and contained some arsenic (a useful inhibitor of dezincification) that probably saved the dividers.

There were two different bells: one from HMS Romney (probably) and one from HMS Association. These, despite similar composition (two phase one copper rich and one tin rich), had corroded in quite different ways with one phase being attacked in one bell and the other phase in the other. Interestingly polarisation/ potentiostatic work done in the lab revealed that the two bells had probably been subjected to different environmental conditions - half of one bell having been buried in mud while the other bell was freely exposed to sea water.

Finally there were the pieces of eight. The interest here was in developing a more efficient cleaning method compared with the normal one which was lengthy and removed significant amount of silver. This was in fact achieved in part by using an electrochemical method. Now this kind of research i.e. understanding long term corrosion, has relevance today when say nuclear waste is being stored. The other big area is Conservation. How do you keep things in the museum environment from corroding? or indeed things outside like statues? One approach is application of thin organic coatings. Getting the right coating is quite a challenge as the appearance of e.g. monuments, must not to be altered, while ensuring maximum protection.

Maybe some people have interesting experiences of archaeological corrosion even if it is just some piece in the garden they have dug up; or you may want to read the whole BNF report; or wish to volunteer for this (archaeological) or any other EFC working party? If so please contact Douglas@harbridge.freeserve.co.uk
FOCUS ON LONDON BRANCH

The London Branch of the Institute of Corrosion meets each second Thursday of the month from October to April at The Naval Club, Hill Street, Mayfair, and has done so for many years without interruption.

In all this time the meetings have been well attended, this we believe is because of a combination of the quality of technical presentations offered, the hard work of the branch committee in organising and planning the technical evenings and of course, the well known hospitality provided after the meetings where members and guests can discuss and network.

In recent years London Branch has worked to increase sustaining membership, to increase membership at all levels and to increase evening meeting attendance, and most recently London Branch have averaged attendance at Hill Street of over 50 members and guests. These goals have been met through the vigorous efforts of the members, and guests. This initiative recognises that the average age of members of the Institute of Corrosion is high and that historically the industry has not been employing young engineers. However London Branch Member and President of ICOR Trevor Osborne said:

“The trend appears to be changing with a recent influx of young engineers into the industry, we need to ensure that the Institute is offering the correct level of support to these Engineers giving them a broad knowledge of the subject and above their specialisation.”

The Institute of Corrosion London Branch has therefore developed a programme aimed at New Entrants in the field of Engineering.

New Entrant Engineers Orientation in Materials and Corrosion

A new initiative aimed at the young engineer called “New Entrant Engineers Orientation in Materials and Corrosion”. Second a two day conference “London Branch, Offshore Cathodic Protection, Structures & Pipelines”

The New Entrant programme has been driven by a small sub-committee headed by David Mobbs past Chair of London Branch with supporting support from Alan Denney, Anthony Setiadi and Charlie Barracough and a team of willing colleagues. This initiative recognises that the average age of members of the Institute of Corrosion is high and that historically the industry has not been employing young engineers. However London Branch Member and President of ICOR Trevor Osborne said:

“The trend appears to be changing with a recent influx of young engineers into the industry, we need to ensure that the Institute is offering the correct level of support to these Engineers giving them a broad knowledge of the subject and above their specialisation.”

The Institute of Corrosion London Branch has therefore developed a programme aimed at New Entrants in the field of Engineering.

The programme is a series of evening lectures spread out over a 12 month period with attendance every 2 months with one additional workshop where each attendee will be given a case study to complete, they will have a mentor assigned who will assist them to complete the task in their own time.

The objectives of the programme are:

1. To introduce basic topics of corrosion to the younger engineers
2. To broaden the attendees views and knowledge by passing on some of the experiences from the more established members.
3. To create a network of younger engineers and establishing contact points.
4. To help facilitate the integration between younger and older members.
5. To help the younger engineers with CP (Continuing Professional Development).

A series of six evening lectures over the course of 12 months have been arranged with the following topics and lecturers with an introduction by Trevor Osborne at the first meeting on 30th January:

- January 30th, Corrosion, Mr George Winning
- March 27th, Materials selection, Dr Dave Shoo
- May 29th, Coatings, Mr James Lawson
- July 31st, Cathodic Protection, Mr Trevor Osborne
- September 25th, Welding, Mr Alan Denney
- November 27th, Inspection/Monitoring, Mr Charlie Barracough

Each event will take place at the offices of International Paint close to Victoria Station and Underground, refreshments with a light dinner to be provided. The duration of the event shall take no more than 2 hours in total, to include 1 hour presentation + 1 hour Q/A.

The attendees will benefit by earning CPD points which helps with ‘their Professional Development. Andrew Taylor the London Branch Chairman said:

“there is no cost for the course and The Institute of Corrosion would like to thank all the speakers and Mentors for giving up their personal time to a wonderful initiative to help young engineers coming into our industry, thank you all”

London Branch, Offshore Cathodic Protection, Structures & Pipelines

During mid June the second of the featured events takes place, this being a conference to be held at the ROSL on Thursday 13th and Friday 14th of June 2013, this conference, like the New Entrant Engineers Orientation programme, has been brought to fruition by another dedicated Branch subcommittee under the leadership of Mash Biagioli and includes the present Branch Chairman Andy Taylor, immediate past Chairman Brian Goldie and Branch committee member Paul Brooks. The emphasis will be on cathodic protection of offshore structures, pipelines and wind farms. Industry renowned experts drawn from all areas of cathodic protection will be presenting leading edge work drawn from recent experience in this important and interesting area.

