Vol. 4 Issue 1 I 2018

# Corrosion Exclusively

**INSIDE:**

- Bridge pile corrosion feature
- AC Mitigation Part 2
- Common misconceptions that contribute to premature coating failures
- AfriCORR
- From the KETTLE

55 YEARS OF EXISTENCE Est. 1960

CORROSION INSTITUTE SOUTHERN AFRICA

CORROSION PROTECTION FOR CARBON STEEL

BECAUSE SOMETHING AS TOUGH AS STEEL NEEDS PROTECTION TOO

www.transgalv.co.za • 011 814 1113/4 • transgalv@transgalv.co.za

3 Third Avenue, Vorsterskroon, Nigel 1491 South Africa

QUALITY SPECIALISTS IN SPIN, DIP AND DRAGLINE GALVANISING


## Transvaal Galvanizers commissions the

# LARGEST GALVANIZING PLANT IN AFRICA

Transvaal Galvanisers boasts 4 galvanizing lines individually equipped with jigging, pretreatment and fettling facilities. From receipt of customer material to dispatching of the final product, Transvaal Galvanisers will ensure the highest quality approved product at the most competitive price.

Transvaal Galvanizers was founded in 1984 by the Managing Director of Imab Engineering with the vision of creating a full turnkey operation when it came to the need for supply of corrosion protected steel articles. With Imab Engineering at the forefront, this expansion into the galvanizing industry would one day become the biggest galvanizing plant in Africa.

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.

Over the last 33 years, Transvaal Galvanizers has galvanized over a million tonnes of steel. This is equivalent to 165 000 Bull Elephants OR 3 676 Boeing 747's OR 137 Eiffel Towers OR 68 Brooklyn Bridges.

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.

Not only will our upgraded facilities provide for a much greater capacity being 10 000 tonnes per month, but they incorporate state of the art equipment aiding in a greener, more environmentally friendly galvanizing process from start to finish. The upgrade incorporates 16tonne crane capacity with the advantage of crane off loading and loading of trucks, to ensure more efficient deliveries and dispatches for our customers.

Our facilities also include a shot blasting workshop, painting workshop, pre and post inspection, multiple approved repair processes, onsite offices for larger projects as well as an onsite boiler workshop where we manufacture and design new methods of dipping and jigging customer steel.

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.

**With qualified, experienced and driven personnel at our forefront, we are your one stop shop when it comes to corrosion protection.**

Vol. 4 Issue 1 | 2018

# Corrosion Exclusively

## ADVERTISERS



## REGULARS



## TECHNICAL FEATURES



## INSTITUTE NEWS AND ACTIVITIES

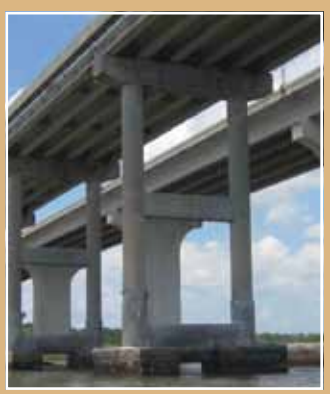


## EDUCATION AND TRAINING



# CONTENTS

OFFICIAL MAGAZINE OF THE CORROSION INSTITUTE OF SOUTHERN AFRICA



PAGE 8

PAGE 14

PAGE 17

PAGE 21

# President's Comment

What a difference a week makes in South African politics.

Most South Africans were contemplating life with Mr Zuma for an additional year and a half and overnight we have a new charismatic president in President Ramaphosa!

Sentiment has totally done an about turn and prospects now seem possible to be implemented.

The industry is a buzz with quotations and specifications and consultants are frantically being contacted to qualify products.

The Corrosion Institute of Southern Africa has also seen the about turn and membership applications have been streaming in at much larger volumes than seen in the past few years.

Our NACE courses are being filled to acceptable levels and courses are being run as per our training schedule without being cancelled. The Corrosion Institute of Southern Africa is in a good space and things are about to get even better!

The formation of CorrISA as a Professional Body is well on track and able and willing volunteers have been added to the various regional councils and committees. All regional members are being represented in the formation of our Professional Body.

The Corrosion Institute of Southern Africa will be holding our Annual Awards Dinner in conjunction with our AfriCORR Dinner. We only have 250 seats available for this event so please book early to avoid disappointment.

We will see many overseas and African delegates booking early, as this year's AfriCORR promises to be the largest yet, due to our friends at NACE assisting with the marketing of the event.

There will be a mini expo being held in conjunction with the event so this would be an opportunistic way to market our South African manufactured products to a greater international audience.

The Corrosion Institute will be celebrating Corrosion Awareness Day on the 24th April at The Core and sponsorships and advertising packages are available from CorrISA.

A special thank you to RandAir for waiving all costs related to our Mini Expo held at their premises in Cape Town last year, 21 September 2017.

I would also like to thank Mr Aaron Raath from Cathtect who generously offered to sponsor a gate intercom system at The Core Midrand.

I wish all our members well in celebrating the new turn of events in our lovely country!

*Hamba Kahle*

*Donavan Slade, CorrISA – President*

**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."



**Published on behalf of:**
**The Corrosion Institute of Southern Africa**
38 Allan Road, Glen Austin, Midrand, South Africa
PO Box 5656 Halfway House 1685
International Tel: +27 (0)10 224 0761
Local Tel: 0861 267772
www.corrosioninstitute.org.za
accounts@corrisa.org.za

**Editor, Producer and Advert Sales**
**Terry Smith**
Tel: 021 797 4735
Fax: 086 612 7284
Cell: 082 893 3911
Email: editor@corrisa.org.za

**Chairman Western Cape**
**Graham Duk**
Cell: 021 683 2100
Email: graham@bamr.co.za

**Chairman KZN**
**Mark Terblanche & Karyn Albrecht**
Cell: 083 406 3341 / 081 711 8907
Email: mark.terblanche@primeinspection.co.za
Email: karyn@avaprojects.co.za

**Design and Layout**
**Sandra Addinall**
Tel: 011 868 3408
Email: cbtdesign@adcot.co.za

**Reproduction and Printing**
**Camera Press**
Tel: 011 334 3815
Fax: 011 334 3912
Email: dtp@camerapress.co.za




***Cover: Corrosion along the False Bay coast in Cape Town is aggressive marine as indicated by the first 3 photos. However, in Randburg (mild corrosivity), street sign boards can also degrade in time with inappropriate coatings and/or excessive service life.***

# MONOWELD
GALVANIZERS


# An Upgraded Monoweld

**Monoweld Galvanizers** boost demand chain efficiency **by partnering with you.**

We are **well equipped** and **ideally structured** to quickly fulfil your order, from **small projects**, to **high-tonnage contracts** that involve large fabricated components.

## OUR OFFERING:

NEW!

- **Line 1 is 15.3m long X 3.5m deep X 2.0m wide**
- Line 3 is 8.2m long X 1.8m deep X 1.4m wide with semi-automatic pipe galvanizing capability
- 66 000m³ concrete laydown area to enhance our logistics offering

## ISO CERTIFICATION:

- **ISO 121 Certified**
- **14001: 2004 Certified**

## BENEFITS TO YOU:

- Increased flexibility
- Shorter lead times
- Increased kettle depth with fewer double dips
- More comprehensive service offering

## LOGISTICS CAPABILITIES:

- Lay down areas
- Crane capacity
- Transport fleet
- On-site offices available on request
- Loading containers

MONOWELD
GALVANIZERS

**Don't just Galvanize it, Monogalv it**

**+27 11 876 2900** **monoweld@monoweld.co.za**
**www.monoweldgalvanizers.co.za**

# Editorial Comment

Welcome to the first edition of *Corrosion Exclusively* in 2018 and the 10th edition since starting in October 2015.

A huge note of thanks must go to all who have contributed to the success as well as those that have supported the magazine in the past by way of advertising, we hope to continue to create a periodical that is both interesting and inviting to all members, prospective members of CorrISA and other interested parties.

With the newly elected Cyril Ramaphosa as our countries President, who on most accounts personally and educationally far surpasses the corrupt and disgraceful Jacob Zuma who together with his cronies in the space of about 10 years almost destroyed this beautiful country or ours. We hope that the new dispensation will in the medium term provide plenty of work opportunities for those wanting to work and slowly rebuild the economy and our countries creditworthiness.

