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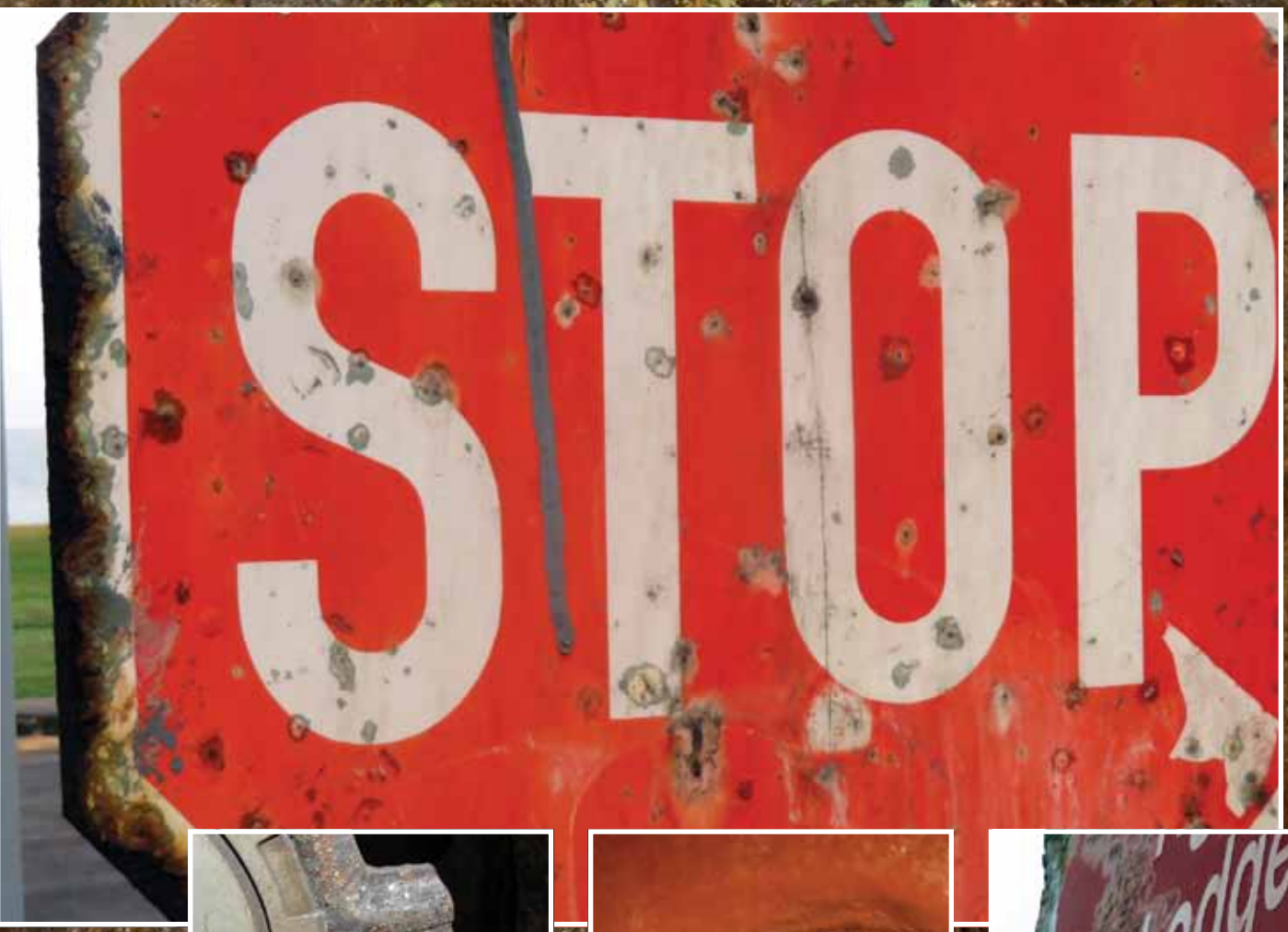
Corrosion Exclusively



INSIDE:

- Pipeline Failure Investigation - is it MIC?
- Digging in for Tunnel Durability
- Issues and Challenges of Field Surface Preparation
- Veracruz Port Parking Garage in Mexico
- Feedback on ACA Corrosion Conference

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With Transvaal Galvanizers celebrating their 33rd birthday this year, it is time to look back, standing on the threshold of this milestone, to the journey that has led us here.

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While looking back we are extremely proud of our history and our heritage, but looking forward is much more important to us. One man that is always looking forward is the Director of Transvaal Galvanizers, Francesco Indiveri. With Mr Indiveri at the helm, Transvaal Galvanizers has expanded into new markets focusing extensively on renewable energy projects.

With this in mind as well as the need for a larger galvanizing kettle in the industry, Transvaal Galvanizers has commissioned the biggest galvanizing plant in Africa in 2017. The size of the kettle is 15.5m L x 2m W x 3.2m D. This will provide steel manufacturers in the industry the flexibility of manufacturing larger items whether it be structural, solar, piping, reinforcing to name a few, without the cost implications of double dipping, forcing costs of projects to rise.

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We constantly aim to continually improve ourselves by adapting to changing times and markets whilst ensuring that we always stay focused on client satisfaction. It is this focus that has brought us to where we are today, and we know that this focus will take us to even greater heights over the next 33 years.

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President's Comment

The Corrosion Institute of Southern Africa has been busy over the last few months.

Meetings have been held with like-minded organisations. In these meetings a Memorandum of Understanding has been signed with SAPMA which will see SAPMA courses being offered to our members with training taking place at "The Core".

A meeting was held in November with SAIW represented by Mr Sean Blake in an effort to bring our two organisations closer. These discussions continue and will be reported on in the near future.

Discussions have been held at SABS head office to discuss how CorrISA may take its rightful position as an authority in local corrosion standards and writing of such standards. The discussion was well received by both organisations and we look forward to our rekindled friendship moving forward.

The Corrosion Institute of Southern Africa will be meeting with the Department of Trade and Industry and we hope to report on the developments of all these discussions in the next publication.

In November 2019 we held a successful CIP 1 course as well as a Corrosion in Refineries and CIP 2 courses. These well attended courses ensured that CorrISA was in a good financial position going into the December break.

In January 2019 we have conducted CIP 1 course and will be holding the CIP 1 course in Durban on the 18-23 February 2019.

We look forward to "World Corrosion Day" which will be held on the 24th April 2019.

I would like to wish you all a prosperous 2019 and may this year bring us all health, wealth and success.

Donovan Slade, President – Corrosion Institute of Southern Africa

OBJECTIVE OF THE MAGAZINE

"The objective of ***'Corrosion Exclusively'*** is to highlight CORRISA activities, raise and debate corrosion related issues, including circumstances where inappropriate material and/or coatings have been incorrectly specified, or have degraded due to excessive service life. Furthermore, it shall ensure that appropriate materials or coatings, be they metallic or otherwise, get equal exposure opportunity to the selected readers, provided these are appropriate for the specified exposure conditions on hand."

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Cover: Effective corrosion control methods are available to "STOP" the medium to long-term effects of corrosion. It all starts at the SPECIFICATION!!

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Editorial Comment

Wow, we are already at the end of February, as they say the older one becomes the quicker the year goes! In this industry I am certain I am not the only one experiencing this.

We want to thank all advertisers who despite difficult economic circumstances and business challenges, still manage to support this publication.

A very special thankyou to the six companies that have supported CE from the outset, namely Denso; Isinyithi Cathodic Protection; Monoweld Galvanizers; NUI; SATactics and Weartech. For these companies we have offered an advertorial twice the size of their current advert at a very cost effective rate. SATactics was the first to respond and in this edition presents us with their DPS Advertorial.

Our feature articles for this first issue of 2019, are:

An article which has previously appeared in Materials Pro contributed by NACE International: Pipeline failure investigation – Is it MIC? by Richard B. Eckert, DNV GL USA, Inc., Commerce Township, Michigan, USA and Torben Lund Skovhus, VIA University College, Horsens, Denmark.

Digging in for tunnel durability, supplied by Christine Filippis of ACA.

Issues and Challenges of Field Surface Preparation by Jared Rigo of HRV Conformance Verification Associates, Inc.

Hot dip galvanized steel reinforcement for the Veracruz Port Parking Garage in Mexico, by Emmanuel A Ramirez (Head of the Technical Department) at the Mexican Hot Dip Galvanizers Association.

Feedback on the Corrosion Prevention Conference – Adelaide November 2018, by ACA.

From the KETTLE, a regular contribution on hot dip galvanizing we discusses surface condition F22 – Ungalvanized areas due to surface contaminants such as labels and residual glue from labels as well as F23 – Ungalvanized surfaces due to the non-removal of shellac or laquer (an essential anti-corrosive coating for imported pipe components).

Hendrick Rasebopye the Executive Director of CorrISA, residing in Johannesburg presents his message.

We report on the CorrISA technical activities that happened late in 2018 or early 2019 such as the NUI technical evening as well as the Kaefer Innovations Day. Under Education and Training Gauteng hosted the first NACE CIP 1 course.

Graham Duk and Mark Terblanche together with Karyn Albrecht the Western Cape and KZN joint chairmen respectively give account of their activities.

In the Cape Region, we report back on the Gala Dinner held in November last year, where an enthusiastic crowd were entertained by Regardt Laubscher and Leigh Collins with their respective clever magical and clowning performances. Alister Penny from Naughty's then kept those who had their dancing shoes on, entertained till late that night.

Two local stalwarts of the industry Dan Durler and David Livesey were deserving recipients of the Corrosion Institutes Honorary Life Membership award, presented by the Executive Director Hendrick Rasbopye.

Cape Region's first technical evening, which proved extremely interesting was hosted by Denie Naidoo of Torre Automotive (Gabriel Shock Absorbers).

Should a reader wish to comment on any of the previously published articles or select a specific subject for discussion in a future edition of the magazine, kindly contact me.

Terry Smith

Issues and challenges of field surface preparation

By Jared Rigo, HRV Conformance Verification Associates, Inc.

As means and methods diversify and structures types become more complex, an innumerable number of challenges can arise when participating in a surface preparation project in the field. While a large quantity of these challenges can be anticipated and planned for in advance of the project inception, a small number often go overlooked. This article will identify three potential issues that arise on nearly every field based industrial coatings project worldwide: abrasive selection, existing condition assessment, and worker access.

Before beginning this conversation, a few disclaimers are in order. First, this is not an attempt to lay blame on any party involved in these projects. Designers, contractors, inspection personnel, asset owners and a number of other entities and individuals all play a pertinent role in the completion of any project. The number one goal is to complete a project efficiently and on schedule while keeping costs – both direct and indirect – down. The goal here is to identify some additional, often unforeseen, concerns that often hinder the successful completion of the objective.

Also, this attempt at outlining some hindrances to field surface preparation is exactly that: an attempt to have an objective discussion of the concerns, not necessarily the solutions. While this discussion addresses issues that permeate nearly every project, no individual project assumptions can be made as every project present its own unique circumstances. There is no "one-size-fits-all" solution to these issues, but having an honest, upfront dialog prior to the inception of any industrial field painting project, paying special attention to the nuances and intricacies particular to that individual project, will allow for the best attempt at resolving these issues.

Abrasive selection

The large majority of field-based surface preparation projects require abrasive blasting to remove the existing coating, clean the substrate and produce the required surface profile. While specifications differ (sometimes greatly) from project to project, they typically all have a couple of clauses that pertain to the selection of abrasives to be utilized on the project – or at least the selection is governed by a certain set of requirements.