Presentation subjects include:

- Modelling of CP systems for submerged and buried monopiles
- Offshore Windfarm External CP Retrofits
- Direct Electrical Heating (DEH) of Subsea Pipelines – What are the effects on Cathodic Protection?
- Offshore Pipeline CP Retrofits – Recent Project Experiences
- Offshore Corrosion Monitoring – Viewing the Potential
- Subsea CP – Electrochemistry Meets Engineering
- The Impact of CP on High Strength Materials and Alloys in Subsea service
- Potential Limited CP design for Susceptible Materials
- Cathodic Protection of Reinforced Concrete Offshore Structures
- Tensioned String Anodes for Cathodic Protection of Offshore Platforms
- Cathodic Protection of Irregular- and Regular-Shaped Steel-Reinforced Concrete Piling Using a Memory enhanced Elastomer/Flexible Composite Jacketing System

The papers are to be presented in four sessions, each containing three presentations. Each group of three will be followed by a panel session where participants from the floor will ask questions, debate the work presented and share their experiences with others in attendance.

At London Branch there is excitement about the future evening technical programme and at both the key events for 2013, they combine to bring understanding and focus to corrosion and provide a service to members and non-members alike. So if you or any of your colleagues are in London during any of the scheduled evening meetings, or the events described, then come and join us - you will be assured of a warm welcome, a good technical presentation and congenial hospitality.
This year, the Corrosion Engineering Division (CED) of the Institute of Corrosion (ICorr) is running a joint meeting with the British Institute of Non-Destructive Testing (BINDT). The meeting will be held at The Centre, Birchwood Park, near Warrington on Wednesday, April 17th. It will be made up of three lectures given by corrosion engineers, describing corrosion issues and the use of monitoring and inspection techniques in three of the areas covered by CED working groups, followed by two lectures given by experts from BINDT, giving an overview of the latest inspection and monitoring techniques. In the afternoon, attendees will have an opportunity to visit Amecon’s nearby corrosion and inspection laboratories in small groups and to take part in CED working group meetings. The working group meetings will include separate topical presentations arranged by the chairs of the individual working groups. There will also be time for topical discussions and formulation of future activities of the groups. Agendas for the working group meetings will be published separately in advance on the ICOrr website (www.icorr.org), in the conferences and events sections. Updates will also be posted in the Institute of Corrosion’s Linkedin group, which you can join by searching for ‘Institute of Corrosion’ in the groups section of Linkedin. Attendees will then receive an email notification whenever an update is posted. The following working groups will be meeting (it may be necessary to combine some meetings on the day, according to demand): Cathodic Protection, Monitoring, Nuclear, Coatings, Oil-field Chemicals, Water Treatment and Monitoring. This working day will be a good opportunity to network with other corrosion and inspection professionals from different industry sectors. During the day attendees will also be able to visit a table-top exhibition provided by trade exhibitors. The price for attendance includes a buffet lunch and refreshments. Details of the programme and a registration form are included with this current issue of Corrosion Management. The documentation can also be downloaded from the ICOrr web site.

MINIMISING INFRASTRUCTURE CORROSION TO PROLONG ASSET LIFE CYCLE WHILE PROTECTING BOTH REPUTATION AND BUSINESS VALUE

Middle East spends an estimated US$10–15 billion every year to keep up with corrosion controls and the combination of ageing oil and gas infrastructure and highly corrosive environments makes proactive adoption of innovative solutions now more crucial than ever.

Tactical prevention or reduction on corrosion problems requires a robust inspection, monitoring and failure analysis routine which will increase productivity and efficiency of any operation. In view of this, marcus evans, one of the world’s leading conference organisers, has launched the 2-day Infrastructure Corrosion and Control conference that will cover current updates in corrosion monitoring, best practices in controls and failure analysis. Scheduled to be held on 29-30 April 2013 in Abu Dhabi, United Arab Emirates, the conference aims to minimise infrastructure corrosion with tactical combination of mitigation methodologies and inspection regime to prolong asset life cycle while protecting both reputation and business value of organisations.

“The only fundamental way to extend asset life is to mitigate against corrosion. This means you have to understand to what you are getting corrosion and develop methods to slow it down” said Dr. Paul Rostron, President and Chairman of NACE MENA and Professor of Chemistry at The Petroleum Institute UAE. Dr. Rostron will be presenting at the conference on the topic of “Analysing Novel Approaches in Corrosion Controls to Decelerate Corrosion”.

Other key presenters at the Infrastructure Corrosion and Control conference include Prof. Michael Hawkins, Dr. Devi Selvakannu, Prof. S. Sharda Poya, Horng-Huei Chang, Dhanpal M Shetty, Takehiro Tsuda, John Blackburn and Ashley F. Goodenough.

Middle East is one of the world’s leading providers and promoters of global summits, strategic conferences, professional trainings, in-Company training, business-to-business congresses, sports hospitality and on-line information services. In 1983, the company now employs over 3500 employees operating in 35 countries around the world. The world-class experts are generated from clients across majority of the world’s top 1000 companies. Our international network of offices provides a one-stop shop for a company’s business intelligence, learning and training needs. For more information, please visit www.marcusevans.com.

For more information about this topic, please contact Cherrie Koay at 603-2723 6662 or email to CherrieK@marcusevanski.com.
THE ROUTE FROM U. R. EVANS’ ORIGINAL APPROACH TO TODAY’S UNDERSTANDING OF SCALE FAILURE

Michael Schütze, DEHEMA-Forschungsinstitut, Frankfurt am Main, Germany

ABSTRACT
A first quantitative description of the mechanical failure of surface scales was given by U.R. Evans in 1937. This approach can still form the basis for today’s understanding but the important role of physical defects is hidden in the energy term for the adhesive work to overcome for scale failure. In the present paper an extended approach is described that is based primarily on defect growth kinetics during high temperature exposure and relates the critical strain to scale failure to physical defect size via a “fingerprint” parameter. If this has been determined once for an oxide/ metal system by metallurgy and mechanical 4-point bending tests, critical oxide failure strains can be assessed simply by metallographic determination of defect sizes without additional mechanical testing. This seems to be of particular interest for the assessment of scale strain tolerance on service exposed components e.g. in power stations. So far the extended concept has been confirmed for Ni oxide and Ti oxide scales, further work is currently in progress.