AfriCORR, the Corrosion Institute's Corrosion Conference which happens every second year and will include the Annual Awards event takes place in July this year.

What is most interesting is that following a signed agreement between CorrISA and NACE, NACE will be responsible to market AfriCORR to all professions and persons aligned with corrosion and its prevention in Africa *(see Vol 3 Issue 4).* From Pamela Nicoletti, Director Education of NACE International, I was told this could be as many as 5 000 persons. We look forward to welcoming many of them to our conference in July where *Corrosion Exclusively* will be covering this exciting event.

Dr Ivor Blumenthal who has been tasked by CorrISA to professionalise qualified members, provides a report back on the progress of this project. Dr Colin Alvey, past president 1993 to 1995 *"On the RUST Spot" Vol 2 Issue 3 2016* would be keen to see this happen. Colin spent much of his time as President researching the interest of tertiary institutions in offering qualifications in the Corrosion Engineering field, with limited success. We support the project and trust that it will be successful.

For this issue we have from NACE "Characterizing Severe Bridge Pile Corrosion in a Florida Marine Environment" – A Case Study by Kathy Riggs Larsen.

From David Blackwell of Belzona we have "Common misconceptions that contribute to premature coating failures" Part 1.

Locally we have the second part of "AC Mitagition" by Cathtect.

Prof Stephen Yeomans provides a snippet on what is "galvanizing".

From the KETTLE, a regular contribution discusses "Modular lengths" and "Uncoated fasteners."

We report on many of the CorrISA activities, both in Johannesburg and Cape Town.

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

Bob Millenaar, a retired member of SAQCC and CorrISA, gives us an account of his past life in "The RUST Spot".

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, or wish to receive future editions, kindly contact us.

Past editions of *Corrosion Exclusively* can be viewed on *www.corrosioninstitute.org.za/category/magazines*

*Terry Smith*

# AC Mitigation – what can be done to avoid stray currents?

## (Part 2)

## *Methods and equipment*

Electricity plays a vital part in our daily life. To Imagine life without it is unthinkable today.

In certain cases, electric current can stray away from its intended path and can flow in unintended circuits and materials. This flow of stray current causes the electrochemical deterioration of metallic surfaces, which is known as stray current corrosion.

The magnitude of the deterioration is directly related to the extent of unintended current flowing in the structure. Localized faults in insulation and connections resulting in localized stray currents causing localized corrosion damage. Structures in the surrounding area of high-voltage equipment and conductors attract stray voltages, even during normal fault-free operation of a high-voltage circuit.

**Some of the commonly occurring sources of stray currents are:**

- Grounded direct current (DC) power systems distributing and transmitting power to consumers
- Electrically operated rapid transit systems
- Corrosion protection systems designed with cathodic protection (CP)
- Electrical welding equipment

**The minimization of the stray currents and voltages involves:**

- Detecting and measuring stray current as well as the source of the voltage and its path
- Mitigation of coating defects and insulation failures
- Repairing defective connections

### Why does stray current occur?

Stray current occurs because of induced or leaked voltage, which is the unintended presence of a voltage difference between two objects, this is increasingly common

as infrastructure of differing nature share servitude and right of ways. Ideally, these should have zero voltage difference between them. Even grounded objects at differing locations may have a voltage difference existing between them, and stray current may flow between them as a result. The presence of induced voltage due to the proximity of high-tension cables along with inductance or capacitance in the circuit is one of the causes of the problem. Current leakage due to insulation failure or defective connections can be another cause of stray currents. This can affect equipment enclosures, which are normally connected to ground. (For more on this topic, see Corrosion and Electrical Interference in Buried Metallic Structures.) Persons coming into contact with the stray voltage may not necessarily sense the current flow, as the current flow may be small.

## Detecting stray soltage

A number of electricity distributors and major users conduct regular tests for stray voltage to ensure public safety and prevent corrosion. The instruments used to sense and detect stray voltage can vary, but some of the common devices are electrical voltage tester and electric field sensors. Confirmatory testing is done with a low-impedance voltage meter. Electrical volt testers are handheld devices that visually indicate a contact with an energized surface.

Then the verification of existence of voltage is done by a low-impedance voltmeter. Electric field detectors sense the electric field in relation to the person's body. It is done by sensing and detecting the gradient of an electric field at a distance, without having to make a direct contact.

Stray current cannot be heard, seen or smelled, there is no easy method to know when a significant stray current exists. Regular system inspection and testing is important, but a serious condition or failure can develop suddenly without any discernible warning.

The corrosion of the stray current is observed as localized pits at points where the current leaves the pipes and structures. Initially, this effect is not visible to the naked eye. The detection is done by measuring metal-structure-to-soil-potential difference. Current-mapping devices use radio detectors. Different instruments are used to detect DC and AC stray currents.

## Prevention of stray current corrosion

The minimization of stray current corrosion is achieved by manipulating the design parameters. The goal is to reduce the flow of stray current, which is accomplished by increasing the overall circuit resistance in various ways.

Cathodic protection with an impressed current system are used to offset the effect of stray current.

In this method, the metallic structure that becomes damaged due to stray current is efficiently connected to the negative terminal of the DC source with a low-resistance connector. The connection is designed as unidirectional, so that stray current can flow from the buried metallic structure to the negative terminal of the power source.

## Basic categories

Pipeline surge protection systems fall into three basic categories:

- SSD – Solid State Decouplers
- PCR - Polarization Cell Replacement Devices
- Spark Gaps / Surge Arresters

Some or all of the above devices can be combined to form surge and steady state mitigation systems to best suit a particular pipeline associated application.

The need for solid state de-couplers arises from mitigating induced voltages on pipelines near overhead power lines. These de-couplers are installed for safety reasons as well as maintaining required DC voltages for protecting the integrity of pipelines.

### SSD – Solid State Decouplers

Are devices that upon a predetermined voltage threshold begin to conduct forming a near short circuit across the circuit it is connected to. Once the fault has passed or been subdued and the voltage falls below the pre-determined device threshold, the device commutates (switches) to the "off" state.

These types of devices do not fully comply with NFP 70 as well as Eskom guidelines when they are in conduction mode. Both cathodic protection applied DC and Induced AC present on the operating circuit (Insulated coated Pipe) is short circuited (to Ground).

These types of devices can have AC mitigation circuits in parallel to decouple AC steady state interference from overhead powerlines on the pipe to cater for AC voltage below the cathodic protection DC fault threshold level. Once "on", current flowing through the device


*Solid State Decoupling Device.*

*Surge Arrestor.*


*PCR – Solid State Decoupling Device.*

can maintain these devices in the conducting state even when the voltage fault threshold has fallen below the level set.

Economical and relatively small in size are some advantages but disadvantages are that their application can result in surging of cathodic protection power supplies and as mentioned above do not fully meet NFP 70 requirements and Eskom guidelines. Typical current discharge limits are 1,2kA and 3,7kA. Greater discharge limits are available but are generally by special request.

**PCR – Polarization Cell Replacement**

Are those devices which conduct once a predetermined voltage has been attained? Once conducting, they maintain the predetermined volt drop across the device. The voltage clamping devices will "soft turn on" as the threshold approaches and have a partial turn on bleeding more and more current off of the pipeline as the voltage threshold is approached. Once at predetermined threshold, the voltage will be clamped whilst the conduction will be at maximum. The Voltage clamping devices truly comply with NFP 70 and Eskom guidelines as they do not "Short Circuit" both the current as well as the voltage off of the pipeline. These types of devices can have AC mitigation circuits in parallel to decouple AC steady state interference from overhead powerlines on the pipe to cater for AC voltage below the cathodic protection DC fault threshold level. Once "on" current flowing through the device will not keep the device conducting if the voltage falls below the predetermined threshold.

Clamping devices are heat generation (ignition temperatures in Hazardous zones) and relative physical size whilst they fully comply with NFP 70 and Eskom guidelines.