Nominally speaking, the following items are usually contained in most project documents. First, there is usually a clause stating something along the lines of, "abrasives must be sized appropriately to produce a dense, angular profile of 1.5-to-3.5 mils." A statement such as this directly pertains to the abrasive selected for the project. Aside from quality workmanship on behalf of the trade worker holding the blast nozzle, the size and type of abrasive has a direct correlation with the profile produced.

Second, there is often a statement contained in the project documents that discusses the standard to which the abrasives must be manufactured and cared for. Often referenced standards include SSPC AB-1 and AB-3 for disposable abrasives and AB-2 for recyclable abrasives. These standards, when specified, often come with a secondary statement about testing for abrasive cleanliness, whether it be by vial test or by conductivity testing.

Finally, it should be noted that some specifications require the contractor to purchase new abrasive (of the recycled type, as disposable abrasive is always purchased new) before beginning of the project. Although this is a rare case, it does help to mitigate the issue we're about to discuss.

One may ask: "How is the selection of abrasives a challenge to field surface preparation projects?" To better answer this question, we will need to play out a typical scenario. While this is just a scenario, it is a pertinent one derived from years of experience with these types of projects that warrants further investigation.

Day one of abrasive blasting begins. The contractor has utilized a recycling machine filled with whichever abrasive they had left from the previous project with perhaps a small amount of new abrasive sprinkled in here and there. Regardless, they have made phenomenal progress cleaning the existing coating from the substrate. After a long and arduous shift for the blasters, it is time to perform inspection of the prepared areas. Usually along with the identification of holidays in the blast, the surface profile is examined with replica tape and a spring micrometer (or digital profilometer, for that matter). The tests reveal a surface profile that is both dense and angular in nature. While this is easily observed to be within project tolerances, it is quickly noted that the profile has a depth in excess of 4.0-to-4.5 mils. This project requires a maximum depth of 3.5-to-4.0 mils. This requirement is not atypical; nearly all projects specify a ceiling of 3.5-to-4.0 mils. So, what happens next?

Photo courtesy of HRV Conformance Verification Associates Inc.

Photo courtesy of HRV Conformance Verification Associates Inc.

Photo courtesy of HRV Conformance Verification Associates Inc.

The inspector brings the issue up to the contractor who then makes a statement of some sort claiming that there is nothing that can be done to bring the profile to within project tolerances. It is not feasible, nor cost effective, to purchase new abrasive, and the operators stood as far away from the substrate as possible so as to be productive yet not obliterate the steel and the profile is still too far above the threshold limits for the project.

At this point in time, on nearly all industrial field blast cleaning jobs, the asset owner or contractor usually procures a letter from the coatings manufacturer stating that this excessive profile is within the tolerances for the coating to be applied. This letter frequently quells the concerns of the designer and the project proceeds uninhibited by the high profile. However, the project wasn't designed this way. There is a ceiling for a reason. There is a maximum depth of profile that was placed there by

design. Yet, on nearly all projects, this limit goes often exceeded. Is this actually okay? Hopefully an informed conversation between the owner, contractor and designer before beginning of the project can allow for achieving the objectives within a reasonable time frame while allowing for the design profile limits to not be exceeded.

Existing condition assessment

A vast majority of structures in the U.S. and around the world often exhibit severely corroded areas. Some of these areas are so badly corroded that they have absolutely no existing coating present and are often structurally deficient. Bearings fall out from under beam ends, top and bottom flange joints are filled with pack rust, holes are blown through the web, once rounded rivets turn to pitted prunes – and the existing condition survey of the structure, usually performed several years prior to project inception, captures very few of these problems.

Replacing the existing structure is often out of the realm of possibility, so rehabilitation becomes a necessity.

Project documents generated for these rehabilitation projects often dictate a few things with regards to surface cleanliness and the existing condition of the structure. Usually, at least for field based projects, the structure is to be blast-cleaned to an SSPC SP-6/NACE No. 3, Commercial Blast Cleaning or an SSPC SP-10/NACE No. 2, Near-White Metal Blast Cleaning finish. All of the accessible structure is to be cleaned to the same degree, regardless of the existing condition of the substrate underneath the remaining coating. The standards of surface cleanliness specified dictate that all tightly adherent material (coating, rust, mil-scale, etc.) be removed and only a percentage of staining may remain.

There is usually also a small, obscure, poorly written clause inserted into the specification somewhere that makes faint, absentminded attempts at discussing caulking, penetrating sealer and steel repairs. The vague ambiguities often associated with these clauses cause innumerable headaches and costly change orders... hence this discussion.

So, all of the tightly adherent material is removed. Areas previously identified for additional surface treatment (caulking, penetrating sealer and steel repairs, for example) are handled as specified in the project documents. However, a large array of other defects was not addressed during the condition assessment previously performed on the structure. These previously unidentified problem areas are treated as dictated in the poorly written "caulking" section of the specification.

Ideally, all of the exposed surface is cleaned and prepared as required and all of the problem areas were previously identified, bid for by the contractor and remediated as directed. This very, very rarely happens, though. In the real world, the contractor usually applies additional gallons of penetrating sealer and tube after tube after tube of caulking, trowels on the pit-filler and allows for hours of difficult-to-schedule steel repairs, which require additional surface treatment and are often performed after mid-coating and/or top-coating. Someone has to pay for all the extra man-hours, scheduling conflicts and materials associated with the additional work required to remediate all of these supplementary "problem children." These costs are often way beyond those which were expected, and the asset owner usually ends up doling out hundreds of thousands of dollars in extra pay items.

While the obvious answer to the problem is to perform condition assessments more frequently and more thoroughly, this is often not a possibility. A number of factors prohibit this, whether they be the size or complexity of the structure, the costs associated with performing the assessments or just the lack of vigilance on the part of the asset owner. Realistically, while there is likely no feasible way to capture all of the detrimental areas on a structure before cleaning and coating it, there should be an upfront, honest discussion before blasting the structure into oblivion and then charging the owner tens or even hundreds of thousands of dollars to apply these additional materials. Awareness of the constant and persistent nature of this issue should allow for owners to better prepare specifications to address the potential for an excessive amount of caulking, penetrating sealer, pit-filler and steel repairs. Remember that each individual project will always possess its own unique set of issues, so there is no possible singular solution.

Worker access

A final, often overlooked concern with regards to field surface preparation is worker access. Laborers, blasters, painters, foremen as well as inspectors (both QC and QA) all

have to access the structure to perform their respective job duties. When a reviewer sits down to examine and approve a proposed containment/access plan, a number of things are taken into consideration.

The first and primary concern when reviewing the containment is safety. Does the proposed plan abide by regulation with regards to worker safety? Also, is the proposed plan safe for the general public to operate around? Does the containment impose an unbearable load on the existing structure?

Assuming the proposed plan allows for a safe work environment for both the worker and the general public, the second consideration is the impact of the plan on the environment. Often required by the project documents is the use of a guide for design and installation. For example, SSPC Guide 6 is often implemented to assist in design compliance. Maintaining compliance with environmental regulation falls into a close second place behind the safety components of the plan.

A little more explanation is required, however, to discover why this is an issue plaguing industrial field painting projects. The implementation of the plan is simple: install each component as indicated in the approved drawings and begin working. Nonetheless, an often-unasked question remains – how efficiently can a worker access the structure to perform their duties under the approved plan? Is work able to be performed effectively and efficiently from the given method of access?

Having worked directly off of pick boards and out of spider lifts, this author can provide a unique perspective with regards to worker efficiency. Often times, the easiest method of installation does not equate to the most efficient form of access. Picks, cables and spider lifts may be much easier and less time consuming to install, but can prove to be very cumbersome to work from. More often than not, though, the use of these particular access methods complies with the two main concerns with regards to containment plan review – safety and environmental protection – and are often implemented as a result.

With efficiency, however, usually comes quality. One should tend to consider a little more carefully how effectively a worker can utilize the intended access. Is the operator (or inspector, for that matter) able to see the top of the diaphragm or the back of the bearing? Does the worker have to carry a board to place in between the two bottom flanges of a bay to access the corners of the x-brace? How will the blast operators change shields? Where will they hang their hose at break time? How do they get up and down? Is the inspector comfortable inspecting from these platforms? How many dozens of times do the picks need to be slid up and down the cables to perform inspection of the entire blast? Is one going to hear, "blasting off of picks is frightening and I can't get to that spot because of it"?

A full platform may be more difficult, expensive and time consuming to install on the structure to be blasted. But if one is to seriously consider the efficiency of work from the platform, maybe the time and expense can be recouped in a hurry. Blasting is simpler when the operator doesn't have

to constantly and deliberately consider his or her footing. Inspection is much simpler when the picks don't have to be slid in 5-foot increments along a 200-foot blast. Touch-up blasting and coatings application are much simpler and efficient when the man-lift doesn't have to be maneuvered about for hours on end to avoid structural elements. Ultimately, a higher quality job is achieved more expeditiously when the worker doesn't have to strain to see or perform acts of acrobatics to blast a particular area.

Some may view this as an issue that doesn't require immediate attention or serious consideration. One can guarantee, though, that these types of worker access will continue to be used all over the planet, and complaints will continue to be ushered up at the lack of quality and efficiency. Deadlines will be missed, schedules conflicted, time lost, money lost, material spent and un-reclaimed and, most of all, workers will continue to operate in unsure conditions until this is seriously considered.

Conclusion

Quickly considered here are three pertinent issues with regards to surface preparation in the field. Honest, earnest and open discussion of abrasive selection, the existing condition and worker access before a project's inception can help to ensure conformance with project documents, save time and money and allow for confident, expeditious working. While each project will present its own unique challenges and solutions, hopefully awareness of the constant and persistent nature of these issues can help to mitigate the loss of time and money on your next industrial painting project.

About the author...

Jared Rigo is coatings operations manager in the construction division of HRV Conformance Verification Associates, Inc. located in Pittsburgh, PA. He has nearly 10 years of coatings application experience and quality inspection expertise in structural steel bridge members, tanks and railcars. Rigo is a NACE-certified Coating Inspector (Level 3) and an SSPC-certified Protective Coatings Specialist (PCS), and is a certified trainer for SSPC's C3 and C5 courses. He holds a B.S. in chemistry from Saint Vincent College in Pennsylvania.

Pipeline failure investigation: is it MIC?

This article was originally published in the January 2019 issue of Materials Performance.
Reprinted with permission from NACE International.

By Richard B. Eckert, DNV GL USA, Inc., Commerce Township, Michigan, USA and Torben Lund Skovhus, VIA University College, Horsens, Denmark

The investigation of pipeline corrosion failures, including those caused by microbiologically influenced corrosion (MIC), requires multiple lines of evidence to identify causative mechanisms and contributing factors. The types of evidence needed for the corrosion analysis include information about the design and history of operation of the asset; the physical, environmental, and metallurgical conditions present where corrosion is observed; and microbiological conditions. Next, this information is integrated and analyzed to assess whether biotic or abiotic processes were responsible for the failure. While the ability to diagnose MIC in the oil and gas industry is improving, practical limitations associated with sample collection in remote locations or from inside pipelines still present challenges to conclusively determine the cause.

Failure investigation and root cause analysis are useful tools to pipeline operators who are seeking ways to optimize performance, control costs, and reduce risks. In the United States, regulated gas and liquid hydrocarbon pipeline operators are required to maintain incident investigation procedures as a part of their operations and maintenance manual. The incident investigation procedures are normally viewed as being applicable only in the event of significant incidents as defined under federal codes[1-2] rather than for all corrosion findings.

Understanding why internal or external corrosion has occurred (beyond the investigations performed after major incidents) is important for optimizing mitigation and prevention measures, and generally worth the minor investment required. The degree of analytical rigor can be proportional to the severity of the corrosion or the level of risk associated with the asset. Whenever corrosion is found on a pipeline, an opportunity presents itself to understand the mechanism causing the corrosion and the contributing factors that supported it. Such an understanding increases the ability to manage the threat of corrosion in the future and extension of asset life.