INTRODUCTION
The oxidation or corrosion resistance of metallic materials at high temperatures is determined by the integrity of the protective oxide scales formed under operation conditions by the reaction between oxygen from the operation environment and the respective elements of the metallic alloy. In this sense oxide scales play the role of a diffusion barrier or passivating layer protecting the attack of harmful species on the metal. During operation different types of mechanical stresses may be superimposed on the high temperature corrosion process and by this have a significant impact on the high-temperature corrosion situation. Oxide scales even at higher temperatures, e.g. under operation conditions are brittle materials that show only a very limited strain tolerance to failure, i.e. the operational stresses or strains that may result from temperature changes, gravity, centrifugal forces, pressure, etc. may easily exceed the critical limits for failure and therefore lead to cracking or spalling of the oxide scales. Figure 1 shows several examples for oxide scale failure that may result either in a loss of the protective scale or in a combination of spots of the technical equipment where blockage can occur or the heat transfer capacity can be decreased. All of these effects are usually unwanted and should, therefore, be avoided. For this reason a number of investigations have been performed and models have been developed to describe the mechanical limits of such oxide scales.

THE U.R. EVANS APPROACH
The first to explicitly discuss the situation of mechanical oxide scale failure was U.R. Evans in 1937 in his book “Metallic Corrosion: Passivity and Protection” [3]. In the chapter “Breakdown of an Oxide Film” he writes, that a “first isolated white area” indicates a “breakdown of the oxide film” (a) and that the “next area” is “an oxygen bubble” (b). In this way, the formation of a “fresh blister” (elamination) under compressive stresses when the thickness of the film growing on the surface has reached a critical value \( y_n \) under the assumption that cohesive forces in the oxide are good but adhesion at certain points is poor. In fact this equation compares the adhesion work per unit area \( W_c \) with the energy \( W_o \) that had elastically been stored in the oxide scale under compression times the proportion of energy \( Q \) liberated when the blister is formed (“strain energy approach”).

This equation predicts the formation of a “fresh blister” (deamination) under compressive stresses when the thickness of the film growing on the surface has reached a critical value \( y_n \) under the assumption that cohesive forces in the oxide are good but adhesion at certain points is poor. In fact this equation compares the adhesion work per unit area \( W_c \) with the energy \( W_o \) that had elastically been stored in the oxide scale under compression times the proportion of energy \( Q \) liberated when the blister is formed (“strain energy approach”).

Fig. 2: The oxide scale failure diagram developed in EPRI report FP686 [5] where the critical strain to scale failure \( y_n \) is plotted vs. oxide scale thickness \( d \) for different failure modes under tensile and compressive stresses.

Later on similar concepts and diagrams have been developed by a number of other authors, see e.g. [6-8].

Fig. 3: Analogies between the mechanical scale failure diagram [a] and the thermodynamic phase stability diagram [b] (10-12) that in both diagrams the operation conditions can be entered and an assessment can be performed whether a protective or non-protective situation can be expected (diagrams from refs. [5] and [9]).

In the chapter “Breakdown of an Oxide Film” he writes, that a “first isolated white area” indicates a “breakdown of the oxide film” (a) and that the “next area” is “an oxygen bubble” (b). In this way, the formation of a “fresh blister” (elamination) under compressive stresses when the thickness of the film growing on the surface has reached a critical value \( y_n \) under the assumption that cohesive forces in the oxide are good but adhesion at certain points is poor. In fact this equation compares the adhesion work per unit area \( W_c \) with the energy \( W_o \) that had elastically been stored in the oxide scale under compression times the proportion of energy \( Q \) liberated when the blister is formed (“strain energy approach”).

This equation predicts the formation of a “fresh blister” (elamination) under compressive stresses when the thickness of the film growing on the surface has reached a critical value \( y_n \) under the assumption that cohesive forces in the oxide are good but adhesion at certain points is poor. In fact this equation compares the adhesion work per unit area \( W_c \) with the energy \( W_o \) that had elastically been stored in the oxide scale under compression times the proportion of energy \( Q \) liberated when the blister is formed (“strain energy approach”).

Generally such oxide scale failure diagrams have the intriguing characteristics that strain limits can be defined below which no scale failure will occur and all the subsequent negative effects of scale failure can thus, be avoided. The other possibility is to plot the operational strain amplitudes into these diagrams and compare these values with the critical strains to scale failure. In such a case the operation time until scale failure can be derived from this diagram. These diagrams can in a certain sense be compared with the thermodynamic stability diagrams that are used to predict protective and non-protective situations in high-temperature corrosion form a chemical point of view, figure 3.

There are a number of reports on experimental investigations where indeed the scale thickness determines the critical strain or critical temperature drop to scale failure e.g. [10-12] and where the strain values seem to follow an equation similar to the one developed by U.R. Evans and later on modified in the EPRI report FP686 report or other publications. However, also examples can be found where thick scales are still adherent on the same material while thin scales have already detached or cracked, e.g. [13]. Such an example is given in figure 4. Already U.R. Evans in his book “Metallic Corrosion” describes some “recent” work on chromium plating that emphasizes the role of “first isolated pores which tend to become continuously less important as the thickness of the layer is increased” and “a network of cracks which are absent in thin films and are present in thick areas”. In particular, thick oxide scales most often pores or microracks are present.
as can be seen e.g. in figures 4 and 5. Thus, the question arises whether these pores were included in the original approach of U.R. Evans and in the equation that had later been used in its modified form also by other researchers.