**Spark Gaps / Surge Arrester**

This device forms an arc in an altered (gas filled) closed environment when a preset voltage threshold is reached. Significant current and voltage relative to the conduction threshold is required to maintain the arc. It therefore stands to reason that if the device is not hermetically sealed the characteristics of the device will fluctuate with climatic changes.

Gas discharge devices cannot accommodate an indefinite number of discharge. Most events discharge devices can only cope with 1 (one) 100kA discharge before the characteristics of the device is irreversibly altered.

## Other areas of attention

Sections of pipeline influenced by AC induction and accessible to the public require special attention as a member of the public may inadvertently provide a current path to ground when touching the exposed section of pipeline.

Typical appurtenance's that are necessary for long term maintenance of the pipeline are the general culprits in this regard. As one cannot do away with the test facility or chamber, special attention needs to be applied at these locations and can take the form of Insulation, ensuring an equipotential plane or both.

Crushed stone or Asphalt surrounds around the exposed facility will insulate the feet of the public so upon touching the facility the person is effectively insulated from providing a current path from the pipeline to ground. The surround must be of sufficient width that the person intending to touch the facility's exposed point, cannot do so, unless they are fully on the insulating surround. Crushed stone unfortunately is not all that viable as it tends to be repurposed for informal building projects.

Equipotential planes are generally the most effective as they are sections of bare metal buried around the exposed facility raising the surrounding soils in which they are buried, to the same potential level as the pipeline. As voltage / potential is the precursor to current flow, without there being a potential difference between the AC influenced pipeline and the soil at the exposed facility, current would not flow through the fiddling public.

Similar treatment needs to be applied to pipe racks, insulating flanges and well insulated above ground pipes, to ensure that the unintending public does not provide an inadvertent current path to ground.

End of pipelines at reservoirs, pump stations, off takes etc. generally have isolating flanges installed. The close proximity of the "live" and earthed sections around the isolating flange demand the "Live" section to be fitted with a voltage clamping device to Ground to ensure that hazardous levels are not reached and excess voltages are decoupled to ground without affecting the required Cathodic Protection current.

The attending consultant should provide a maintenance plan with regards to the AC mitigation system to ensure continued operation of the installed safety equipment. The equipment deployed to protect casual contact does not, and cannot withstand an infinite number of surge events and will require maintenance from time to time.

AC Mitigation is not just protecting your assets but gives you peace of mind knowing that your community are protected too.

*For more about AC Mitigation Systems and Equipment visit our website: www.cathtect.com*

AfriCORR 18: 16-20 2018
Ditsong Museum of Military History
Johannesburg,
South Africa

# AfriCORR 2018

african solutions for african problems

## African Corrosion Congress

Commencing on the centennial anniversary of the birth of Nelson Mandela,
AfriCORR18 is a celebration of

## African Solutions to African Corrosion Challenges

### Key Dates for AfriCORR 18

| | |
|---|---|
| AfriCORR 18 Congress | 18-20 July 2018 |
| Corrosion Workshop 1 | 16-17 July 2018 |
| Corrosion Workshop 2 | 17 July 2018 |

Submission of Papers for peer review: **31 March 2018**

Registration open online @ www. africorr.org.za

### Rates for AfriCORR 18

| Rates | Early Bird | Full Price |
|---|---|---|
| AfriCORR18 - 3 day Congress only (18-20 July) | R5400.00 | R6000.00 |
| CorrISA Member Special - 3 day Congress only | R5400.00 | R5500.00 |
| Registered Student - 3 day Congress only | R3300.00 | R3600.00 |
| Corrosion Workshop 1 only (16-17 July) | R2700.00 | R3000.00 |
| Corrosion Workshop 2 only (17 July) | R1350.00 | R1500.00 |
| Student full package (5days) | R5200.00 | R5600.00 |

**Workshop 1 : Techniques in Corrosion Research**
A hands-on 2 day workshop, primarily geared to students, exploring a variety of corrosion research techniques available including some "Tricks of the Trade"

**Workshop 2 : Pipeline Integrity Management**
An industry focused discussion, facilitated by Dr. Iftikhar Ahmad, in mitigating and monitoring internal and external corrosion of oil and gas pipelines.

AfriCORR Congress has an exciting line up of Plenary and Key Note speakers including:

**Mr Jianqiang Zhang**
School of Materials Science and Engineering
University of New South Wales - Australia

**Prof. Dr. Elsayed Mohamed Ahmed Sherif**
Center of Excellence for Research in Engineering Materials
King Saudi University - Kingdom of Saudi Arabia

**Prof. Robert Knutsen**
Centre for Materials Engineering
Cape Town University - South Africa

CORROSION INSTITUTE SOUTHERN AFRICA

**Register online at**

**www.africorr.org.za**

in partnership with

NACE INTERNATIONAL

# Characterising severe bridge pile corrosion in a Florida marine environment – A case study

*Researchers suspect microbiologically influenced corrosion caused localized degradation*

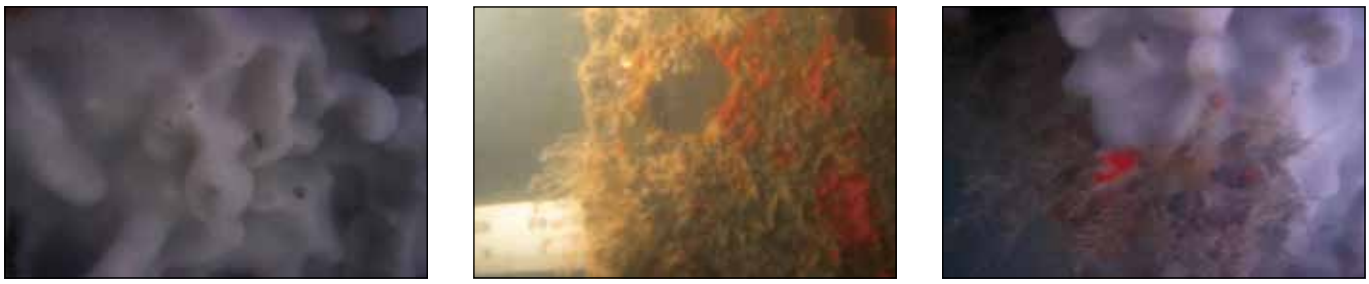
Kathy Riggs Larsen, Editor

The Matanzas River in St. Johns County is a narrow, 23-mile (37km) long saltwater estuary located just off the northeastern coast of Florida in the United States. It is sheltered from the Atlantic Ocean by a barrier island, Anastasia Island. To connect Anastasia Island with the mainland, two major bridges cross the Matanzas River – the Bridge of Lions in St. Augustine and the Mickler-O'Connell Bridge located just south of St. Augustine. Currently, the Mickler-O'Connell Bridge, which is experiencing corrosion of its steel H-piles, is being studied by the Florida International University (FIU) (Miami, Florida, USA), at the request of the Florida Department of Transportation (FDOT) (Gainesville, Florida, USA), for the possibility of microbiologically influenced corrosion (MIC).

The Mickler-O'Connell Bridge, built in 1976, carries an average of 18,750 vehicles daily. It is a typical concrete beam structure on footings/columns/strut piers with 5.5-ft (1.7m) steel girders on the three main channel spans. Each of its 14 footings is supported by seven to nine concrete piles along with two uncoated steel H-piles. According to NACE International member Matthew Duncan, a corrosion mitigation technologist with FDOT, divers conducting bridge inspections in 2000 detected heavy corrosion of the steel H-piles that other bridges in that area were not experiencing. To mitigate the corrosion on the H-piles, the FDOT's corrosion group decided at that time to implement a galvanic cathodic protection (CP) system using bulk zinc anodes.

Photo courtesy of FIU

*The Mickler-O'Connell Bridge, located just south of St. Augustine in northeastern Florida, crosses the Matanzas River to connect Anastasia Island with the mainland.*



*The presence of macrofouling and MIC is suspected to have caused holes in the H-piles. Photos courtesy of FIU and FDOT.*

The CP system, installed and energized in 2006, included an anode string for each of the bridge's nine piers. Seven anode strings were comprised of three 50-lb (23kg) zinc anodes cast onto a galvanized cable, and two anode strings consisted of two 50-lb zinc anodes on a galvanized cable (for H-piles with a small amount of seawater exposure between the mudline and the footing). The bottom ends of the anode strings were anchored into the mudline.