While there are many potential pipeline corrosion mechanisms, they can be generally divided between biotic (caused or promoted by microorganisms and/or their activities) and abiotic (corrosion in the absence of any direct microbiological contribution). Abiotic mechanisms, for example, include corrosion of steel in an electrolyte in the presence of dissolved carbon dioxide (CO_2), hydrogen sulfide (H_2S), or oxygen. The definition of biotic corrosion is more complicated because microbiological activities may be intertwined with chemical/electrochemical processes that cause corrosion. Biotic and abiotic processes are also affected by complex transformations of chemical species that have growth, inhibitory, or synergistic effects on biotic activities that cause microbiologically influenced corrosion (MIC).[3]

MIC analysis process

While there is a lack of industry consensus procedures specifically for MIC failure investigation, there is some helpful guidance available.

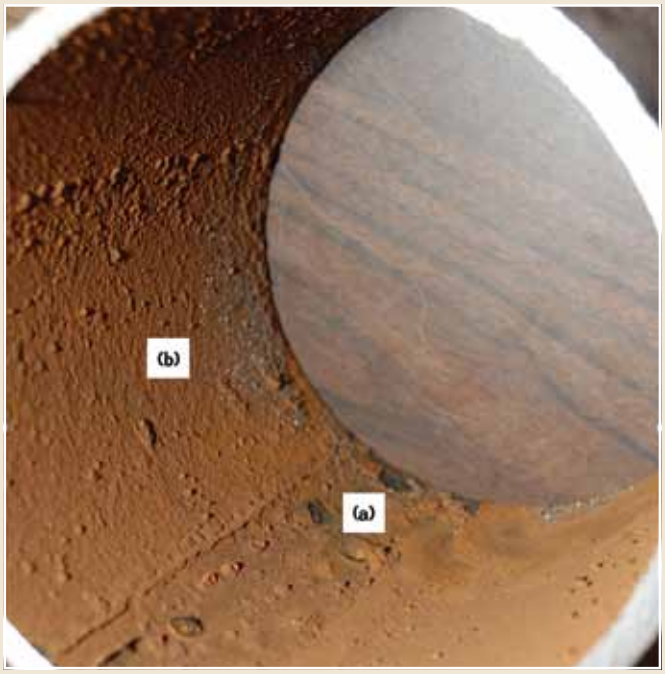

Figure 1: Deposits inside a 6-in (152.4mm) nominal diameter pipe sample, showing locations where comparative samples could be collected for chemical and microbiological analysis: (A) a corrosion pit beneath deposits and nodules in a "channel" of deposits about 2-in (51mm) wide at the 6:00 position in the pipe, and (B) an area on the side wall of the pipe that is above the "channel" of deposits on the bottom of the pipe.

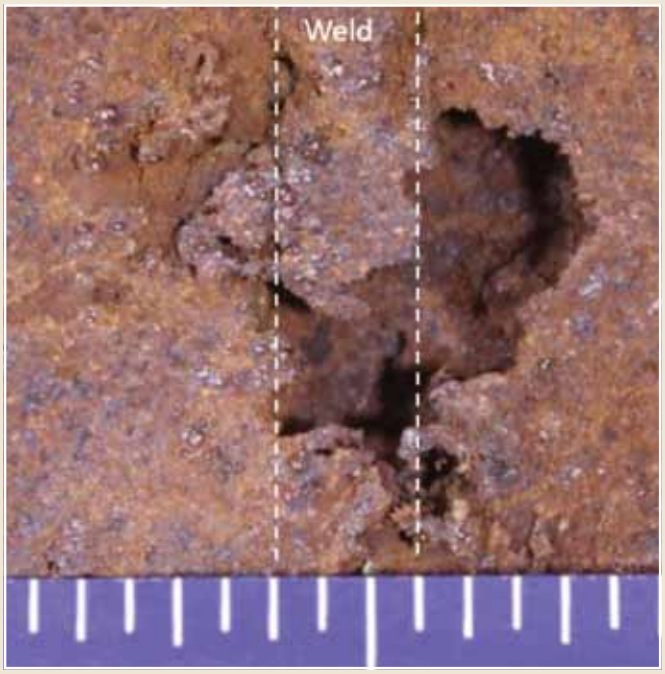

Figure 2: Sample showing localized internal corrosion located at a girth weld in a pipeline carrying water-saturated natural gas with 10 to 50 ppm of H_2S. After removal from the pipeline, the sample was left exposed outdoors, causing oxidation of the surface and alteration of the corrosion deposits such that no sulfur could be detected by compositional analysis.

For example, NACE TM0212[4] for internal MIC and NACE TM0106[5] for external MIC of pipelines provide information about sampling and test methods that can be used to support corrosion investigations.

ASTM G161-00[6] provides a useful overview of the corrosion failure analysis process and a checklist that can be used when collecting information that will be used to support the corrosion failure analysis, as do the appendices of the two aforementioned NACE standards.

Samples are essential

Sampling and preservation of biofilms from inside an operating pipeline is difficult. Removable devices, such as coupons or spool pieces,[7] provide representative surface samples if the removable devices are located properly or if a removed section of the pipeline is prepared and transported correctly. Samples should be:

- Collected using sterile tools and placed into the recommended containers
- Collected as soon as possible after exposure to atmospheric conditions to avoid changes to corrosion products and consortia of microorganisms
- Protected from contamination and stored/shipped under recommended conditions to avoid degradation/ alternation

Sampling can be performed to provide material to characterize the liquid phase, layers of deposits and biofilm on the metal surface, and the corroded metal surface itself. It is helpful to collect samples from corroded and uncorroded locations on the same sample, and from multiple locations for comparison. An example is shown in *Figure 1*; the deposits in the pipe sample have a reddish color due to oxidation from the atmosphere of iron compounds that are present.

Since most crude oil, gas, and products pipelines operate with little or no oxygen present, exposing the corrosion products to air before sampling can change the mineral composition of the deposits. *Figure 2* shows an example of this, where a pipe section with internal corrosion near a girth weld was left uncovered outside for several days before samples could be collected. Although the pipeline carried water-saturated natural gas with 10 to 50 ppm of H_2S, no sulfur or iron sulfides were found in the corrosion deposits. Exposure to air and dehydration also affected any biofilm that would have been present, hampering the ability to understand if microorganisms were involved in the corrosion.

Typically, samples for microbiological laboratory analysis are shipped in an

Functional Group	Chemical Species Essential for Growth	End Products
Acid producers	Organic carbon compounds, hydrocarbons, oxygen	Organic acids
Nitrate reducers	Nitrate, nitrite, nitrogen, oxygen	N_2, NO_2, NO
Iron reducers	Ferric iron, sulfur, oxygen, nitrate	Soluble ferrous iron
Iron/manganese oxidizers	Ferrous iron in solution, Mn^{2+}	Insoluble ferric iron
Sulfur oxidizers	Elemental sulfur, sulfate, thiosulfate, CO_2, oxygen, organic compounds	Sulfuric acid (H_2SO_4)
Sulfate reducers	Alcohols, organic acids, H_2, sulfate, elemental sulfur, thiosulfate	Sulfide
Methanogens	CO_2, carbonate, bicarbonate, H_2	Methane, CO

Table 1: Examples of functional groups of microorganisms, chemical species essential for growth and end products.

Method	Method Based On	Measurement Principle
Adenosine triphosphate (ATP)	Enzyme assay	Quantification of ATP through enzymatic light reaction
Flow cytometry	Laser-based biophysical technology	Automated counting of fluorescently labeled cells in a stream of fluids
qPCR	DNA amplification (PCR)	Real-time quantification of specific genes (DNA) of interest from live and dead target organisms
Microbial community analysis (Speciation)	DNA amplification (PCR) and sequencing of DNA amplicons	Amplified and sequenced 16S rRNA genes are compared to public databases to identify microbial Genera, Phyla, and Species

Table 2: Example of different microbiological methods described in NACE TM0212-2018.

insulated box or portable cooler with ice packs and delivered within 24 h whenever possible to a specialist laboratory. Other preservation methods are sometimes used when samples cannot be shipped overnight. In Norway, Equinor,[8] for example, used 100-mL volume screw top glass bottles and a lid with two hose connections to purge the bottle with inert gas (nitrogen) after sampling solid deposits and pigging debris. This approach also helped to keep oxygen from changing the corrosion products. ASTM E1492-11[9] is a resource that provides practices for receiving, documenting, storing, and retrieving samples for laboratory analysis.

Chemical analyses

Chemical composition information is desirable for samples such as:

- Liquid (water) phase
- General surface deposits
- Corrosion products removed from isolated pits
- Deposits collected from on top of or beneath coatings
- Surface films adhered to the metal surface.

For corrosion failure analysis, it is common to cut the metal specimen into smaller samples that can be prepared as metallographic cross sections or placed directly in a scanning electron microscope for energy dispersive x-ray spectroscopy, or other techniques that allow compositional analysis of the deposits in situ. Corrosion products are often analyzed using x-ray diffraction to characterize the composition of the crystalline phases present, such as corrosion products (iron sulfides, iron oxides, etc.).

API 45, "Recommended Practice for Analysis of Oilfield Waters,"[10] is a useful resource that describes the types of analysis that can be performed on aqueous samples to characterize cations, anions, and other parameters that are relevant to corrosion.

The chemical composition of the environment, including the pH, salinity, organic carbon sources, and chemical species usable by microorganisms, is determined to help identify the types of microorganisms that could grow in that environment. *Table 1* shows some examples of functional groups of microorganisms, the chemical species needed for growth, and some typical end products produced because of their metabolism. The metabolism of microorganisms is dependent on the availability of water, an energy source (electron donor), carbon source, nutrients, and electron acceptors (e.g., oxygen, sulfate, nitrate, iron (III), or CO_2).[3]

Microbiological analyses

The environment present where corrosion is occurring and the most prolific members of the active microbial consortia often reflect one another. Microorganisms exist under wide ranges of temperature, water activity, salinity, pH, and oxygen conditions, and can use many substrates for growth. However, functional groups for which the environment is optimal for growth will tend to dominate. The use of molecular microbiological methods (MMM) can help provide insights for diagnosis of MIC.

Generally, microbiological characterization is focused on determining the diversity, abundance, and activity of the various microorganisms present in a sample. It is not enough to know only "who" is there and "how many," but also their activity level. Genetic methods, such as next-generation sequencing, may identify hundreds of different types of microorganisms to be present in a sample, but many may be in a dormant stage – waiting for episodic events when conditions change to their advantage.

In NACE TM0212, *Table 2* provides a very useful resource for comparing the benefits and limitations of several microbiological methods; a short example of the list of methods is shown in *Table 2*.

One of the challenges that industry has faced with implementing MMM is that data from different labs may not be comparable

because of differences in the methods used. A group of NACE International members is working in Task Group (TG) 561 to establish standards to promote consistency in the molecular analytical methods used by different labs, specifically with regards to sampling/transportation, DNA extraction, and the primers used in quantitative polymerase chain reaction (qPCR) methods and sequencing.

Data integration

The need for using multiple lines of evidence to diagnose MIC has been an industry mantra since the 1980s, and it continues to be relevant today. Longstanding MIC experts Jason Lee and Brenda Little, FNACE recently wrote a chapter on MIC analysis, identifying these requirements for an accurate diagnosis:[11]

1) A sample of the corrosion product or affected surface that has not been altered
2) Identification of a corrosion mechanism that is consistent with the vulnerabilities of the material being examined
3) Identification of microorganisms capable of growth and maintenance of the corrosion mechanism in the particular environment
4) Demonstration of an association of the microorganisms with the observed corrosion.