THE ROLE OF PHYSICAL DETAILS IN THE OXIDE/METAL SYSTEM

A frequently used equation in the literature describing strain to scale failure is the following:

\[ \varepsilon_{ES} = \frac{2\gamma_t}{E_0}(1-v) \]  

(2)

where \( \varepsilon_{ES} \) is the critical strain to failure (under compression), \( E_0 \) is the scale thickness, \( \gamma_t \) is the Young’s modulus of the oxide, \( v \) is the Poisson’s ratio. This equation is a modified version of U.R. Evans’ original equation for a critical scale thickness and has been used to establish the scale failure diagram in ref 5.

Concluding from work in reference [5] and the original work of U.R. Evans a factor can be introduced in the energy terms that takes into account a decrease of the energy \( \gamma_t \) needed for the formation of two new surfaces if pores or other physical defects are present in the plane of failure.

The easiest way to take into account the physical defects is to modify the energy term \( \gamma_t \) by a geometrical term that regards the area of the oxide scale in the plane of failure, see equation \( \gamma_t \) [15].

\[ \gamma_t = \left(1 + \frac{c}{\lambda} + \frac{r}{\lambda} \right)\frac{\gamma_t}{A_{0}} \]  

(3)

\( \gamma_t \) is the “intrinsic” energy term representing the material strength (and, thus, a material constant), \( r \) and \( \lambda \) are geometrical factors describing the situation in the plane of failure. \( A_0 \) is the area of the oxide scale regarded and \( A_{sep} \) the already separated part in this area (e.g. pores). The separated area \( A_{sep} \) can be approximated by the number of pores or microcracks \( n \), times their average size \( c \) as given in equation (4):

\[ \frac{A_{sep}}{A_0} = 1 - \frac{n}{A_{0}} \]  

(4)

\( n \) is the radius of “circular” physical defects. Only the term of equation 4 is dependent on physical defect size while the rest in equation 3 is not.

In the literature \( \gamma_t \) in equation 2 is commonly regarded as constant over exposure/oxidation time, i.e. the role of physical defects according to equation 4 seems to be negligible. It seems to be interesting to assess the impact of equation 4 on the critical strain to failure, i.e. the impact of physical defects via a decrease of the energy \( \gamma_t \). In equation 2. In other words, \( \gamma_t \) itself would depend on exposure time and scale thickness, respectively.

In fig. 6 the critical strain values without and with assuming an influence of physical defects have been plotted based on physical defect data taken from fig. 5 for “calibration” and energy/mechanical data from ref. 7. There a scale thickness of 120 \( \mu \)m with an average physical defect diameter of 120 \( \mu \)m. It was assumed that on an area of 500 \( \times \) 500 \( \mu \)m about 20 physical defects are present, see micrograph in figure 4 for illustration of the non-adherent area between scale thickness and average defect diameter was assumed as \( 2 = d \).

The interface roughness \( r/d \) was taken as close to zero for simplicity so that the second term in equation 3 can be approximated as 1. Increased interface roughness would increase the constant term in the first parentheses but would not influence the term given by equation 4.

The data used for “calibration” are also given in fig. 6. As this figure shows there is not much of an influence of the defects at low scale thickness values but with increasing thickness the role of the non-adherent area and, thus, of the defects starts to dominate over the scale thickness. For the specific situation of fig. 5 the defects would reduce the tolerable strain to less than half of what would be predicted by looking at the influence of scale thickness only.

THE EXTENDED STRATEGY

This observation proposes an extended strategy that includes the role of the physical defects. Such a strategy has been described in reference [15] where also fracture mechanics tools are used for the description of the parameters determining the strain to failure. In this reference it was again the aim to develop a universal oxide scale failure diagram that is easy to apply for the qualitative assessment of the strain tolerance of oxide scales. A significant difference is, however, that a multi-level approach was developed that includes all relevant parameters influencing the mechanical properties of the scales and due to this aspect can serve as a fingerprint of oxide metal systems. This approach first categorizes all the different types of oxide scale failure as shown in fig. 7. At the next step the equations are compiled that can be used to describe the different failure mechanisms and at the same time allow the introduction of high impact parameters and low-impact parameters:

a) Through scale cracking (tensile)

\[ \varepsilon_{f} = \frac{K_{IC}}{\sqrt{\pi a}} \]  

(5)

b) Interfacial crack growth (compressive)

\[ \varepsilon_{f} = \frac{K_{IC}}{\sqrt{\pi a}} \frac{(1+r/d)(1+\nu)}{2E_{eff}} \]  

(6)

c) Spalling (compressive)

\[ \varepsilon_{f} = \frac{K_{IC}}{\sqrt{\pi a}} \frac{2\gamma_s}{E_{eff}} \]  

(7)

High impact parameters are such that change significantly during high temperature operation and, thus, have a direct impact on the critical strain to scale failure. The low-impact parameters are such that remain more or less constant during operation and have the character of materials or system parameters.

High impact parameters are \( c, d, r/d, \lambda \), and \( \left(A_0 - A_{sep}\right)/A_0 \) in these equations while the remaining parameters have low impact and, thus, of the defects starts to dominate over the tolerable strain to less than half of what would be predicted by looking at the influence of scale thickness only.