## High anode consumption and continued corrosion

The CP system was monitored, and after one year of service, the FDOT corrosion group observed a high consumption rate of the anodes. During a biannual visual inspection, it was verified that the anodes were depleting faster than anticipated. In 2008, the FDOT corrosion group determined that the galvanic CP system was inadequate. Corrosion on the H-piles had continued. The corrosion was not generalized—it did not cover the entire surface of the steel. Instead, it appeared as localized sections of pitting and holes on the H-piles' web and flanges. The corrosion pitting and holes were discovered in water depths that ranged from ~1 to 30 ft (0.4 to 9m) below the pile cap, with a median water depth of 2.5ft (0.8m). A large percentage of the deficiencies occurred close to the water surface. Most of the corrosion pits were 0.125 in (3mm) in diameter, but pits with diameters up to 0.5 in (12mm) and corrosion holes with diameters as large as 3 in (76mm) were recorded. The corrosion cells/pits were covered with a bright orange plume. When the plume was removed, flakey, grey/black corrosion product was found underneath. In 2009, the galvanic CP system was replaced with an impressed current CP system designed to protect the H-piles as well as remediate footings, columns, and struts on selected piers.

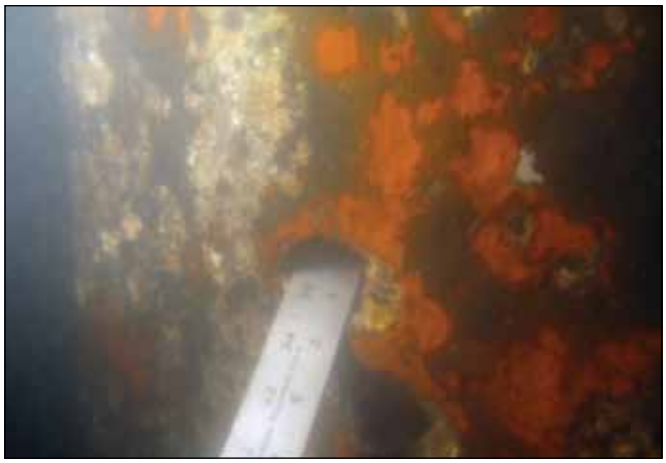
"We were surprised because we thought the CP system would be sufficient," Duncan says, noting that the magnitude of the galvanic anode consumption was quite significant.

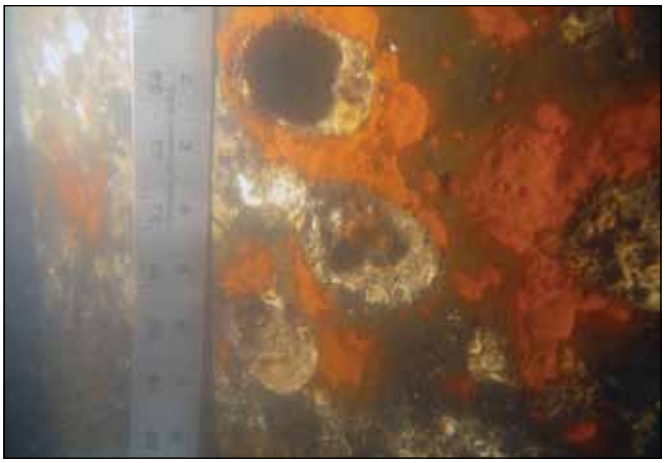
Marine environments are notorious for supporting aggressive corrosion. For bridges, it's the presence of chloride ions that typically creates corrosion problems for steel structural elements as well as steel reinforcement embedded in concrete. Chloride contamination can affect bridge elements submerged in seawater, as well as those exposed to the tidal zone, the splash zone above high tide, and the atmospheric zone.1 However, discussions on the corrosion found on the H-piles of the Mickler- O'Connell Bridge led the FDOT corrosion group to consider the possibility that the damage was being caused by MIC. Traditionally, MIC has not been a major degradation concern for Florida coastal and inland bridges; however, the severe corrosion on the steel bridge piles presented strong evidence of microbial activity.

Microorganisms can adhere to most surfaces in contact with natural waters, according to researchers at FIU. For the microorganisms to survive, the availability of nutrients is essential. The water needs to contain suitable forms of carbon, hydrogen, oxygen, sulfur, phosphorus, potassium, magnesium, calcium, manganese, nitrogen, and other elements to support microbial growth and biofilm formation. Many microorganisms, when they reproduce, create exopolymers that influence the chemistry on the surface where they are attached. MIC, an electrochemical process where corrosion is influenced by microorganisms – usually through the interaction of a biofilm with the metal surface – is known to degrade materials in a variety of industries.

According to NACE International member Samanbar Permeh, a scientist with FIU, a biofilm creates an internal environment with physical and chemical properties, such as pH, dissolved oxygen (DO), etc., that may be significantly different than the environmental properties outside of the biofilm. This causes changes in the electrochemistry of the biofilm/metal interface and can accelerate corrosion. Research has shown that 20% of corrosion costs on marine steel infrastructure such as bridges, wharfs, platforms, and pipelines is due to microorganism activity. A large portion of these corrosion costs are attributed to sulfate-reducing bacteria (SRB) that form biofilms on iron and steel, Permeh adds.

When the Mickler-O'Connell Bridge was inspected in 2014, the inspectors noted that all 28 H-piles had suffered further corrosion and were rated as being in poor condition. Random, dense patterns of corrosion cells and pits were present and a bright orange plume again covered flakey, grey/black corrosion product. The bare metal underneath was bright, and several holes (with diameters up to 3 in) were found on the web and flanges. Some of the corrosion cells and pits were located at the flange/web interface.





Photos courtesy of FDOT

*MIC is suspected to have caused holes in the H-piles.*

## Microbiologically influenced corrosion is suspected

To determine if MIC is responsible for the degradation of the steel H-piles, Permeh and NACE member Kingsley Lau, as well as other scientists at FIU, are working with Duncan and the FDOT corrosion group to research the corrosion found on the Mickler-O'Connell Bridge H-piles. The investigation will determine the bacteria present, nutrient levels, environmental conditions, and other factors at the bridge site that could support MIC.

"You have to do a test to find out which nutrients and other components are in the water that support MIC," explains Lau. "It's a multistep process. We're not 100% positive, but there is a strong likelihood the MIC is causing the corrosion problem."

During a visit to the bridge site in 2016, water samples were collected from two locations at two depths (10 and 20 ft [3 and 6 m]) below high tide (BHT). Underwater photographs were also taken. Water analysis was performed to determine if microorganisms were present as well as characterize the water's environmental conditions (i.e., DO, pH, conductivity, sulfate, chloride, phosphorus, nitrate, total organic nitrogen, total nitrogen, ammonia (NH3), and iron content) to establish whether it could support the microorganisms related to MIC.

Photo courtesy of FIU

*The corrosion cells/pits were covered with a bright orange plume with flakey, grey/black corrosion product underneath.*

Earlier assessments in 2013 using steel coupons and water samples from the bridge site had determined the presence of bacteria often associated with MIC. Bacteria found on steel coupons included a large number of anaerobic SRB (>100,000 colony forming units [CFU]/mL), and smaller numbers of acid-producing bacteria (APB) and slime-forming bacteria (SFB). Water sample analysis also indicated the presence of anaerobic SRB ( from ~100 to 10,000 CFU/mL), APB, and SFB.

Lau comments that testing on site showed that all the bacterial culprits responsible for MIC were still present. Similar to the earlier test results in 2013, SFB, APB, and SFB were identified in all the water samples tested in 2016. There was a high accumulation of SRB (~27,000 CFU/mL) at both depths at both test locations. The researchers note it is understood that the quantity of bacteria identified in the water samples cannot directly correlate to MIC risk; however, the high concentrations indicate there is a greater possibility for the bacteria to proliferate and contribute to MIC. Analyses of the water samples also confirmed the presence of important nutrients such as sulfate, phosphorous, nitrogen, and iron that can support a large bacteria colony.