The objective is to have three independent types of measurements (metallurgical, chemical, and microbiological) that are consistent with a mechanism for MIC.

Some questions that may be helpful to consider when integrating MIC failure analysis data are as follows:

- What differences in the types and numbers of microorganisms were observed between corroded vs. uncorroded areas?
- Does the chemical environment that was present include the necessary chemical species for the groups of microorganisms that were identified?
- Are there chemical indicators (sulfides, organic acids, etc.) that could be indicative of activity of specific groups of microorganisms?
- Which microorganisms are capable of growth under the conditions of pH, flow, temperature, oxygen levels, and salinity present in the environment?

More information on MIC failure analysis

There are many publications and technical events where more can be learned about MIC failure analysis. Industry case studies and examples of failures from the field can be helpful in demonstrating how MMM are used in MIC failure analysis.[12-13]

The NACE Northern Area Western Conference is holding a half-day forum on "Assessment of Microbiologically Influenced Corrosion (MIC) Threats and Failures: Approaches and Challenges," as a part of its conference on February 7, 2019, in Calgary, Alberta, Canada.

A forum will be held at CORROSION 2019 in Nashville, Tennessee, USA: "Update on Latest MIC Developments in Onshore and Offshore Oil and Gas." Multiple symposia and TG meetings on MIC will also be held throughout the week.

Another venue for more information is the 7th International Symposium on Applied Microbiology and Molecular Biology of Oilfield Systems (ISMOS-7) that will take place on June 18 to 21, 2019 in Halifax, Nova Scotia, Canada.[14]

More MIC guidelines, models, and technologies will be among the deliverables from the project, "Managing Microbial Corrosion in Canadian Offshore and Onshore Oil Production," which received $7.9 million in funding through Genome Canada.[15]

References

1. U.S. Code of Federal Regulations (CFR) Title 49, "Investigation of Failures," Part 192.617 (Washington, DC: Office of the Federal Register).
2. U.S. Code of Federal Regulations (CFR) Title 49, "Operating Procedures," Part 195.402(c) 5 (Washington, DC: Office of the Federal Register).
3. A. Ibrahim, K. Hawboldt, C. Bottaro, F. Khan, "Review and Analysis of Microbiologically Influenced Corrosion: The Chemical Environment in Oil and Gas Facilities," *Corrosion Engineering, Science and Technology* 53, 8 (2018): pp. 549-563.
4. NACE TM0212-2018, "Detection, Testing, and Evaluation of Microbiologically Influenced Corrosion on Internal Surfaces of Pipelines" (Houston, TX: NACE International, 2018).
5. NACE TM0106-2016, "Detection, Testing, and Evaluation of Microbiologically Influenced Corrosion on External Surfaces of Pipelines" (Houston, TX: NACE, 2016).
6. ASTM G161-00, "Standard Guide for Corrosion-Related Failure Analysis" (West Conshohocken, PA: ASTM International, 2018).
7. T. Skovhus, R. Eckert, E. Rodrigues, "Management and Control of Microbiologically Influenced Corrosion (MIC) in the Oil and Gas Industry—Overview and a North Sea Case Study," *J. of Biotechnology* 256, 8 (2017).
8. V. Eroini, H. Anfindsen, A.F. Mitchell, "Investigation, Classification and Remediation of Amorphous Deposits in Oilfield Systems," SPE-173719, SPE International Symposium on Oilfield Chemistry, Society of Petroleum Engineers (London, UK: SPE, 2015).
9. ASTM E1492-11 "Standard Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory" (West Conshohocken, PA: ASTM, 2017).
10. API 45, "Recommended Practice for Analysis of Oilfield Waters" (Washington, DC: API: 1998).
11. J. Lee, B. Little, "Diagnosing Microbiologically Influenced Corrosion," *Microbiologically Influenced Corrosion in the Upstream Oil & Gas Industry*, T.L. Skovhus, J. Lee, D. Enning, eds. (Boca Raton, FL: CRC Press, 2017).
12 F.M. Al-Abbas, "MIC Case Histories in Oil, Gas and Associated Operation," *Microbiologically Influenced Corrosion in the Upstream Oil & Gas Industry*, T.L. Skovhus, J. Lee, D. Enning, eds. (Boca Raton, FL: CRC Press, 2017).
13. R. Eckert, *CorrCompilations: Introduction to Corrosion Management of Microbiologically Influenced Corrosion* (Houston, TX: NACE, 2015).
14. ISMOS-7: http://www.ismos-7.org.
15. Project web page for "Managing Microbial Corrosion in Canadian Offshore and Onshore Oil Production," http://www.geno-MIC.ca.

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SATactics 12 years on...

Simple Active Tactics (SATactics), celebrating over 12 years serving the corrosion protection industry, is a Cape Town based company, specializing in the manufacture and distribution of granular abrasives for the surface preparation and coatings industry.

Manufactured products include recycled steel abrasives and crushed glass media. The company also has an impressive range of locally sourced steel and stainless-steel abrasives and offers an expendable blasting grit, through an associated company, Ecoworks Industrial Products, trade named Ecoblast®.

RECYCLED STEEL ABRASIVES

SATactics, has established a plant in Atlantis, Cape Town, specifically designed to recycle steel abrasives. The operation uses spent steel shot as a raw material to produce a range of commonly used sizes of both grit and shot. Prior to the operation being established, spent steel shot was costly to dispose of in "hazardous" waste sites designed for metallic waste. Recycling steel shot waste streams offers a saving to the waste generators and an opportunity to add value to recovered materials.

New steel shot used by foundries (1.5 – 2.5mm) either fractures in use or is simply worn down to a smaller size reaching a point at which it is no longer economical to use to clean iron castings. The broken or worn shot is automatically removed from the shot blasting equipment and sent to a waste stream along with other waste products.

The waste stream is meticulously cleaned using a dry, double drum magnetic separator which removes all non-magnetic (silica sand) and partially magnetic material (chrome sand). The pure metal extract from the process yields a highly cost-effective range of steel shot and grit, sized and bagged according to industry requirements whilst the non-magnetic products are further processed for resale back into the foundry industry and for general applications..

The most popular of the company's recycled products are two general blasting grades, "A" Blast (size equivalent G40/G25/S280) and "J" Blast (size equivalent G50/G80) which offer outstanding value compared with new steel grit. The

main demand for these products is coming from general blasting yards that previously used and recycled expendable slag abrasives in a semi-recoverable environment. Sat-Steel not only offers an almost dust free blasting environment but having the durability of steel versus slag, the products can be used many times over.

The steel products processed are also sold into diverse markets including metal refining (as a source of iron), the ferro alloy industries, ballast for offshore drilling rigs and water treatment chemicals in the production of ferric sulphate and ferric chloride.

CRUSHED GLASS ABRASIVE AND FILTRATION MEDIA

Inspired by the unique availability of clean, virgin plate glass off cuts from the industrial and commercial glazing industry in the Cape Town area, SATactics set up a glass recycling plant in addition to the steel plant at Atlantis. The plant produces swimming pool filtration media (Crystal Sands®), Glass WhizDom® abrasive blasting media, fillers for paints, polyurethanes and epoxies and media for decorative applications. A key success factor to crushing glass is to find a balanced market to which all products produced can be sold. Markets for glass media are therefore necessarily diverse. Made from virgin (predominantly clear) glass, Glass WhizDom® is typically very low in soluble salts, desired for abrasive blasting media and as a non-ferrous abrasive, is finding applications for blasting of stainless steel, weld seams prior to nondestructive testing in refineries and aesthetically pleasing finishes on new equipment manufactured by stainless steel fabricators.

Glass WhizDom® abrasives are produced in 3 standard grades, #80 (very fine), 40/60 and 20/40. The product should not be confused with imported glass beads (round, not angular), unable to be manufactured in South Africa due to exorbitant energy costs. However, glass grit is proving to be a worthy and highly competitive substitute for some glass bead applications at a fraction of the cost. cleaning efficiently and providing satin smooth finishes. The finest grade (#80) is commonly used in wet blasting equipment, ideal for removing graffiti, removing paint from cars or any thin metals, road marking removal, roof cleaning, building restoration and any application requiring an iron free abrasive.

The operation diverts over 100 tons per month of glass, previously sent to landfill which is now converted to industrial products.

STEEL AND STAINLESS STEEL SHOT AND GRIT

SATactics offers steel and stainless-steel shot and grit, manufactured locally. Markets for stainless steel abrasives are highly specialized and the company has assisted various clients to convert their operations to using stainless steel in favour of less economic alternatives such as glass beads and aluminium oxide. Stainless steel abrasives are expensive and are only economical provided that recovery systems are effective often requiring high initial capital cost to convert but with good long term savings and a cleaner, dust free working environment.

ECOBLAST®

Through associated company, Ecoworks, and now over ten years in the making, Ecoblast® is a high-performance expendable abrasive, likened to garnet due to its similar physical and chemical properties and performance. Ecoblast®, available and proven in the local market, enjoys approvals from all major paint companies at well as international oil companies for use on major contracts. Distribution contracts have been concluded with partners in Malaysia, Saudi Arabia, United Arab Emirates, South Korea, Bangladesh and Indonesia. Expansions to plant capacity are already taking place to meet rapidly growing demand.

RECYCLING FOR A SUSTAINABLE, CLEANER PLANET

Simple Active Tactics aims to be South Africa's leading supplier of granular abrasives utilizing local resources in an environmentally friendly way, reducing consumption, recycling waste materials and re-using recyclable products in a responsible and sustainable manner.

The reduction of landfill waste by recycling is on the rise in South Africa as environmental regulations seem to become more stringent every day for businesses, and government departments begin to clamp down in this area. SATactics is passionate about reducing waste and recycling. The operations at Atlantis are fully compliant with the Waste Management Act and carries approval from the Department of Environment Affairs

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For further details contact SIMPLE ACTIVE TACTICS on + 27 (0)21 789 1884 or Charles Dominion directly on 082 7796 071, email: chuck@satactics.co.za or visit www.satactics.co.za [Factory address on google maps] [See advert on back cover]

Digging in for tunnel durability

Tunnels that carry road, rail and utility services are usually built to minimise the cost and time it takes to move people, freight and services around a city or country. Many are built underground or through mountain ranges in order to minimise the cost of going over or around them. The longest road tunnel in the world is currently the Laerdal Tunnel near Bergen in Norway and the longest rail tunnel is the Gotthard Tunnel that was bored through the Swiss Alps.

New Zealand's longest tunnel is the nine kilometre long Kaimai rail tunnel near Apata. In Australia, both the longest road and rail tunnels are part of high speed links to airports: rail in Sydney and road in Brisbane.

Tunnels, however, are not a modern idea; they have been an important part of public and private infrastructure for millennia. Archaeological digs through Roman ruins have uncovered evidence of tubular brick- and tile-lined hypercausts and aquifers running beneath towns and roads.

Tunnels are mostly of two types of construction. The less expensive method is referred to as "cut and cover" where a trench is dug and the road or rail or services are installed. A roof is then placed over the trench and the ground reinstated and landscaped. The alternative is to manually or mechanically dig through rock and soil and then line the inside of the tunnel with concrete for strength and stability. The road, rail or services are built or installed behind the advancing end of the tunnel.

A common design for modern tunnels is to use a boring machine to dig through the ground substrate. The development of large, mechanical machines in the mid-20th Century, simplified construction of underground tunnels. Initially, the concrete linings were cast in situ behind the excavating machine head as it worked its way slowly forward. Today, pre-cast reinforced, high-strength concrete panels are delivered to site and mechanically placed around the circumference in an interlocking pattern. Such a method is vastly different to that employed in the construction of London's 'Tube', where many of that network's older tunnels are beautiful, hand-built, brick lined constructs.