As a conclusion one could now make the step from the original U.R. Evans approach over the \( \gamma_t \)-approach to the \( \gamma_t \)-method, where \( \gamma_t \) has been replaced by the normalized physical defect size, \( c \), divided by \( \lambda \), see equation (11).

\[ \frac{\gamma_t}{\lambda} = \frac{\gamma_{s}}{\lambda} + \frac{\gamma_{w}}{\lambda} \]  

(8)

In order to make use of this approach it is absolutely necessary to create an experimental database. This can be done by combining two types of experimental investigations. The first is metallographic investigations of oxide scales after different exposure times and different exposure conditions, where the size of the physical defects is determined and plotted versus exposure history, see fig. 6a. The second is that for all these exposure conditions and times four-point bending tests in conjunction with acoustic emission measurements have to be performed where the critical strains are determined for each defect situation. This is shown schematically in fig. 9. Now when all these data have been quantified the value for \( \gamma_t / \lambda \) can be determined that is characteristic for such an oxide/metal system, see fig. 9.

The first experimental investigations in this respect have been performed on pure nickel, pure titanium and pure iron. These data will be published in detail elsewhere [15], for illustration of the concept here part of the data for NiO and TiO2 will be used.
results for the kinetics of scale thickness growth and physical defect growth of NiO are given in figure 10. These measurements have been performed in dry air, in air with 10% water vapour and in air with 30% water vapour at 800°C. As the plots show there is no significant difference between the dry and wet environment except for an oxidation time of 100 hours where at least for 30% water vapour the physical defect size seems to be somewhat higher than for the other conditions. When plotting the critical strain versus scale thickness as in the conventional approaches, see figure 11, no clear tendencies become evident with regards to the influence of water vapour and scale thickness. There seems to be only a very general tendency that with increasing scale thickness the values for the critical strain seem to decrease. The situation becomes significantly different, if the critical strain is plotted versus the physical defect size determined by metallography, see figure 12. Here the values very much follow the γ-c approach. Interestingly even if one uses the “theoretical” data from reference 15 the measured values lie very close to this theoretical line. Another tendency that may be taken from this plot is that water vapour in this case does not seem to have a significant influence on the γ value as both curves lie in the same range.

The same approach was applied to the situation of the oxide scale on titanium 99.6, see figure 13. Again the experimental data follow the γ-c approach very closely while as shown in reference 15 they would not fit into a plot of critical strain versus scale thickness in a reasonable manner. Furthermore this plot indicates that the presence of water vapour for titanium oxide has a significant influence on the γ value which is not surprising since a potential effect of hydrogen on the properties of titanium oxide has been mentioned in the literature [17]. The data for pure iron indicate that the γ-c approach also seems to apply for this type of metal/oxide system [15].

INDUSTRIAL RELEVANCE OF THE EXTENDED APPROACH
So far this may have looked like an academic exercise but it should not be forgotten that this approach has significant potential for practical applications. Figure 14 illustrates that once the γ values have been determined in laboratory experiments it becomes possible to assess the failure strains of oxide scales on components of industrial plants in conjunction with metallographic information. Furthermore if an atlas of oxide scale structures from plant operation and from lab data would exist similar to the MTI Atlas of microstructures [18] developed at DEHEMA-Forschungsinstitut for exposure times of up to 149,000 hours it would be possible to assess the failure strain values of oxide scales on service exposed components without the necessity of any experimental work. Simply the defect growth kinetics are needed that should be part of such an atlas of oxide scale structures, where for the establishment of this atlas the defect growth kinetics can e.g. be determined by the exposure of ring samples in plants and subsequent metallography after different exposure times.

CONCLUSIONS
The U. R. Evans approach still provides a valid basis for the description of oxide scale failure, however, focusing only on the role of scale thickness can underestimate the important role of physical defects that is hidden in the energy term W_A or ω-c. The extended γ-c approach overcomes this problem and even in its simplified form as an ε versus c plot (γ-c approach) offers an interesting potential for describing the mechanical limits of oxide scales. The conclusions of this work are:

- if it has been determined for a scale type the critical strains to failure can be assessed simply from metallographic data, i.e. physical defect sizes (γ as a “mechanical k_p”), no additional mechanical testing would be needed.
- for the examples of nickel oxide and titanium oxide clear tendencies were observed contrary to the plot ω vs. d γ can evidently reveal differences in the mechanical properties of the scales, e.g. scales in humid and in dry environment.
- further data are needed in particular to establish a wider data basis of γ-values for different oxide/metal systems.

ACKNOWLEDGEMENT
The help of Dr. Mario Rudolphi in the preparation of this manuscript is gratefully acknowledged.
A new dedicated training programme has been developed for supervisors of protective coatings operstions and projects.

Corrodere Coatings & Corrosion Control Training has developed the specialised course to help coatings supervisors gain a thorough understanding of their roles and responsibilities.

The comprehensive two day programme has been endorsed by the Institute of Corrosion under the Industry Coating Applicator Scheme (ICATS) and Lloyds Register.

The two day, classroom-based course looks at surface preparation, coatings technology, specifications, inspection techniques, equipment and other technical issues. Health and safety, COSHH and environmental legislation are also covered.

The course is available for those coatings personnel who have completed the ICATS course or other approved training programme.

For further information contact:
Corrodere Coatings and Control Training, www.coatingsupervisor.com Tel: 01252 732220 or e.mail: corrodere@mpigroup.co.uk

For all the latest news, events and debates join us on Linked in
LINCOLNSHIRE PIPEBRIDGES PROTECTED WITH DENSO STEELCOAT SYSTEM

Engineering and coating contractors Repair Protection & Maintenance Ltd of Kellingham, North Yorks, are currently applying Winn & Coales (Denso) Ltd’s Denso Steelcoat system to protect four pipebridges in Lincolnshire for the Environment Agency. Main contractors for the project are Interserve Construction Ltd.