"They [bacteria] can be prolific in this area, and the environment sustains their growth. We can put two and two together and say that MIC can happen on this site. Whether those holes are caused by MIC? It can be likely," Lau says, noting that MIC may be compounded by heavy marine growth, which could intensify its effect.

Lau acknowledges that more research is needed to determine if MIC is causing the metal loss and degradation of the H-piles and how to mitigate the corrosion and prevent holes from occurring. One big question the researchers want to answer is the effect of marine growth, since it's so abundant at this site. If the marine growth is heavy, will it enhance the proliferation of bacteria that support MIC?

Part of the research project will focus on macrofouling – the adhesion of barnacles and other marine life – on the steel, and how it is associated with the bacteria present and MIC. Macrofouling organisms use bacteria to seed themselves on surfaces, and the H-piles had a large amount of marine growth. Additionally,

macrofouling adhered to the H-piles created a crevice environment, which is corrosive in nature. "What we're trying to address is the effect from crevice environments that form with macrofoulers, and can they support MIC," Lau adds.

Crevice corrosion is a type of attack associated with small volumes of stagnant water or moisture found near holes, gaskets, lap joints, bolts, rivets, under insoluble deposits and disbonded coatings, and in other crevice-like areas such as under macro- and microbiological colonies. The crevice must be wide enough for reactants to enter the corrosion site, yet sufficiently narrow to contain stagnation in the crevice area. Initially the corrosion mechanism follows the same process as general corrosion, where the metal loses electrons as it corrodes at the anode. Those electrons lost by the metal are consumed at the cathode, typically by the reduction of oxygen. With time, crevice corrosion can reduce the pH in the crevice, which further accelerates the corrosion process.[1]

"We can't rule out the effect of marine growth because it is so significant and can create a local environment," Lau says, noting that macrofouling along with the presence of MIC is thought to cause localized heavy corrosion. "First, we want to understand if MIC is present underneath the macrofouling in the crevice environment. If we can determine that, we will have a better direction to turn in terms of mitigation," he adds.

## Mitigating the corrosion

The CP system used on the H-piles interests the scientists. They theorize that one reason why the corrosion damage is so considerable on the H-piles may be an inadequate level of CP. Although the level of CP on the pile was in the accepted polarization range, higher levels of CP—polarization potentials that are more negative than –950 mV vs. a copper/copper sulfate (Cu/CuSO4) reference electrode (CSE)—are typically required in the presence of MIC. "We're trying to address that at the site, especially since we have a presence of macrofouling that may shield the protected surface from being sufficiently polarized," says Lau.

The effectiveness of CP in this case also may be affected by the chemical composition of the macrofouling organisms, particularly barnacles. These creatures create a layer of calcium carbonate ($CaCO_3$) that forms crevices on the surface of the structure. When applying CP in any crevice environment, Lau explains, it is hard to cathodically polarize the environment within the crevice in a pit. In this case, the crevice is being formed by the marine growth, he says, and the CP is working to polarize the entire surface area underneath it. "It's our feeling that underneath the macrofouling, in these crevice areas, MIC is prolific and that is why mitigation by CP may be reduced and less effective," Lau adds. "We want to try more negative polarization and hopefully it will compensate for the problem with current distribution. This is a known problem with crevice environments."

Photo courtesy of FDOT

*A high accumulation of SRB was found at both depths at both test locations at the bridge site.Analyses of the water samples also confirmed the presence of important nutrients that can support a large bacteria colony.*

To identify the level of polarization that can mitigate MIC in the crevice environment caused by macrofouling, the researchers have created artificial crevices in the laboratory to represent what might be formed by sea life, and are polarizing those environments with CP. Additionally, they plan to bring in samples with existing marine growth from the bridge site. "We're looking at the physical effects of macrofouling and how it acts as a shield and may affect the CP system," Lau explains, adding that their research will also focus on SRB since the site had high sulfate concentrations that can support bacteria growth. Once the researchers determine the role of macrofouling in the corrosion of the H-piles, they can make recommendations on whether routine cleaning would reduce its effect on the steel.

In addition to CP, the researchers are looking at coatings to mitigate the corrosion on the H-piles. One type, a commercially available antifouling coating with a copper-free biocide, would prevent the formation of a biofilm or settlement of macrofouling so cathodic polarization would be improved, says Permeh. This is particularly beneficial when you have a shielding effect from barnacles and other sea life, she adds. A polyurea coating also is being evaluated to determine its effect on biofilm formation. Polyurea, a 100% solids elastomer technology, is a highly elastic, waterproof coating that has been used in wastewater plants, which also have MIC problems associated with SRB.

There are many marine regions in Florida with environmental characteristics similar to the Mickler-O'Connell Bridge site and conditions that may sustain microbial activity and support MIC. The researchers took their work a step further to identify these areas. They compared results on water chemistry and microorganism content from the case study site tests with available environmental databases from Florida's water management districts to identify locations with comparable conditions that are conducive to MIC. As a result, many sites with characteristics similar to the case study site were found. Verifying microbial activity at other sites and identifying the possibility of MIC there is of interest, and further laboratory and field testing is ongoing.

### Reference

[1] "Corrosion Control Plan for Bridges," NACE International white paper, November 2012, https://www.nace.org/uploadedFiles/ Corrosion_Central/Corrosion_101/White_ Papers/CorrosionControlPlanForBridges.pdf (November 8, 2017).

### Bibliography

Permeh, S., C. Reid, M. Echeverría-Boan, K. Lau, B. Tansel, M. Duncan, I. Lasa, "Microbiological Influenced Corrosion (MIC) in Florida Marine Environment: A Case Study." CORROSION 2017, paper no. 9536. Houston, TX: NACE International, 2017.

**MICROBIOLOGICAL ANALYSIS OF WATER SAMPLES**

| Sample ID | Water Depth BHT (ft) | Iron-Reducing Bacteria (CFU/mL) | Slime-Forming Bacteria (CFU/mL) | Sulfate-Reducing Bacteria (CFU/mL) | Acid-Producing Bacteria (CFU/mL) |
|---|---|---|---|---|---|
| A1 | ~10 | 150 | 13,000 | 27,000 | 450 |
| A2 | ~20 | 500 | 13,000 | 27,000 | 450 |
| B1 | ~10 | 500 | 13,000 | 27,000 | 450 |

**CHEMICAL ANALYSIS RESULTS OF WATER SAMPLES**

| Sample ID | Sulfate (mg/L) | Chloride (mg/L) | Phosphorous (mg/L) | Ammonia (mg/L) | Iron (mg/L) | Nitrate (mg/L) | Total Organic Nitrogen (mg/L) | Total Nitrogen (mg/L) |
|---|---|---|---|---|---|---|---|---|
| A1 | 2,700 | 20,000 | 0.11 | 0.03 | 0.58 | 0.50 | 0.29 | 0.81 |
| A2 | 2,700 | 19,000 | 0.12 | 0.03 | 0.08 | 0.50 | 0.41 | 0.93 |
| B1 | 2,700 | 20,000 | 0.10 | 0.05 | 0.08 | 0.50 | 0.51 | 1.06 |

Source: CORROSION 2017, paper no. 9536

# PosiTector® Inspection

## *PosiTector gauge bodies accept ALL PosTector probes*


Available on the App Store

GET IT ON Google Play

WiFi

### Coating Thickness
■ Ferrous ■ Non-Ferrous ■ Ultrasonic

### Surface Profile
■ Depth Micrometer ■ Replica Tape Reader

### Environmental Conditions
■ Built-in ■ Separate Magnetic Probe

### Shore Hardness
■ Shore A ■ Shore D

### Salt Contamination
■ Bresle Method

### Ultrasonic Wall Thickness
■ Corrosion ■ Multiple Echo Thru-Paint


**Customized Inspection Kits...**
Build your own kit from a selection of gauge bodies and probes to suit your needs.

Made in U.S.A.