Rob Kilgour, Principal Engineer for Materials Technology at WSP – a leading global engineering consultancy, whose role covers durability planning and material selection for new projects stated that the use of pre-cast concrete panels greatly improved quality assurance as the pieces were prepared under controlled, factory conditions.

As a tunnel is dug, a water-resistant lining system is installed to provide structural support and waterproofing. The concrete elements may be either in situ or pre-cast panels. Polymer membranes may be placed prior to installing the concrete lining – typically an approach used for cast in place linings. Where precast segments are used, a rubber gasket is used to prevent water ingress between the segments. The gaskets are made from ethylene propylene diene monomer (EPDM) rubber.

Kilgour added that it is not just the physical route that has to be checked. "When we build through brownfield sites it is essential to conduct a thorough analysis of the soil to check for contaminants," he said. "Hydrocarbons often leak into the ground around and under industrial plants and petrol stations which can damage waterproofing membranes and the rubber seals between concrete segments."

Building under a large modern city – such as Melbourne, Auckland, or Dubai – presents many challenges to the construction company delivering the project. The route must be carefully planned so as to avoid other infrastructure such as pipelines for gas, water and other utilities, building foundations and existing transport tunnels. When the Victorian government approved the underground rail tunnels and stations in Melbourne in the 1970s, planning the route had to take the railway deep enough to avoid much of the infrastructure and around or through the footprint of some the city's tallest buildings. The challenge of avoiding existing transport tunnels was highlighted in the English Crossrail project when the excavating and concrete handling equipment passed just 450 mm above the roof of a platform of one of the Tube's largest and busiest stations.

One project Kilgour worked on was the underground metro train system in Dubai. "We carried out a baseline survey of all the buildings in the oldest parts of Dubai to make sure that we could prove that the tunnelling works did not cause any damage to buildings and property adjacent to the route."

Waterview tunnel under construction, ©WSP.

The different types of tunnelling systems are very dependent on the nature of the ground conditions.

Tunnelling through sand presents different challenges to those encountered when working through mud and rock. "A variety of techniques can be used in terrain that is soft," Kilgour stated "These include techniques such as ground freezing or emulsification that increase the density of the ground and allow excavation and construction of the tunnel lining to be completed before the ground softens again."

To this day, one of the greatest tunnel engineering feats is the nearly 2 000 kilometres of sewers that were dug by hand under London almost 160 years ago. Designed by Joseph Bazalgette in the mid-19th Century, the system remains a masterpiece of Victorian engineering. There are approximately 132 kilometres of main sewer where the diameter is large enough for a man to comfortably walk upright in them; while public tours were stopped decades ago, if you know the right people, it is still possible to be taken into the tunnels beneath the busy streets of central London.

Today, infrastructure requirements often call for a life expectancy of 100 years, so durability planning is starting to be incorporated into the whole design process. According to New Zealand-based Les Boulton, a Consultant to the Nickel Institute, this was not always the case. "During much of the 20th Century, it was often the case of constructing a project as cheaply as practical and letting others worry about paying for the maintenance."

In the past, little thought was given to materials selection for durability or the potential impact this may have for the asset owners in terms of ongoing maintenance costs, . This resulted in a modest construction cost but very expensive continual monitoring. Too often it was a matter of putting up with a repeating cycle of repair and replace after a structure had been built.

Boulton added "However, engineering graduates are now being taught – and then putting into practice – the concept of lifecycle costing." Durability planning provides a method for assessing performance requirements specific to the prevailing exposure environment and required design life and controlling material selection so that the appropriate strength and grade of materials are procured and used for construction.

"In modern road and rail tunnels there is a large amount of machinery and equipment that the users rarely notice." This equipment includes large jet fans that circulate the air in the tunnel, fixed and interactive signage, as well as the trays and brackets supporting service ducts and cables. All inaccessible or unmaintainable equipment and attachment points must be designed to last up to 100 years. According to Boulton, designs call for stainless steel to be used for casings and fixings.

Waterview tunnel – complete, ©WSP.

Pipes for a range of services and utilities as well as servicing tunnels and large stormwater drains are often placed under the road or rail deck, in the space referred to as the "tunnel invert."

Most tunnels – rail, communication, utility or service – are usually bare concrete because owners don't value aesthetics. "Road tunnels are often painted or tiled to give a pleasing pattern that breaks up the monotony of the view for drivers," added Boulton.

Safety has also contributed to the move away from cheaper project options. A multi vehicle crash deep inside one of the many tunnels through the Swiss countryside in the 1980s resulted in many deaths and a fire that burned for a number of days. The insides were made of steel with a corrosion protection coating.

Carbon steel starts to yields at 350 degrees Celsius at which point structures can start to fail under their own weight. "You can't get excellent durability and strength from steel and paint," Boulton said. "Everyone involved has to sign up to the planning for durability and safety." In contrast, stainless steel can withstand temperatures of 1000 degrees Celsius.

Specifying corrosion resistant stainless steel is more expensive as a construction cost, but greatly reduces the ongoing maintenance costs. "Specifying durable materials has been slow to be adopted because maintenance traditionally is treated as an expense and is accounted for differently," said Boulton.

To support industry, the Australasian Corrosion Association (ACA) works with private companies, organisations and academia to research all aspects of corrosion such as rubber degradation from hydrocarbons. The ACA provides an extensive knowledge base that supports best practice in corrosion management, thus ensuring all impacts of corrosion are responsibly managed, the environment is protected, public safety enhanced and economies improved.

Latest advancements in corrosion mitigation revealed at Corrosion & Prevention Adelaide – November 2018

Corrosion & Prevention 2018 was recently held at the Adelaide Convention Centre.

The largest corrosion conference and exhibition in the Southern Hemisphere, Corrosion & Prevention 2018 was recently held in Adelaide. More than 500 delegates attended the conference from a broad range of industries including protective coatings, water, defence, building and construction, mining, oil & gas, cathodic protection, power and more. Attendees from Australia and all over the world attended the lectures, seminars and workshops.

Corrosion continues to have a major economic impact on industry and the wider community: it is estimated that governments and organisations spend approximately three percent of GDP – the equivalent of billions of dollars each year – mitigating and repairing corrosion damage.

The first plenary was presented by Miles Buckhurst, Global Concept Director, Jotun and was titled 'The Circular Economy from Paint Manufacturer's Point of View'. The circular economy is a philosophy to help reduce the impact on the environment whilst still managing to carry on our full and demanding lives with little compromise. Miles explained that in the modern world, we have got used to considering the environment around us and most people would wish to do all we can to protect it. The circular economy is a way of thinking and behaving that will ultimately allow industry and us all to continue our lives and businesses in a positive way, reducing and eventually eliminating our impact on the environment we live in. It is not simply saying 'stop' but even providing jobs, profit and a long term future in all aspects of business including oil, gas and chemical sectors and well beyond.

The focus of the conference was the safe and effective management of the continuing challenge posed by corrosion.
The PF Thompson Lecture, was delivered by Professor Brian Kinsella, Deputy Director Applied Corrosion Research and Testing, Curtin Corrosion Engineering Industry Centre at Curtin University. The presentation detailed how to address several critical issues on the mechanism of CO2 corrosion and its inhibition. The PF Thompson Lecture commemorates the work of corrosion science pioneer, P F Thompson, and has been delivered every year at the ACA's annual conference since 1951.
Corrosion and Protection 2018 provided the ultimate venue for corrosion stakeholders to meet and discuss a wide range of topics. The diverse technical streams showcased the latest developments in corrosion prevention, management and mitigation.
The event also featured a trade exhibition with more than 60 exhibitors showcasing the latest products and services. The range of exhibitors included materials suppliers, equipment vendors, specialist contractors and consultants. The exhibition provided a valuable opportunity for corrosion professionals, interested parties and the general public to meet with the exhibitors. There was also a learning centre for exhibitors to showcase a product and give those interested the chance to ask questions and be hands on over the lunch break period.

As part of the conference, there was an Applicator Trade Day that was presented by the ACA and BlastOne International. Attendees were able to visit the BlastOne site and experience demonstrating mist and vapour blasting equipment, traditional blasting equipment, spray equipment, dust collector and vacuload and interceptor training.

"There was a great response to the free trade exhibition with over 140 people attending. The Learning Centre, Applicators Forum and BlastOne site visit, were all well attended and provided the opportunity for participants to experience the products first-hand and ask questions about their own specific application challenges," explained Tracey Winn, Marketing and Communications Manager at the ACA.

The ACA Foundation is committed to advancing corrosion mitigation through education by providing scholarships, bursaries and awards for academic excellence. An exciting new corporate sponsorship by Denso Australia was announced at the conference.

In announcing the sponsorship, Paul Fortune, CEO, Denso Australia, said, "In honour of David Winn OBE, it is with great pride that Denso Australia confirms its sponsorship of an educational scholarship aimed at developing the skillset of ACA members through the ACA Foundation.

The scholarship, named the Denso Award will contribute to the development of ACA Members' skills through sponsorship of

recipients' ACA or NACE training courses and conference attendance. In total, Denso Australia has committed $50,000 to be made available to members over the next 5 years, with $10,000 dollars awarded annually to winners whom will be selected by an independent panel of judges."

Co-founder of Denso Australia, David Winn OBE, has been a passionate supporter of the ACA for more than five decades. Starting with the very first Denso Australia advertisement published in the ACA's flagship publication, Corrosion & Materials back in 1968, David has been a committed contributor to the success of the ACA, playing a key role in the association alongside other Denso employees. Denso Australia have also been a regular sponsor of the ACA's annual dinner and continues to attend and exhibit at the ACA's Annual Corrosion and Prevention conferences. David has personally attended in excess of 45 ACA conferences, representing the company he co-founded with Bill Rogers fifty years ago.

In Australia, the yearly cost of asset maintenance is estimated to be approximately $32 billion, with $8 billion attributed to avoidable corrosion damage, according to a report commissioned by NACE, the international body for professional corrosion engineers.

The annual Corrosion and Prevention Conference is just one aspect of how the ACA collaborates with industry and academia to research all aspects of corrosion mitigation in order to provide an extensive knowledge base that supports best practice in corrosion management, thereby ensuring all aspects of corrosion are responsibly managed, the environment is protected, public safety enhanced and economies improved.

Corrosion and Prevention 2018 brought together corrosion practitioners and researchers, as well as asset owners and operators, from around the world in order to promote a better understanding of corrosion mitigation.

The ACA's Corrosion and Prevention conference has earned the enviable reputation as the premier corrosion event in the Asia Pacific region, attracting delegates from all over the world. Save the date for next year's conference: Corrosion and Prevention 2019 will be held at Melbourne's Crown Exhibition Centre, 24-27 November 2019.

Veracruz Port parking garage – import and export needs

VERACRUZ PORT, VERACRUZ, MÉXICO
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Emmanuel A. Ramirez G. (Technical Services, Mexican Galvanizers Association: AMEGAC).

The Mexican Galvanizers Association (AMEGAC) is a non-profit association established in April, 1998. Its aim is to serve our members as the main HDG promoter in Mexico and lately provide technical support to our members and HDG steel users in order to encourage the use of HDG steel in Mexico. The technical department was created in 2016 and one of the objectives is to strengthen relations with researching institutes and Mexican universities. Therefore, we have come to understand the importance of the following goals:

1. There must be science-based support in order to promote the use of hot dip galvanized steel.
2. Along with this, the practice of hot dip galvanization must be standardized.
3. Lastly, collaboration among worldwide associations must be encouraged, with the goal of creating a strong, science-based bank of the most common scenarios in galvanizing plants.