The function of the pipebridges is to take away drainage water. There are two at Torksey, near Lincoln, which discharge drainage water into the nearby River Trent. The contract also includes pipebridges in Lincolnshire for the Environment Agency. Main contractors for the project are Interserve Construction Ltd.

RPM have chosen the Denso Steelcoat system to give the long-term protection required for the pipebridges. The surfaces are first manually prepared by wire brushing / scraping to ST2, removing all rust and loose coating material, which consists of a previous bituminous coating on two of the bridges. Denso profiling mastic is then used to provide an even surface and provide a smooth contour over flanges etc. The Denso Steelcoat system then applied consists of: Hi-Tack Primer, Denso Hi-Tack Tape, Ultraseal Tape, followed by a final two coats of a moisture cured polyurethane topcoat.

RPM have undertaken this contract as a turnkey project by looking after the refurbishment of the air valves, replacing a pipe coupling and organised the access scaffolding.

For further information contact: Winn & Coales (Denso) Ltd, Chapel Road, London SE27 OTR
Tel: 020 8670 7511 Fax: 020 8761 2456 e-mail: mail@denso.net website: www.denso.net

CATHODIC PROTECTION
CONSULTANCY SERVICES

BEASY
Ashurst Lodge, Ashurst, Southampton, Hants, SO40 7AA
Tel. 02392 299223 Fax: 02392 292853
e: t.frone@beasy.com www.beasy.com

CATHODE PROTECTION CONTROL

3 Ivy Court, Acton Trussell, Staffordshire ST17 0SN
Tel. 01923 493032 Email: info@corrosionengineering.co.uk
www.corrosionengineering.co.uk

CATHODE PROTECTION ENGINEERING SOLUTIONS LTD

25 Longman Close, Welford, W018 8AP
Tel. 01923 493032 Email: info@corrosionengineering.co.uk
www.corrosionengineering.co.uk

CUMBERLAND CATHODIC PROTECTION LTD

CO2 & CO3 The Bridgewater Complex, Canal Street, Bootle L20 2AH
Tel: 0151 5500015 Fax: 0151 5500016

PRO-TECH CP LTD

76A Girdler Road, Formby, Merseyside L37 8DQ
Tel. 07717 487632 Fax: 01704 380194
Email: pmsmed@protechcp.com www.protechcp.com

3C CATHODE PROTECTION CONTROL COMPANY

Box 72, Billberga, Sweden 268 03
Tel: +46 418 411 900 Email: info@3ccc.se Website: www.3ccc.se

CATHODE PROTECTION AND MONITORING

ADVANCED TECHNICAL ENGINEERING SERVICES

Room 811, Torshults huset (East Wing) 66 Mody Road, Kowloon, SAR Hong Kong
Tel. 852-23639399 Email: atsk@10039@yahoo.com.hk

CATHODE PROTECTION HOUSE, 4 MILL COURT, SOUTHAMPTON

Corrosion, Engineering, Chemical Protection, Environmental Monitoring

50 YEARS OF EXCELLENCE

Corrosion, Environmental Protection, Chemical Protection, Engineering & Testing Services

Tel. +44 (0) 1489 861980 Fax: +44 (0) 1489 861981 Email: ccall@corrpro.co.uk

SUSTAINING MEMBERS

MEMBERS

CATHODE PROTECTION CONTROL CO LIMITED

55 YEARS OF EXCELLENCE

Corrosion Engineers, Environmental Protection

Tel: +44 (0) 1476 506666 Fax: +44 (0) 1476 570605 Email: cp@catco.co.uk www.catco.co.uk

CATHEDRAL

Marine House, Dunston Road, Chesterfield S41 8NY
Tel: +44 (0) 1246 457900 Fax: +44 (0) 1246 457901 Email: sales@catheleco.com www.catheleco.com

CORROCELL LIMITED

17 South Meade, Maghull, Liverpool L31 8EC
Tel: 0151 249 8641 Email: 087087 9525 Email: dp@corrocell.co.uk

Corrosion Control Services Ltd

SPECIALISTS IN CATHODIC PROTECTION

Innovation House, Euston Way, Town Center, Telford TF3 1LT
Tel: 01952 230900 Fax: 01952 230906 www.corrosioncontrolservices.co.uk

www.denso.net

CATHODE PROTECTION SYSTEMS LIMITED

The Sawmills, Durley, Southampton, SO32 2EJ
Tel: 0151 249 8641 Email: 087087 95258
www.corrosionengineering.co.uk

PRO-TECH CP LTD

76A Girdler Road, Formby, Merseyside L37 8DQ
Tel. 07717 487632 Fax: 01704 380194
Email: pmsmed@protechcp.com www.protechcp.com

3C CATHODE PROTECTION CONTROL COMPANY

Box 72, Billberga, Sweden 268 03
Tel: +46 418 411 900 Email: info@3ccc.se Website: www.3ccc.se

CATHODE PROTECTION AND MONITORING

ADVANCED TECHNICAL ENGINEERING SERVICES

Room 811, Torshults huset (East Wing) 66 Mody Road, Kowloon, SAR Hong Kong
Tel. 852-23639399 Email: atsk@10039@yahoo.com.hk

CATHODE PROTECTION HOUSE, 4 MILL COURT, SOUTHAMPTON

Corrosion, Engineering, Chemical Protection, Environmental Monitoring

50 YEARS OF EXCELLENCE

Corrosion, Environmental Protection, Chemical Protection, Engineering & Testing Services

Tel. +44 (0) 1489 861980 Fax: +44 (0) 1489 861981 Email: ccall@corrpro.co.uk

SUSTAINING MEMBERS

MEMBERS

CATHODE PROTECTION CONTROL CO LIMITED

55 YEARS OF EXCELLENCE

Corrosion Engineers, Environmental Protection

Tel: +44 (0) 1476 506666 Fax: +44 (0) 1476 570605 Email: cp@catco.co.uk www.catco.co.uk