***Award Winning Compatibility!*** *The PosiTector gauge body accepts ALL coating thickness (6000/200), environmental (DPM), surface profile (SPG/RTR), salt contamination (SST), Shore hardness (SHD) and ultrasonic wall thickness (UTG) probes.*

strictly superior

Storm machinery™

**Gauteng - Head Office**
Tel: +27 (0)11 894 2005
sales@stormmachinery.co.za

**Kwazulu Natal**
Tel: +27 (0)31 700 8332
salesdbn@stormmachinery.co.za

**Western Cape**
Tel: +27 (0)21 510 6385
salescpt@stormmachinery.co.za

**Eastern Cape**
Tel: +27 (0)41 581 0280
salescpt@stormmachinery.co.za

**Proud suppliers of DeFelsko Inspection Instruments**

# Success requires teamwork (Part 1)

By David Blackwell Engineering Director of Belzona Polymerics Ltd. Harrowgate N Yorks.

Manufacturers within the protective coatings and linings industry recognise that an unacceptably high percentage of the projects, to which we supply our products, fail prematurely. Generally, the industry is fully aware and agrees that the primary reason for this depressing statistic is that many of these applications are carried out under less than ideal conditions. Often they are suffering from inadequate/incorrect preparation and application respectively.

Most protective coatings and linings manufacturers would agree that it is becoming increasingly unlikely that these failures can be attributed to 'bad' product. Due, in part, to the vast experience gained in product formulation, coupled with the extensive product performance data gathered, it would appear that these failures can be attributed to one thing – the application.

## Teamwork begins with testing

Conscientious manufacturers subject their products to rigorous testing protocols before they even think about releasing them to industry and once this test regime is completed, most would then release the products for field trials. This first step ensures that, as far as possible, laboratory testing is corroborated by performance testing on real world equipment. Only then, would a new product be released for sale within the relevant market sector. However, in the interests of impartiality, there are many examples in industry where these protocols have not been adhered to, for one reason or another. In cases of this nature, the product in question has been swiftly withdrawn from sale until the problem has been eliminated.

*Laboratory testing of atlas cells.*

*Process vessel shapes can prove difficult to coat and inspect.*

Further to this, many potential clients have developed their own inventory of stringent "product acceptance test criteria", which must be passed if products are to be included within the client's "Coatings and Linings Specifications". This document details where and when commercially available products can be used.

Taking all of this into consideration, it is fair to assume that the cause of a premature in-service failure, of modern protective coatings, is unlikely to be a product problem. As already agreed by most, it is more likely to be associated with the application method of that product, or a correct application procedure carried out under less than ideal conditions.

For most within the industry, this conclusion is not a revelation. In fact, it is a cause which has been championed by numerous scholarly and technical bodies for many years now; NACE, SSPC, ISO, ASTM, to name but a few. All of these institutions continue to work tirelessly in promoting the principle that the correct application of any coating or lining is fundamental to ensuring an acceptable and economical system service life.

Yet the risks still remain. So what needs to be done to minimise the risk of premature coating failure and maximise the performance life of the applied coating? The answer to this question is not an easy one – if it were then it would probably have already happened!

## Maximising lifetime and minimising risk

In order to achieve the ultimate goal of minimal risk and maximum life for any coating project, several factors need to be taken into account and all of them must

work in synergy for the desired outcome to be realised. The main factors which can have an adverse effect on the quality and longevity of any coating project are, in the author's opinion, as follows:

1. Equipment design
2. Application environment
3. Application contractor experience
4. Client expectations and misconceptions
5. Coating characteristics

Within the first part of this post, we will explore the implications of equipment design in relation to their repair and protection, before examining the application environment in further detail.

## Equipment design

Until recently, the experience of most industry professionals was that process vessel designers did not automatically accept that the equipment they design may need to have a protective coating. This includes either internal linings or external coatings applied from new or at some stage during its operational life. Indeed, opinions may even indicate that since most Design Engineer training has its roots firmly embedded in metallurgy, some would dismiss the use of internal linings from the outset. Instead, they would prefer ever more complex corrosion and erosion resistant metal alloys and alloy overlays. Fortunately, due to availability and economy constraints, alongside in-service experience, this trend is now beginning to decline.

Occasionally, manufacturers, and more importantly the lining applicator, can be confronted with a process vessel that just was not designed with lining application in mind, highlighted by the examples below:

- Baffle plates too close together
- Sumps that are too deep for an applicator's arm to reach
- Welded internal furniture, making access to sections of the vessel pretty much impossible
- Small bore nozzles and nozzles that twist and turn in a multitude of directions

The list goes on. However, clients are now beginning to realise that organic linings are, if correctly installed, a viable alternative option to expensive exotic alloys. In fact, they are beginning to instruct design houses, up front, that a lining will be considered as an option for corrosion protection and that any design should take this into consideration. This message indicates that the use of an organic lining solution must become an integral part of the vessel design and delivery, requiring its own dedicated management and maintenance regimes. Any hope of making this corrosion management solution a successful and economically viable part of the equipment's life cycle costs is dependent upon this message.

Despite many asset owners and operators beginning to understand the concept, coatings and linings manufacturers must still impress that successful application and operation of any lining begins with equipment design.

## Application environment

Although the mechanisms of environmental cause and effect are fully understood, they still need to be correctly applied in order to maximise the service life of the coating or lining. It is now generally understood and accepted that the environment prevailing during any application will have an effect upon the outcome of that application. Therefore, the responsibility for applying the correct environmental controls is usually allocated to the Coatings Inspector; in fact most projects would utilise the services of at least one fully qualified professional.

Coating Inspectors are qualified and certified by the industry, for the industry and are in essence Quality Control Technicians. Unfortunately, if you ask clients, project managers or contractors what the role of the Coating Inspector is, you would be surprised at the many and varied answers you are given. Many clients assume that if there is a Coating Inspector on site, then all will be well and if it is not, then he must be responsible. Contractors generally look upon the Inspector with suspicion and distrust, convinced he is there to make them do more than is actually required and losing them their profits in the process.

In reality, the responsibilities of the Coating Inspector are to ensure that, under prevailing circumstances, the application is carried out in accordance with a written and agreed specification document. It is their responsibility to carry out specific testing in agreement with a QCP (quality control plan), in order to verify that the conditions itemised within the coating specification have been observed as far as possible. At the very minimum, they are there to observe, measure, document, and report; overall, a good Inspector will accomplish this in a completely unbiased fashion.

The Coating Inspector is a necessary requirement in order to minimise risk as much as is practically and economically possible. It is generally agreed that the Coating Inspector is a vital cog in the coatings application machine, without which the chances of success are less than optimum. However this latter statement, of course, assumes that the specification, often written by the client, is adequate for the application in hand and is not merely generic in nature. It also assumes that the application contractor can actually undertake the work in accordance with it.

*Coatings Inspector on site.*

Unfortunately, many coatings and linings specifications do not take into account the specifics of the application in hand, or in fact the environment in which the application is to be undertaken. Many are written without any knowledge at all of the application location, the product requirements or the application situation, and this is where conflicts begin to occur. Discrepancies between reality and the specification document can cause contractors to misjudge applications before realising that they cannot deliver what is required, due to the constraints of the application location. Coating Inspectors adhering to the specification then come into conflict with the contractor, who cannot comply because of additions to the original quotation.

This scenario happens all too often during the lining application phase of a project and with a small amount of cooperation, any application risks can be minimised by organising a 'Pre-Start Meeting'. By involving all parties, the specification and subsequent changes can be agreed, dependent upon the prevailing environmental conditions and location of the work site. Additionally, each party can be informed via 'Pre-Start Meeting' minutes of their agreed individual roles, authority and responsibilities.

# 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 F15 and F17.**

**Legend**

**#1** As the life of a zinc coating is proportional to its thickness, a thicker coating will proportionally outlast a thinner one, however, a thicker coating can be more prone to mechanical damage, when handled inappropriately.

**#2** All passivation products including sodium di-chromate will be excluded by the galvanizer when he has received written instructions that the hot dip galvanized steel is to be painted.

**#3** While double dipping is occasionally seen to be necessary due to a limited bath size, the galvanizer must inform the customer that this practice can increase the propensity for distortion, before he commences with the work.

**#4** While the galvanizer can lower the zinc temperature and shorten the immersion time to limit coating pickup, however, due to increased costs to himself, he is not obliged to do this and if necessary will recover the cost from the purchaser. Insufficient vent, fill and drain holes will lengthen immersion times.

**Hdg** Hot dip galvanizing **A** Accept **R** Reject **N** Negotiate **C** Clean **REP** Repair **SS** Significant surface.