For these goals to become attainable, two steps must be taken:

1. Research on behalf of the hot dip galvanizing sector must be promoted.
2. The use of hot dip galvanized steel must be fostered among many sectors and currently, our priority: THE CONSTRUCTION INDUSTRY.

Targeting the above-mentioned points, we have constantly broadened our knowledge base and continually find relevant scientific information in the hot dip galvanizing sector. We have also suggested new methods of improvement for our industry along with environmental alternatives so necessary in today's sustainable development framework.

Through our interactions with Universities, Mexican Construction Chamber (CMIC), International Associations, among others, we have shared the technical information needed to convince our audiences that Zinc is the best option to protect steel against corrosion, hence promoting the use of hot dip galvanized steel.

We work actively for our members in Mexico and in November (during IZA-LatinGalva 2018, Lima, Peru) last year, we came to an agreement with other Latin-American HDG Associations and institutions, sharing the technical information and new researching developments generated in our countries. This will undoubtedly be on behalf of the sector in the Spanish speaking countries in America. In Mexico there are around about 40 HDG facilities. Our members include Mexican galvanizers, foreign galvanizers and different product and equipment suppliers from different parts of the world.

When not taken into account, corrosion can amount to substantial economic loses for a country. Because of this, it is imperative to evaluate the physical features and the lifetime of the steel infrastructure in Mexico. Consequently, it is necessary to also gauge the best way to protect steel against corrosion for a long period of time. Hot dip galvanized steel offers extended protection against corrosion and generates less expense due to upkeep since the maintenance will be performed several times less than other coatings.

One of our members: MetalyZinc S.A. de C.V. has been actively promoting the use of HDG steel in Veracruz due to the fact that the corrosion in that state, and more specifically in Veracruz Port is an issue that must be solved. Some of the steel utility poles, for example, don't last more than 6 months without significant signs of corrosion.

In 1989, to fight long and very long term substantial damage caused by corrosion of steel and other metals along the entire coast of the Gulf of Mexico, GRUPO COBOS, a pioneer since 1934 of batch galvanizing in Mexico, created MetalyZinc S.A. DE C.V. The first

company to apply the super-protection provided by Metallization with Zinc, Aluminum and its alloys. The group offers durable protection for pieces as small as a screw to as large as a ship.To ensure this desired long term protection, MetalyZinc is committed to working to the highest standards of quality that guarantee the long-term satisfaction of the customers. The plant works under the standards: NMX (NOM), SSPC, NACE, ASTM, AWS, and ISO recommendations according to the item being protected and the protection chosen. Before coating, all contaminants that can hinder or inhibit protection are removed from the surface, and in some cases an anchor pattern or etch profile is generated, thus, offering the best grip for the coating. To do so, the facility has the following line of abrasives applicable both wet or dry: Grit-Blasting, Silica Sand (Sand-Blasting), Garnet (Blasting), and Bicarbonate (Soda-Blasting).

Due to Mexico's geographic location, its susceptibility to earthquakes, and the extension of its coastal line it is necessary to protect the Steel against corrosion. The Zinc coating provides a triple protection:

1. Barrier: between steel and the atmosphere.
2. Cathodic protection: Zinc corrodes in preference to steel.
3. Patina protective layer: resulting from the Zinc corrosion products which protect the coating from further corrosion.

In this way, the steel will keep its chemical, physical and mechanical properties for a long time and as above-mentioned: maintenance free (short-middle term period).* We have to keep in mind that the lifetime of the coating is directly related to the Zn thickness.

*Depends on the environmental conditions.

Concrete is by nature a porous material and the steel embedded in it should be protected against the Veracruz Port corrosion. When the rebar is not galvanized and it begins to corrode, the iron oxides (greater volume than metal ions from the steel) resulting from this natural process will increase the pressure on the surrounding concrete, generating cracks and eventually creating the snowball effect allowing the electrolyte to reach the steel. Therefore, the size of the previously generated cracks will increase and finally an irreversible damage and spalling of concrete. [1]

The weather features at the Veracruz Port are extreme for the Steel along the coast line especially by the sea side. The following table shows some of the atmospheric conditions of the Veracruz city:

VERACRUZ HARBOUR
Climate/ Köppen-Geiger: Aw/ Tropical Savanna
ISO 9223:2012: CX/ Extreme
Average Annual Relative humidity/%: 85

Table 1: Climate and corrosivity classification of Veracruz Port. [2, 3, 4]

CX classification belongs to offshore areas with high salinity and industrial areas with extreme humidity and aggressive atmosphere and sub-tropical and tropical atmospheres. Veracruz Port fulfills the specifications and it is therefore considered CX.

MetalyZinc S.A. de C.V. has been showing its commitment to solve the corrosion issues in Veracruz state, and this time, the parking garage will comprise more than 8'000 metric tons of hot dip galvanized reinforcing rebar according to the Mexican standard N-CMT-2-03-004/06. The civil works began in 2018 and it is intended to be finished in 2019.

This parking garage will have suitable parking spaces for approximately 9'000 cars. The facility will serve mainly for temporary storage of new importing or exporting cars. The parking garage is located in an aggressive environment where the temperature range is from 17.8ºC (in January) to 31.8ºC (in June) (64ºF to 89.2ºF). [3] With an annual average of 126cm (49.6 in) of precipitation each year and right by the sea side (Gulf of México), the parking structure will be submitted to high airborne chloride content and high relative humidity *(Table 1)* among other contaminants.

The depassivation process is a step that defines the service-life of the Zinc coating in concrete. It is slower than black steel due to the fact that the Zinc layer protecting the steel has a higher tolerance to chloride (2-4 times the threshold of uncoated steel) ions. Besides, as the zinc protects the underlying steel sacrificially, the time taken for the consumption of the zinc coating will be even longer. Once the coating has been totally consumed, the corrosion of steel will begin. The stress generation in the surrounding concrete due to the formation of the Zinc corrosion products (alongside their ability to migrate into the matrix) will undoubtedly be less than the one generated by the iron corrosion products. [1]

With an average of 152 microns (6mils) of Zinc coating thickness, the galvanized steel reinforcement will easily deliver at least 80 years of maintenance-free protection from corrosion.

The Parking Facility (Estacionamiento Vehicular: Importación y exportación) will be a multilevel structure. Galvanized reinforcing

rebar was selected based on the performance of other structures; bridge (Distribuidor vial Bicentenario, 2009) and the Aquarium (Acuario de Veracruz, 1992) in Veracruz Port which were built using hot dip galvanized rebar. [5]

Veracruz Port serves as the primary point on the Atlantic side for imports (U.S.A, China and different European countries) and exports. In 2014 the main exports were: minerals (39%), metals (24.7%), food and wood (14.3%). On the other hand, the main imports were: paper products, organic cleaning products (except soap), paints and varnishes. [5]

Constructing the garage using galvanized steel reinforcement was an easy decision when considering the high chloride content in the Port. Some studies in chloride contaminated revealed the behavior of galvanized rebar over the black steel. Under the same exposure conditions HDG steel resisted 2.5 times chloride levels higher than black steel. Moreover, the zinc coating delayed the time of corrosion on the steel by 4-5 times confirming the aforementioned. [6]

According to the Mexican Ministry of Communications and Transport (SCT), the primary goal of the enlargement of the Veracruz Port is to develop world-class sustainable infrastructure which will be able to keep the supply over the demand leading to an integral suitable capacity. [7]

Along with the increase of the Port capacity, the need of a parking facility for improved convenience became apparent. Compañía de Ingeniería Marítima y Terrestre S.A. de C.V. was hired then to build the parking facility.

One of the biggest challenges which Veracruz Port is facing is to improve its performance and participation in the global (Europe and North America) logistics due to its privileged geographic position. Besides, its proximity to the main product consumer areas in the central part of Mexico would definitely lead the Port as one of the most important in the Gulf of Mexico and the most important in the country. In this sense, the expansion project of the Port will accomplish the goal of developing the transport and logistics infrastructure established by the Ministry of Communications and Transport (SCT) in 2016. Thus, generating competitive costs, improving the local safety and improving the social and economic development not only of the Port but also of the city. [7]

Knowing the performance of the galvanized rebar in different bridges and structures in Europe and U.S.A. MetalyZinc convinced the hired engineering firm in charge of building the parking facility to choose hot dip galvanized rebar. One of the most important reasons: the elimination of expensive maintenance for several years (more than 80) of the facility structure's life). [8] Besides, the integrity of the steel properties will last much longer than the non-galvanized rebar once corrosion reaches the coating. Since, the maintenance budgets assigned for the maintenance of the structure are still unknown and most probably really small, the choice of hot dip galvanizing would free up future budget funds for much-needed new projects in Veracruz coastal line. The 80 year expected life time could be easily surpassed according to the behaviour of many structures (comprising hot dip galvanized steel) around the globe: Elzher bridge (Holland), [9] Lyndlich Bridge (UK), Sterns-Bayou (U.S.A.) and different Bermudas bridges among many others. [10]

In order to accomplish this vision, both AMEGAC and MetalyZinc S.A. de C.V. will continue to promote the use of hot dip galvanized steel in the construction industry until it is specified in Official Mexican Standards.

References

[1] Hochstein A., *Hot dip Galvanized Reinforcing Steel webinar.* American Galvanizers Association. Denver, U.S.A., 2018.

[2] Maaβ P., Peiβker P. et.al. *Handbook of hot dip galvanization*. 3rd ed., pp.357. Wiley-VCH Verlag GmbH & Co. KGaA., Weinheim, Alemania, 2011.

[3] https://es.climate-data.org/america-del-norte/mexico/veracruz-de-ignacio-de-la-llave/veracruz-4695/

[4] https://weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,veracruz,Mexico

[5] Mexico's Ministry of Economy, *Atlas de complejidad económica de México: Veracruz*, Veracruz, México, 2014.

[6] Yeomans S.R., *Galvanized Steel Reinforcement in Concrete*, pp.8, Elsevier, Australia, 2004.

[7] Mexico's Ministry of Communications and Transport, *Programa maestro de desarrollo portuario del Puerto de Veracruz 2016-2021*, pp. 50-55, Veracruz, México, 2016.

[8] American Galvanizers Association, *Parking for the future: A Collection of Hot dip Galvanized Steel Parking Garages*, Denver, U.S.A., 2006.

[9] Sabadell J., *"La sostenibilidad del acero galvanizado frente a sus principales competidores" webinar*. CIDIZEX-AMEGAC. Mexico, 2019.

[10] Sabadell J., *"Construyendo puentes y carreteras con acero galvanizado" webinar.* CIDIZEX-AMEGAC. Mexico, 2018.

CORROSION INSTITUTE SOUTHERN AFRICA

THE CORNERSTONE OF ENGINEERING

DATE:
24TH APRIL 2019

CORROSION CONTROL & MANAGEMENT NATIONAL CONFERENCE & EXHIBITION

CELEBRATING WORLD CORROSION AWARENESS DAY

VENUE:
Accolades Conference Centre,
Midrand, Gauteng, South Africa

www.corrosioninstitute.org.za

CORROSION INSTITUTE SOUTHERN AFRICA

From the KETTLE

The role specifiers and end-users have in selecting a corrosion control coating, suggests that all aspects of a hot dip galvanized coating be highlighted and if necessarily de-mystified. The intension of this series of surface conditions is to ensure that the customer or specifier has a greater understanding of the coating so that it is not necessarily rejected or accepted for the wrong reasons, resulting in wasted time for all personnel. See F22 and F23.