CATHEDRAL

Marine House, Dunston Road, Chesterfield S41 8NY
Tel: +44 (0) 1246 457900 Fax: +44 (0) 1246 457901 Email: sales@catheleco.com www.catheleco.com

CORROCELL LIMITED

17 South Meade, Maghull, Liverpool L31 8EC
Tel: 0151 249 8641 Email: 087087 95258
www.corrosionengineering.co.uk

Corrosion Control Services Ltd

SPECIALISTS IN CATHODIC PROTECTION

Innovation House, Euston Way, Town Center, Telford TF3 1LT
Tel: 01952 230900 Fax: 01952 230906 www.corrosioncontrolservices.co.uk

www.denso.net
COATING APPLICATORS

H & H PAINTING CONTRACTORS LTD
6 Harbourside Court, Hawkers Avenue, Plymouth PL4 5QQ
Tel: 01752 261248 Mob: 0783738261
Email: hayesandhome@btiscali.co.uk

MABEY BRIDGE LIMITED
Station Road, Chasetop, Monmouthshire NP16 5YL
Tel: +44 (0)1291 623801 Fax: +44 (0)1291 625453
Email: mail@mabeybridge.co.uk

MARK SMITH INSPECTION SERVICES LTD
14 Seaburn Close, South Shields, Tyne & Wear NE34 7ER
Tel: 07760175446 Email: smark.smith@btinternet.com

MCL COATINGS LTD
Pickingsgill Road, Halsall Industrial Estate, Widnes, Cheshire WA8 8WU
Tel: 0151 423 6166 Fax: 0151 495 1437
Email: info@mclc.eu Website: www.mclc.com

ICS
Industrial Coating Services
We have over 2500 years of experience and are ISO 9001 accredited. Our services include:
- Painting
- High Level Painting
- Specialist Painting
- Surface Prerparation
- Sandblasting
- Shot Blasting
- Shot Peening
- Protection Coating
- High Pressure Water Jetting
- General Cleaning
- Scaffold and Encapsulation
- Protective Coating Application
- Surface preparation
- OHSAS 18001
- ISO 9001
- Constructionline
- NHSS 19A

MONA LIFTING LTD
Unit 5 Parc Bryn Celys, Llangefni, Anglesey LL77 7XA Tel: 01248 751330 Email: info@onaliftings.co.uk Website: www.onaliftings.co.uk

MPM NORTH WEST LTD
Marine Road, Maryport, Cumbria CA15 6AY Tel: 01900 810299 Fax: 01900 812000 Email: mkip@mpmwest.co.uk Website: www.mpmmarine.co.uk

NORTHERN PROTECTIVE COATINGS LTD
16 High Street, Fairfield Industrial Estate, Bill Quay, Gateshead, Tyne & Wear NE10 0LR Tel: 0191 438 3082 Fax: 0191 438 5555 Email: jack.walsh@npcoatings.co.uk Website: www.npcos.coatings.co.uk

NUSTEEL STRUCTURES
Lymne, Hythe, Kent CT21 4LR Email: simon.alun@nusteelstructures.com Website: www.nusteelstructures.com

OPIUS INDUSTRIAL SERVICES LIMITED
Ethan House, Royce Avenue, Cowpen Lane Industrial Estate,Billingham TS23 4BX Tel: 01642 371850 Fax: 01642 561971 Email: ops@opuiservices.com

ORRMAC COATINGS LTD
Newton Chambers Road, Thornlie Park Estate, Chapelhall Road, Cheadle, Cheshire SK5 5PH Tel: 0114 246127 Fax: 0114 2507151 Email: irmac@aol.com Website: www.ormac.co.uk

Pipeline Induction Heat Ltd
The Pipeline Centre,Farrington Road, Rosedale Road Industrial Estate Burslem, Lancs B11 5SW Tel: 01282 415323 Fax: 01282 415326 Email: Sales@phb.co.uk Website: www.phb.co.uk

PIPERCREST LTD
17A Halls Specialised Services Brooklyn Farm, North Hill, Norden on the A66, Essex SS17 8QA Tel: 01375 361408 Fax: 01375 361448 Email: halls@phbconnect.com

PORT PAINTERS LTD
Unit 3, Ringside Business Park, Hesy-Hyl-Hising, Cardiff CF3 2EW Tel: 029 2077 7070 Fax: 029 2036 3023 Email: portpainters@talk21.com

RANDELL INDUSTRIAL SERVICES LTD
75 Stanley Avenue, Holby, Southampton SO45 2JF Tel: 023 8089 2749 Email: info@randellindustrial.com Website: www.randellindustrial.com

ROWECORD ENGINEERING LTD
Neptune Works, Usk Way, Newport, South Wales NP20 2SS Tel: 01633 250511 Fax: 01633 253219 Email: enquiries@rowecord.com Website: www.rowecord.com

SHUTDOWN MAINTENANCE SERVICES LIMITED
Tallgrass Point, Tallgrass Way, Southend On Sea, Essex SS2 5JL Tel: 01702 599988 Fax: 01702 599989 Email: info@shutdownmaintenance.co.uk Website: www.shutdownmaintenance.co.uk

SUPABLAST
Chesterfield, Derbyshire, DE12 9BY Email: enquiries@supablast.co.uk Website: www.supablast.co.uk

STANDISH METAL TREATMENT LTD
Potter Place, West Bexley, Uxbridge, Middlesex UB8 9EF Tel: 01592 585987 Fax: 01592 588302 Email: info@standishmetal.co.uk Website: www.standishmetal.co.uk