## F15

**DESCRIPTION:**

Design structures in modular lengths and optimum widths to suit available bath sizes. #7

**CAUSE:**

Double end or side dipping or progressive galvanizing can be used to process fabrications that are too long, deep or wide for single immersion in the zinc bath. If the fabricated component exceeds the bath size and progressive dipping is used, touch up of overlapping or uncoated areas will be necessary. Alternatively, partial fabrication and making use of masking to prevent coating formation at the joining area, for subsequent welding and appropriate coating repair, can be used.

**EFFECT / REMEDY:**

Touch up and repair can be avoided, the cost of hot dip galvanizing reduced and the overall quality improved, if the design of the component is restricted to the length, width and depth of the galvanizing bath or alternatively partial fabrication with appropriate coating repair at the intentional weld areas, are used.

**ACCEPTABLE TO SANS 121:**

A

**ACCEPTABLE FOR DUPLEX AND ARCHITECTURAL FINISH:**

A

## F17

**DESCRIPTION:**

Uncoated and inappropriate fasteners used for bolted assemblies of hot dip galvanized structures.

**CAUSE:**

Uncoated steel fasteners that must be subsequently over coated on site with some organic coating product after installation will require more frequent coating touch-up

**F17 continued...**

and repair when compared to the service life obtainable from a hot dip galvanized equivalent.

Limiting the zinc coating on holding down bolts is unnecessary and time consuming. There is no loss of bonding when casting hot dip galvanized bolts into concrete.

**EFFECT / REMEDY:**

Specify hot dip galvanized fasteners to SANS 121:2011 (ISO 1461:2009) or ISO 10684:2004 for grade 10,9 high strength bolts.

While all holding down bolt configurations can be hot dip galvanized, more consistent coating quality is likely to be achieved if the bolts are single so that they may be centrifuged rather than fabricated into cage configurations.

For additional barrier protection overcoat the fastener with an appropriate zinc rich paint, epoxy or other appropriate top coating system. See F65 and the Association's Recommended Coating Repair Procedure.[#8]

**ACCEPTABLE TO SANS 121:**

A and REP

**ACCEPTABLE FOR DUPLEX AND ARCHITECTURAL FINISH:**

R

## When specifying galvanizing, why is it necessary to specify hot dip galvanizing?

Zinc can be applied to steel in a number of ways including hot dipping, electroplating, spraying and mechanical alloying. Each method produces a specific type of coating which will vary in its structure, thickness and performance, especially its anticipated life in different exposure conditions. This is because the life of a galvanized coating is primarily determined by its thickness.

Hot dip galvanizing is the most common method of galvanizing and is that which should always be specified for the coating of structural steels including reinforcing bar. The coating produced by hot dipping, which is metallurgically bonded to the steel and generally more than 100 µm thick, is strongly adhered to the base steel and is quite tough and damage resistant.

It is important to remember that the term *galvanizing* is often used to broadly mean the *coating of steel with zinc*. When used in isolation, it does not specifically identify the method of coating and so may be taken to allow coating by any of the available methods. This is the reason why it is important to be precise when specifying galvanizing in order that the requisite coating thickness and coating morphology will be obtained. Thus, for reinforcing steel as with most structural steel sections, *hot dip* galvanizing should always be specified.

*We wish to thank Prof. Stephen Yeomans, author of a number of books on the subject, for this contribution.*

***Editorial comment: Should hot dip galvanizing be required include reference to the standard i.e. Hot Dip Galvanize to SANS 121 (ISO 1461)." "Galvanise" versus "Galvanize" – Zinc is spelt with a "Z".***

# Comment – Overall Senior Manager-On-Site

We welcome back all our Core staff after a well-deserved break in December. We bid a sad goodbye to Ratanang who left us at the end of November last year, but I am happy to welcome the multi-talented Brenda Maree back on our staff. Brenda returned to us in January, and as a result, our membership count has already increased.

Our database will now be captured on Access, which should make our operation much smoother than it has ever been. We urge our members to continuously update their details in order to maintain an accurate database. Brenda is currently offering her secretarial and administrative skills to the various sub-committees, maintaining and building the membership database and performing the media and administrative duties of CorrISA, which will soon include the Professional Body.

We officially welcome Dr Ivor Blumenthal to our team and look forward to all the new and exciting transformations he is bringing about in our industry with the establishment of the Professional Body. We will also be welcoming a new director/general manager at the Core in the coming months.

Thus far our courses are running smoothly, events are pre-planned and our technical evenings continue to be a successful monthly event, offering a perfect networking opportunity to industry. Currently they are booked up till June. Please feel free to contact us should your organisation wish to present a technical evening.

Nominations are open for the Annual Awards. We urge our members to submit noteworthy projects as well as medal nominations for consideration. All information in this regard can be located on our website under the "Awards" tab.

Our staff at the Core would like to thank our president Mr Donovan Slade and his team of council members who offer up endless hours of their own time to support and assist the staff at the Core on an ongoing basis, this also includes the Kwa-Zulu Natal and Western Cape committee members.

Let's make this year one of the best our industry has ever experienced.

*Till next time, Liz Rathgens*

# Comment – Chairman of the Western Cape

This promises to be another busy year for Corrosion Institute of the Western Cape. We kicked off the year with a very interesting and well attended talk by Terry Smith entitled "Making an appropriate and cost effective choice of corrosion control for a particular environment" in January. Terry is a stalwart in the industry and his thoughts and ideas on the subject were of particular interest to all those who attended.

In February Hennie de Clercq who was the CEO of the SA Institute of Steel Construction gave an interesting and thought provoking talk from the steel angle entitled "Steel, the corroding material".

Last year was another busy year with well attended technical presentations, a few site visits and our first ever Expo which was very well received and a popular event. This year the Expo promises to be bigger and better so please keep an eye out for more details. It will be taking place again in September.

We also had a very successful annual dinner with the very entertaining Barry Hilton as our guest. He lived up to expectations as the quintessential South African comedy giant and made it a very enjoyable evening for all who attended.

The rest of the year is still in the planning stage but the technical presentations and the site visits that we propose should be of interest to all in the industry. Hopefully we can increase our membership base in the Western Cape and convert those who have an interest in the industry into members of the Corrosion Institute.

See you at Kelvin Grove for one of our functions soon! If you have not attended before, please feel free to join and if you have, bring a friend to the next gathering.

*Yours in Corrosion*
*Graham Duk, on behalf of Tammy Barendilla, Leonie du Rand, Thinus Grobbelaar, John Houston, Sieg le Cock, Indrin Naidoo, Terry Smith, Gilbert Theron, Flippie van Dyk, Pieter van Riet*

# Comment – Chairman of KwaZulu Natal

2018 has arrived with somewhat of a "bang". Personally, I've been fortunate to visit and instruct CIP courses with NACE International, Houston Texas. It was a privileged opportunity and an incredible learning experience.

KZN section has grown the local committee by 150% to three members – probably the single largest committee increase in the history of CorrISA. We welcome Justin du Toit from Storm Machinery to our committee and look forward to his input and assistance in our regrowth endeavours.

We're going ahead with our plan to host technical presentations every 2nd month as breakfast sessions. This concept has met with favourable input and the first is planned for March the 8th. Please make sure your contact details are correct with CorrISA so that notifications and adverts get to the correct end-user.

Once again, we welcome any ideas/input into the rebuilding of the KZN section. Please contact any of us, all details can be obtained via CorrISA, with your comments.

*Regards*
*Mark, Karyn and Justin*

# Western Cape Committee Braai

Due to work pressure at the tail end of 2017 we didn't manage to get together as a committee until mid-January. The occasion happened at Graham and Helena Duk's home where partners were also invited.

The evening for some started at "Forries" for a few beers then moved onto Graham's home where besides future events, presentation effectiveness and possible opportunities were discussed, we enjoyed laughs and a lot of fun. For an enterprising few, fun was extended to the Duk's shiny stainless steel fireman's pole where climbing up was more enterprising than just sliding down.