Legend
A Accept **R** Reject **REP** Repair

F22

DESCRIPTION:

Ungalvanized surfaces caused by residual glue from a label.

CAUSE:

Residues, such as the glue from labels or tape on the steel surface, can result in localised ungalvanized areas in an otherwise continuous galvanized coating.

Any label/tape including the consequent residual adhesive on the steel must be comprehensively removed in order to ensure the hot dip galvanized coating is continuous.

EFFECT / REMEDY:

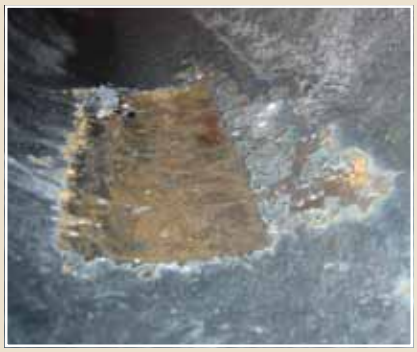
Ensure all labels/tape and consequent residual adhesive has been comprehensively removed prior to hot dip galvanizing, or negotiate with the galvanizer and leave the entire label/tape intact for his proper removal.

ACCEPTABLE TO SANS 121:

A / REP

ACCEPTABLE FOR DUPLEX AND ARCHITECTURAL FINISH:

R



F23

DESCRIPTION:

Ungalvanized surfaces caused by shellac or lacquers on imported pipe and accessories.

CAUSE:

Residues, such as shellac or laquer, can result in localised ungalvanized areas in an otherwise continuous galvanized coating.

F23 continued

EFFECT / REMEDY:

Ensure that all imported pipe accessories are comprehensively abrasive blasted to remove all traces of shellac or laquer internally or externally prior to welding up a pipe configuration.

Failing this, when the uncleaned pipe configuration is galvanized it will result in uncoated areas.

The galvanizer can offer a solution following galvanizing but it is expensive and time consuming.

ACCEPTABLE TO SANS 121:

A / REP / R (If uncoated areas are seen inside the pipe configuration)

ACCEPTABLE FOR DUPLEX AND ARCHITECTURAL FINISH:

R

Gauteng Golf Day – Jackal Creek Golf Estate

The weather allowed us to have a great time on Friday the 9th of November at Jackal Creek Golf Estate. The first tee took off just after 11 where the last team handed in their score card just after 5pm. At the end of the successful Golf Challenge, everyone gathered in the clubhouse for a delicious dinner and prize-giving.

It started off with a charity auction by Off Course Golf Promotions which was well supported by the players.

Prizes were awarded for 'nearest to the pin', 'longest drive', and 'pink lady competition', just to name a few.

A result like this cannot be achieved without the support of our sponsors, thank you to all those that sponsored our charity event and also those that came through to support their colleagues and friends.

Well done to the Kaefer Thermal team: Trevor Sampson, Steven Brown, Wynand Strydom and Harry Reinach for taking the golf cup home.

Be sure not to miss the next one, see you there!!

Executive Director's Message

Happy greetings to you members and potential members of the Corrosion Institution of Southern Africa.

As much as year 2018 was a challenge for our industry, we can safely say that we made it to the year 2019. The Institute really appreciates your patience and perseverance in a very difficult economy going through a technical recession and slowly but surely working ourselves out of it.

We go into the year 2019 and look forward to more growth and sustainability of our industry as we make inroads to engage with critical government institutions. I write to you this Friday morning with lots of positivity after the SONA last night. If you listened to what the President has said about business and how you as business can work with government in order to improve the market and grow our GDP. It was a mouthful and I suggest that you go through it and look at how you can contribute to the set targets. I urge you as business to take part in Presidential discussions that are happening on a regular basis, because you need to be part of the solutions that are initiated especially with regards to capital infrastructure projects.

With regards to what the President stated in the SONA for business towards learnership and training, I believe this provides members a start to placing unemployed youth training as part of their company objective with plans to send them for corrosion courses here at the CORE. Donovan Slade (Institute President) will in his comments give you some details of the progress we are making at the Institute with regards partnerships and the Institute's growth.

The Institute was on a break for two weeks in December and January and came back on the 7th January 2019. We convened one course already, attended by 10 candidates and we are looking forward to Durban CIP level 1 which will be hosted from the 18th to the 23rd February where we have at least 15 candidates registered. Kindly check our website and this edition of CE for this year's training schedule. We are also looking forward to partnering with members who innovatively present solutions to our courses and value adding to the training growth of the Institute.

The Institute annually hosts hundreds of candidates for courses. Our monthly technical evenings both at the CORE and in Cape Town are well attended

On the 24th April 2019 it is a World Corrosion Awareness Day Celebration which will be held at the Accolades Conference Centre in Midrand *(see our separate advert)*. There will be exhibition and conference on that day. We are expecting a great amount of support from members and government especially with the current accidents that we are experiencing in our country which are due to aging infrastructure.

We are looking forward to your contribution with regards to our events this year, from Technical evenings, Expos, Fishing day, Annual awards dinner, Golf days, etc.

Corrosion Champ, Hendrick Rasebopye – Executive Director

Comment – Chairman of the Cape Region

The Corrosion Institute Cape Region had a really successful and well attended Gala Dinner in the Grill Room at Kelvin Grove in November. We were honoured to have the Director of the Corrosion Institute, Hendrik Rasebopye as well as Nonkanyiso Mabaso as our guests from Johannesburg. Regardt Laubscher and Leigh Collins were exceptionally talented and kept us all entertained and amused during the early evening. Alister Penny from Naughty's then kept us on the dance floor till the early hours.

Tammy Barendilla deserves special mention in being the catalyst to making the Cape Regions Gala dinners so well run. This was her last Gala dinner for a while and we as a committee and region would like to thank her for all her efforts.

Two gentleman were honoured for their life long contributions to the industry and we would like to congratulate Dan Durler and David Goldblatt for the Honorary Life Memberships which they received. They are both worthy recipients of this award.

Charles Dominion from Simple Active Tactics was the winner of the best Technical Presentation or Site Visit. Congratulations Charles! Dry Force were the recipients of the best stand award at our Mini Expo.

In January we visited Gabriel Shock Absorbers which was an exceptionally interesting and eye opening experience. Seeing a well run operation in action was a real privilege and all those who attended enjoyed the opportunity.

Our second technical presentation took place on 21 February and it was both interesting and educational. Steve Holt who has been involved in the industry for many years, presented on Pipeline Survey Techniques. In March Rob White an ex-president of the Corrosion Institute will present a paper entitled: A View on The Development Of The Galvanizing Industry In China (A 20 Year Journey). We look forward to this presentation with great interest.

If you are new in the industry or one of the stalwarts there is something for everyone at our monthly get togethers and we encourage you to join us. Feel free to bring a colleague and/or a friend.

Yours in Corrosion

Graham Duk on behalf of Dan Durler, David Goldblatt, Thinus Grobbelaar, John Houston, Daryl Livesay, Indrin Naidoo, Hilton Olivier, Terry Smith, Gilbert Theron, Eric van der Spuy, Flippie van Dyk and Pieter van Riet

Comment – Chairman of KwaZulu Natal

CorriSA KZN Annual Charity Golf Day was held on the 30th November 2018 at the Kloof Country Club. This year's event was a great success – even with the load shedding during prize giving. It was really exciting to see over 70 people coming together to enjoy a game of golf in the name of charity. We have targeted two charities – Highway Hospice and Open Door Crisis Centre – which will benefit from all the initiatives.

We really appreciate the support we had and everyone that made the day a memorable one. The company members that were present are:

- Kaefer Thermal
- Corrocoat
- Jotun Paints
- Storm Machinery
- NUI
- VZ Coatings
- ASP Rope Access
- Scott Bader
- R&D Coatings
- Pipe Coatings
- D&B Industrial
- Flowcrete

Sponsors were:

- Storm Machinery – golf T-shirts
- Kaefer Thermal – hole sponsor
- Corrocoat – hole sponsor
- Flowcrete – hole sponsor and
- Pipe Coatings – hole sponsor

We are hoping to have an even larger golf day in 2019, so please look out for the invitation and give your support to this fun filled day.

Regards, Mark and Karyn

KZN Region Golf Day – Kloof Country Club

November 2018 Awards Event – Cape Region

The Cape Region committee wishes to take this opportunity to thank all Gala Evening Sponsors, without whom this annual Awards event would not take place. The following companies sponsored the evening:

Akzonobel / International Paints (Entertainment sponsor) | Corrocoat (Wine Sponsor – Self sourced) | BAMR (DJ Sponsor)

Dry Force (Gift Sponsor – Self sourced) | Blastrite (Print Sponsor)

Dan Durler (FAR LEFT) being congratulated by Graham Duk, and David Livesey (received by John Houston, CENTRE) on their respective Honorary Life Membership Awards. Patrick Robinson (FAR RIGHT) of Dry Force being congratulated by Hendrick Rasbopye for their winning stand at the mini expo.

Hendrick Rasbopye (RIGHT) and Nonkanyiso Mabaso (LEFT) thanking Tammy Barendilla for making this event the success that it is.

LEFT: Prior to the Cape Region Gala Awards evening last November the Executive Director - Hendrick Rasebopye; Honorary Treasurer - Graham Duk and Editor and Producer of CE - Terry Smith had a strategic discussion on several issues regarding the strategic direction of the magazine.

CorrISA Corporate Membership

We wish to thank all our longstanding and new corporate members for their ongoing support. Thank you all who have been loyal and those who have renewed their memberships. We are currently in the process of categorising company membership in terms of their field of work and expertise and will report on this shortly.

MEMBER	DATE JOINED
CORROCOAT SA (PTY) LTD	1970
BLASTRITE (PTY) LTD	1991
KANSAI PLASCON (PTY) LTD	1991
SOUTHEY HOLDINGS (PTY) LTD	1991
COLUMBUS STAINLESS (PTY) LTD	1993
DENSO SOUTH AFRICA (PTY) LTD	1993
MINTEK	1993
SAPPI SOUTHERN AFRICA LTD	1993
SIGMA COATINGS(PTY) LTD	1993
ISINYITHI CATHODIC PROTECTION	1994
NORDBAK (PTY) LTD	1994
DEKRO PAINTS (PTY) LTD	1996
AFRIGRIT CC	1998
SPEC GROUP	1998
M&S CORROSION CC	1999
ABE CONSTRUCTION CHEMICALS	2000
DPA SPECIALIST CONSULTING ENGS	2000
JOTUN PAINTS SOUTH AFRICA	2001
STONCOR AFRICA (PTY)LTD	2001
NATIONAL URETHANE INDUSTRIES	2003
KARE INDUSTRIAL SUPPLIERS (PTY) LTD	2004
WACO AFRICA T/A SGB CAPE	2004
AKZO NOBEL POWDER COATINGS SA	2005
DRAM TRADING CC	2006
KAEFER THERMAL CONTRACTING SERVICES	2007
SIMPLE ACTIVE TACTICS SA (PTY) LTD	2007
INTEGRITY ENVIRONMENTAL SOLUTIONS	2009
ORANGEIMPACT (PTY) LTD	2009
TOPROPE	2009
ASP ROPE ACCESS (PTY) LTD	2010
BAMR (PTY) LTD	2010
ICI DULUX / INTERNATIONAL PAINTS	2010
PRO PAINT MANUFACTURING (PTY) LTD	2010
BENGUELLA ENTERPRISES (PTY) LTD	2011
BLUCHEM COIL TREATMENT CT	2011
HEMPEL PAINTS SOUTH AFRICA (PTY) LTD	2011
MCM BLASTING AND COATING CC	2011
PIPE COATINGS CC	2012
MAXLIFE COATINGS CC	2013
NMT ELECTRODES (PTY) LTD	2013
SKYRIDERS ACCESS SPECIALISTS (PTY) LTD	2013
BAYPAC (PTY) LTD	2014
BUSINESS CONNEXION (PTY) LTD	2014