SURFACE TECHNIK (OLD HILL) LIMITED
Sovereign Works, Deepdale Lane, Lower Gornal, Dudley DY3 2AF Tel: 01384 457610 Fax: 01384 238563 Email: peter.morris@surfatechnik.co.uk Website: www.surfatechnik.co.uk

TEES VALLEY COATINGS LIMITED
Unit 20, Dawson Wheat, Riverside Park Road, Middlesbrough TS2 1UT Tel: 01642 228141 Email: sales@teesvalleycoatings.com Website: www.teesvalleycoatings.com

TORISHIMA SERVICE SOLUTIONS
318 Brook Street, Birmingham, B1 3NT Tel: 0121 320 2704 Fax: 0121 320 2705 Email: admin@torishima.co.uk Website: www.torishima.co.uk

W C BEAUMONT & SON LTD
Beaumont House, 8 Bermond Road, Romford, RM7 DXH Tel: 01708 749202 Fax: 020 85908885 Email: tom.costello@wgbeaumont.co.uk Website: www.wedge-galv.co.uk

WILLIAM HARE LTD
Brandleshope House, Brandleshope Road, Bury BL8 1Jj Tel: 0161 609 0000 Fax: 0161 609 0468 Email: jeff.grundy@whhare.co.uk Website: www.williamhare.co.uk

WIND TOWERS (SCOTLAND) LTD
D E Machrihanish, Campbeltown, Argyll PA28 6QU Tel: 01586 555000 Website: www.windtowersscotland.com Email: tma@windtowersscotland.com
DIARY DATES 2013/2014

14th February 2013
London Branch Meeting
Speaker: Robin Wade, Technical Manager
PFP International Paint on ‘Key performance considerations when selecting epoxy PFP for on-shore and off-shore oil and gas applications’.
17.30 for 18.15 start. Venue: The Naval Club, 38 Hill Street, Mayfair, London W1J

14th March 2013
London Branch AGM
17.30 for 18.00 start. Venue: The Naval Club, 38 Hill Street, Mayfair, London W1J
Speaker: Alex Delwiche of Deepwater EU Ltd: ‘Designing CP systems and understanding CP date in arid environments for pipelines.’

11th April 2013
London Branch joint meeting with NACE (GB)
17.30 for 18.15 start. Venue: The Naval Club, 38 Hill Street, Mayfair, London W1J
Speaker at 18.15: Trevor Osborne, ICorr President, ‘Corrosion friend or foe?’

17th April 2013
Inspection and Monitoring Techniques to Manage the Corrosion of Valuable Assets
The Centre, Birchwood Park, Warrington WA3 6YN  T: +44 (0)1925 282940
E: Thecentre@birchwoodpark.co.uk
Directions at: http://www.thecentreatbirchwoodpark.co.uk/location.aspx
Accommodation: There is a hotel on site: http://www.encorewarrington.co.uk/ramada-encore-warrington/bedrooms.html

24th April 2013
Midland Branch Workshop
Loughborough Surface Analysis Ltd (LSA) and Midlands Surface Analysis Ltd (MSA) in association with the Institute of Corrosion
Midlands Branch are organizing a one-day workshop addressing surface analysis and depth profiling techniques and how they can be used to help with a variety of challenges relating to corrosion.
Please register with Denise at ICorr Denise@icorr.org if you will be attending, places will be limited.

29-30th April 2013
Infrastructure Corrosion and Control conference
The conference aims to minimise infrastructure corrosion with tactical combination of mitigation methodologies and inspection regime to prolong asset life cycle while protecting both reputation and business value of organisations.
To be held in Abu Dhabi, United Arab Emirates.
For more information please contact Cherrie Koay at 603-2723 6662 or email to CherrieK@marcusevanskl.com.

6th June 2013
London Branch Golf Day
London Branch Golf Day at Silvermere, Surrey
Contact Derek Hoskins: dhoskins@waitrose.com

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

visit the new ICorr website
Details of all Branch activities, dates and venues can be found at www.icorr.org

BRANCH CONTACT DIRECTORY

ABERDEEN:
Frances Blackburn (Secretary)
Tel: 01224 243360
Email: ICorrABZ@gmail.com

DUBLIN:
Martha Hidalgo (Secretary)
Tel: +353 01 4027945
Terry Hinds (Chairman)
Tel: 0145 066 71  Fax: 0145 662 13
Email: info@galcosteel.ie

NORTH EAST:
Brendan Fitzsimons
Tel: 0191 493 2600

NORTH WEST:
Brenda Peters, Analysis Scientific
Tel: 01706 871700
Email: brenda.peters@analysis-scientific.co.uk

LONDON:
Andy Taylor (Chairman)
Tel: 0771 7205406 (UK)
Tel: +994773251548 (Azerbaijan)
Email: aetaylor12@yahoo.com
Mike Moffat (Secretary)
Tel: 01737 762222
Mobile: 07768 537590
Email: MMoffat@Corrpro.co.uk
Geoff White (Public Relations Officer)
Tel: 01728 602289
Mobile: 07811 037407
Email: geoff.white237@btinternet.com

YORKSHIRE:
Nigel Peterson-White
Tel: 01422 356752
Email: nigel@specialisedcoatings.co.uk
Young ICorr Chairman:
Oliver Lewis
Email: oliver.lewis@shu.ac.uk

CSD Division:
Cherrie Koay at 603-2723 6662 or email to CherrieK@marcusevanskl.com.

CSD Division:
Cherrie Koay at 603-2723 6662 or email to CherrieK@marcusevanskl.com.

6th June 2013
London Branch Golf Day
London Branch Golf Day at Silvermere, Surrey
Contact Derek Hoskins: dhoskins@waitrose.com

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

visit the new ICorr website
Details of all Branch activities, dates and venues can be found at www.icorr.org