MEMBER	DATE JOINED
CATHTECT ENGINEERING (PTY) LTD	2014
ORYTECH (PTY) LTD	2014
REMISTAR	2014
TERRATECH	2014
TOTAL CONTAMINATION CONTROL SA	2014
AFSA	2014
D I M D SERVICES CC	2015
ENERMECH ENGINEERING SERVICES	2015
SECMET (PTY) LTD	2015
PATERSON & COOKE CONSULTING ENG	2015
POFU SUPPLY ON DEMAND	2015
STOPAQ	2015
SASSDA	2015
RAND WATER	2016
AESSEAL (PTY) LTD	2016
BEYOND WATER (PTY) LTD	2016
DEFELSKO	2016
GROUP FIVE PIPE	2016
JMS SANDBLASTING (PTY) LTD	2016
OPTIMA COATINGS SA (PTY) LTD	2016
PLASCOAT SYSTEMS LTD	2016
REDEC	2016
REIGNITE (PTY) LTD	2016
SA ROPE ACCESS	2016
SHOREY ENGINEERING (PTY) LTD	2016
SPECIALISED CLIMATE ENGINEERING (PTY) LTD	2016
STORM MACHINERY (PTY) LTD	2016
TRENTBRIDGE ENGINEERING CC	2016
UNYAZI SALES AND SERVICES	2016
WEARTECH (PTY) LTD	2016
TRANSNET PIPELINES	2017
ELECTRO SCAN CC	2017
MIRROR DATA (PTY) LTD T/A SPS CORROSION PROTECT	2017
WACO AFRICA HUMAN RESOURCES DEVELOPMENT	2017
EXARRO RESOURCES LIMITED	2017
BIDA CATHODIC PROTECTION SERVICES	2018
BLYGOLD SA CAPE TOWN (PTY) LTD	2018
GRAFTED POLYMERS (PTY) LTD	2018
J A M S GEOLOGICAL SERVICES	2018
MONALEBO ENGINEERING SERVICES	2018
SURCOTEC (PTY) LTD	2018
TECHNICAL FINISHES (PTY) LTD	2018

TECHNICAL EVENTS: Gauteng

The November Technical Evening was held at the request of our SAECC Subcommittee polyurethane coatings. We had a presentation by Heinie le Roux of National Urethane Industries (NUI) who presented on their superior RPU.

Thank you to NUI for sponsoring the evening's snacks, dinner and drinks.

TECHNICAL EVENTS: Cape Region

In January Cape Region members visited Gabriel Shock Absorbers (Torre Automotive) which was an exceptionally interesting, eye opening experience and well managed facility. Here Denie Naidoo tells us about a surface corrosion issue they had with one of their suppliers.

Corrisa wishes to thank them for this interesting plant tour.

KAEFER INNOVATIONS DAY

The Institute was fortunate to be invited to exhibit at the100th Kaefer Innovations Day on the 16th November 2018 from 07:30 am which took place in their premises at Germiston.

CorrISA wishes to thank the organizers for allowing Nonkanyiso Mabaso and Brenda Maree to celebrate with them. The occasion offered them a great opportunity to network with Kaefer clients.

CIP1 TRAINING COURSE: 21 - 26 January 2019

The first course for 2019 (CIP 1) was held in Johannesburg 21 - 26 January 2019. 10 students attended the course and it was enjoyed by all. A big THANK YOU to Blastrite who hosted the Practical Day and Stoncor who supplied the paint supplies we required.

TECHNICAL EVENING CALENDAR 2019

GAUTENG REGION		
Dates	**Speaker Booked**	**Topic**
14 March	Rob White	A View on The Development of the Galvanizing Industry in China (A 20 Year Journey)
11 April	Enecon: Derick le Grange	Corrosion Protection Using Polymer Composites
May	TBA	TBA
13 June	Darelle van Rensburg – Orytech	TBA
July	TBA	TBA
August	John Andersen, Director SCE	The Fundamentals of Corrosion Control Utilising Specialised Materials & Coatings
September	No Technical Evening	
October	TBA	TBA
November	Nick Trebeki	Cement Mortar Lining of Pipelines – Factors to Consider
December	TBA	TBA
WESTERN CAPE REGION		
Dates	**Speaker Booked**	**Topic**
March	Rob White	20 Years Evolution of the Galvanizing Industry in China
19 April	180 Degrees	TBA
May	Southey	Asbestos Talk
June	Fireside chat with stalwarts in the industry	Various
July	Dry Force	TBA
Aug	AGM	
Sept	Mini Expo	
Oct	Site Visit to Navy	TBA
Nov	Gala Awards Evening	

CORRISA COURSE SCHEDULE 2019

NACE CIP 1 – Coating Inspector Program Level 1

25th – 30 March 2019	The CORē, Midrand
13th – 18th May 2019	The CORē, Midrand
3rd – 8th June 2019	Cape Town
8th – 13th July 2019	The CORē, Midrand
16th – 21st September 2019	The CORē, Midrand
4th – 9th November 2019	The CORē, Midrand

NACE CIP 2 – Coating Inspector Program Level 2

27th May – 1st June 2019	The CORē, Midrand
25th – 30th November 2019	The CORē, Midrand

NACE CP 1 – Cathodic Protection Tester

4th – 8th March 2019	The CORē, Midrand

NACE CP 2 – Cathodic Protection Technician

10th – 4th June 2019	The CORē, Midrand

Corrosion Engineering Exam

8th – 12th April 2019	The CORē, Midrand
2nd – 6th September 2019	The CORē, Midrand
7th – 11th October 2019	Cape Town

Corrosion Management

11th – 12th March 2019	The CORē, Midrand
5th – 6th August 2019	The CORē, Midrand

Not Just Rust

17th April 2019	The CORē, Midrand
26th June 2019	The CORē, Midrand
28th August 2019	The CORē, Midrand
30th October 2019	The CORē, Midrand

CITWI BPA – Corrosion in the Water Industry

20th – 23rd May 2019	The CORē, Midrand
18th – 21st November 2019	The CORē, Midrand

NACE OCAT (Offhsore Corrosion Assessment Training)

19th – 23rd August 2019	Cape Town

Corrosion Control in the Refining Industry

21st – 25th October 2019	The CORē, Midrand

Marine Coating Technology

22nd – 25th July 2019	The CORē, Midrand

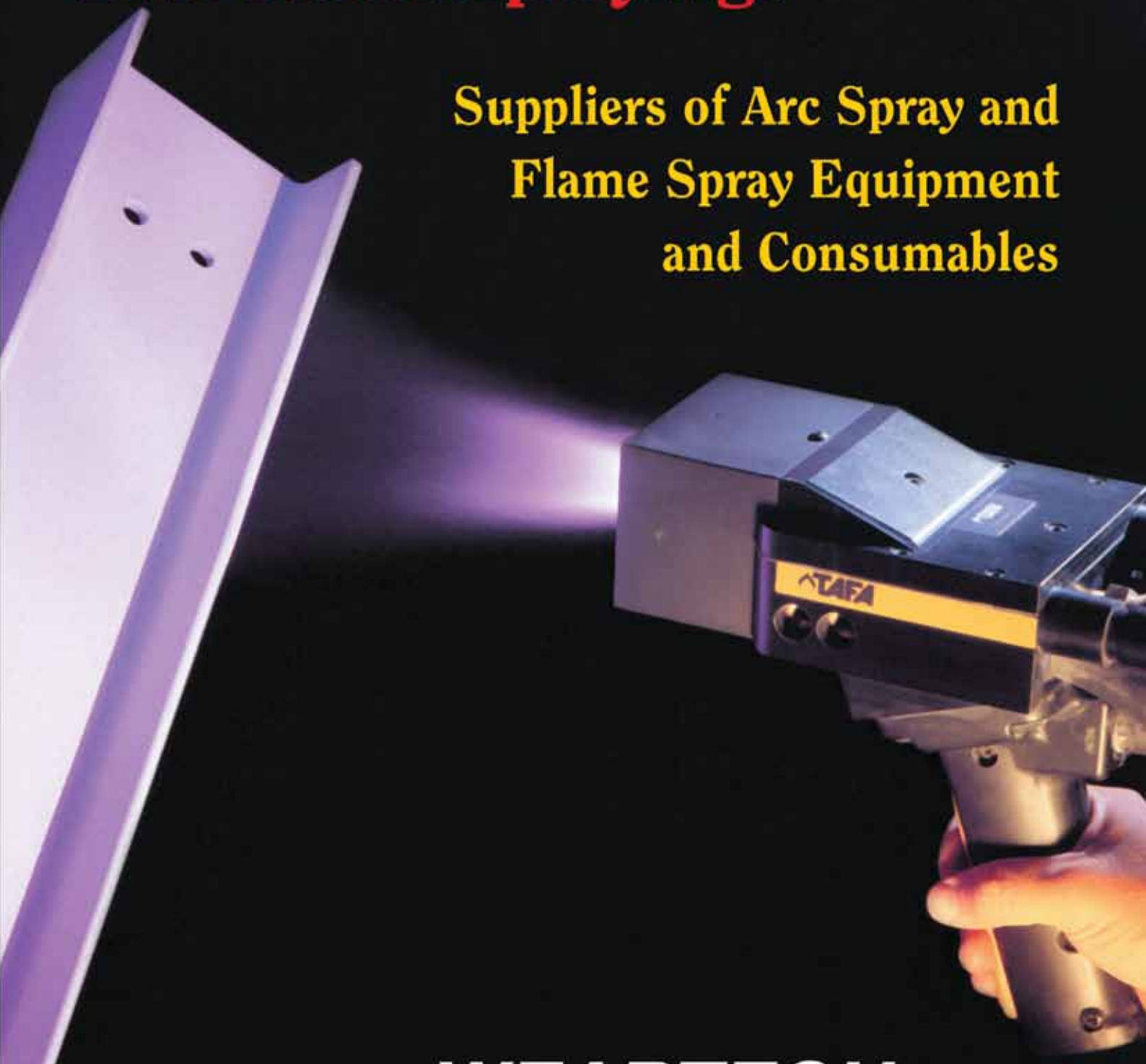
Corrosion and Protection of Concrete Structures and buildings

27th – 28th May 2019	The CORē, Midrand

REGISTRATION LINK:
https://docs.google.com/forms/d/1e9ZGDsMO1Sd8aXuCvys2bstXr5SrpVBxuqEQPK9lfUM/viewform?c=0&w=1

Zinc Metal Spraying?

Suppliers of Arc Spray and Flame Spray Equipment and Consumables



WEARTECH (Pty) Ltd

THERMAL SPRAY DIVISION

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ABRASIVE BLASTING MEDIA

CRUSHED GLASS WhizDom®

Key features and applications:

- No iron or free silica
- Stainless steel blasting
- Replaces glass bead and soda blasting
- Graffiti removal and building restoration
- General blasting

RECYCLED STEEL ABRASIVES

Key features and applications:

- Outstanding value
- Replaces slag abrasives
- Recyclable – ideal for tank internals and blasting booths

ECOBLAST® 30/60 GRIT

Key features and applications:

- Expendable abrasive – replaces garnet
- Approvals from major oil and paint companies
- Ultra-competitive performance

STAINLESS SHOT AND GRIT

Key features and applications

- Replaces glass beads and aluminium oxide
- Finishing non-ferrous castings
- Stainless steel fabrication

NEW STEEL SHOT/GRIT

Key features and applications:

- World class product
- Structural steel
- Castings
- Blasting booths

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