*A most memorable evening!*

# CorrISA Gala Dinner, Western Cape 2017

The Corrosion Institute Western Cape's 2017 Gala Dinner held in the Ballroom at Kelvin Grove was a great success. We had more guests than in previous years, despite 2017 being a tough economic year for most. Our theme was *Grill 'n Chill*, and our guests enjoyed a delicious three course gourmet braai-style meal. For our entertainment, we had South Africa's most well known comedian, Barry Hilton. Our favourite Cousin kept the laughter flowing. Our DJ played some great music for those guests who like to set the dance floor on fire and at the end of the evening there was a team of drivers to assist our guests safely home.

We thank all our sponsors for making the evening possible and all our guests and their partners for supporting the Gala Dinner and enjoying the evening with us. Our sponsors were as follows: Defelsko Corporation as Title Sponsor, Kansai Plascon, BAMR, Blastrite, Pyro-Cote, Pro-Galv, Dry Force, Satactics, Corrocoat and Jotun. This year the Gala Dinner is on 23 November and it will be a pleasure to once again delight our guests with an evening of good food, drinks and entertainment in the company of our colleagues of the industry. So please do save the date and keep an eye on your emails for our early bird special rates.


















# Progression of the Professional Body for Coatings, Corrosion and Applicators (PBCCA)

By Dr Ivor Blumenthal – Project Manager for the PBCCA

Practitioners within the coatings, corrosion or contracting industries in South Africa, are not formally recognised as professionals. They do not have the benefit either of statutory recognition nor of any self-governed scheme of professionalisation. This lack of professional dignity results in very little industry or sectoral cohesion or public identity. Certainly each industry is not viewed as suitably accountable either as individual practitioners nor as the companies which employ those practitioners, to the public at large.

In 2010, the South African Qualifications Authority (SAQA) opened a register for Industry and Sectoral Professional Bodies, which are voluntary and not statutory, to be initiated and registered, and the categories of Professional Designations, to similarly be registered and thereby formalised with SAQA.

It is for this reason that the various associations involved in coatings, corrosion and contracting have taken it upon themselves to create a professional body with the intent of professionalising each Industry and thereby the Sector as a whole.

The advantages are many. They include the development of an identity as a profession, accountable amongst peers, within a community of companies recognised as centres of excellence as employers, amongst customers and clients. Another advantage to being viewed as a profession and developing an identity to which future practitioners are able to aspire to, is that the Department of Trade and Industry has a number of supply-side incentive schemes which are then able to include companies within professions with such an identity, making grants and special project awards available which to date have not been available to consolidate and grow the sector.

Perhaps and specifically with reference to corrosion practitioners, to-date very few training instruments exist. The primary such instrument is an international set of programmes offered by NACE, through its partnership with CorrISA. Consequently thousands of NACE graduates are working in SA and throughout the world, but in our own country, South Africa their qualifications and the NACE Certifications have no formal recognised or professional standing. Importantly that means that as far as the South Africa National Qualifications Framework, National Learners Records Database or Designation Framework is concerned, NACE graduates remain unqualified, uncertified and without professional recognition.

It is primarily for this reason that CorrISA is aggressively pursuing the implementation of this professional body. It will allow the NACE qualifications and certifications to be mapped to our locally registered designations, in one of the four relevant designation categories, which remain the

- Professional Technician,
- Professional Operator,
- Chartered Professional Practitioner
- Master Professional Practitioner

Similarly CorrISA is now accredited by the MESETA for particular SAQCC-related part qualifications. These will also all be mapped to the respective Professional Designations so that those practitioners in possession of either NACE or CorrISA qualifications or certifications, will have the opportunity of applying and being considered for Professional Designations awarded by this Professional Body.

To date the following structures have received nominations of subject matter experts from each industry and are ready to commence the work necessary to complete the development and implementation of the Professional Body.

A Corrosion Chamber Board has been constituted under the Chairpersonship of Donovan Slade, current President of CorrISA. The purpose of this Board is to ensure that the Professional Body is fully mandated for services by all members of CorrISA. Similarly for coatings a Coatings Chamber Board has been constituted. These two chambers are currently the only structures within the PBCCA which are industry specific.

The PBCCA Sub-Committees all have equal number of subject matter experts from the various industries constituting the sector, which sub-committee's include:

***The Professional Designation Development Sub-Committee***

*This is the structure responsible for identifying and developing the Professional Designation Taxonomy against which jobs, qualifications and certifications which currently are circulating amongst corrosion practitioners, will be mapped and included.*

***The Education Sub-Committee***

*Responsible for establishing a policy framework for Training Provider and Learning Programme Endorsement to ensure that only those Training Providers and Learning Programmes audited and accepted by the effected industry and sector itself, are recommended, sought after and accepted amongst employers.*

***The Quality Assurance Sub-Committee***

*Responsible for developing all assessment activities for each sesignation, for conducting all assessments and for all quality assurance activities determined as necessary in relation to Endorsed Training Providers and their Learning Programmes*

***The Continuous Professional Development Sub-Committee (CPD)***

*Is charged with ensuring that there is a comprehensive calendar of lifelong development available once designation has been awarded from Endorsed Training Providers, Manufacturers and Suppliers into the sector*

***The Marketing and Advocacy Sub-Committee***

*Is responsible for taking all Professional Body Services such as designations, CPD and also the Code of Conduct administered by Patron Associations of the Professional Body (such as CorrISA for Corrosion Practitioners), to market.*

It is critical that those subject matter experts from corrosion, who have been identified and have volunteered their time to build our Professional Body for Coatings, Corrosion and Applicators are acknowledged. They are:

***Professional Designation Development:***

| | |
|---|---|
| *Tebogo Bhulose* | *Eskom* |
| *Simon Norton* | *Chem Detect* |
| *Josef Kolarovic* | *Department of Water & Sanitation* |
| *Mark Terblanche* | *Prime Inspection* |
| *Edward Livesey* | *Johannesburg Water* |

***The Education Sub-Committee:***

| | |
|---|---|
| *Armin Schwab* | *Consultant* |
| *Nomagugu Mthimunye* | *Total Contamination* |
| *Pieter van Riet* | *Corrocoat* |

***The Quality Assurance Sub Committee:***

| | |
|---|---|
| *Graham Duk* | *BAMR* |
| *Peter De Rouwe* | *Storm Machinery* |
| *Greg Combrink* | *Total Contamination* |

***The Sub-Committee for Continuing Professional Development:***

| | |
|---|---|
| *Neil Webb* | *Isinyithi Cathodic Protection* |
| *Nic Trebicki* | *Consultant* |
| *Darelle Janse van Rensburg* | *Orytech* |

***The Marketing and Advocacy Sub-Committee:***

| | |
|---|---|
| *Donovan Edward* | *Denso* |
| *Aaron Raath* | *Cathtect* |
| *Jonathan Starmer* | *Stoncor* |
| *Vanessa Sealy-Fisher* | *Isinyithi Cathodic Protection* |
| *Bruce Trembling* | *BT Paints* |
| *Terry Smith* | *Corrosion Exclusively* |

***The Corrosion Chamber Board:***

| | |
|---|---|
| *Don Slade* | *NUI* |
| *Louis Pretorius* | *Corrocoat* |
| *Greg Combrink* | *Total Contamination* |
| *Edward Livesey* | *Johannesburg Water* |
| *Armin Schwab* | *Consultant* |
| *Neil Webb* | *Isinyithi Cathodic Protection* |
| *Bruce Trembling* | *BT Paints* |
| *Donovan Edward* | *Denso* |
| *Mboneni Maruvha* | *Consultant* |
| *Terry Smith* | *Corrosion Exclusively* |
| *Robin Clarke* | *HDGASA* |

## Where to from here?

Now that we have stakeholders capable of serving as the authority for the PBCCA, and a Chamber Board capable of taking responsibility for devising the Professional Designation Taxonomy for Corrosion Practitioners, determining how professional competence will be assessed and what additional criteria will be required for the awarding of Professional Designations, we are good-to-go. The test will eventually be in the suitability of the continuing professional development the Professional Body is able

to offer which will be both of a generic and a corrosion-specific nature.

**What we do know, in the short-term is this:**

By the end of May 2018 we will have begun processing applications for designations from corrosion practitioners who are in possession of NACE and CorrISA qualifications and the requisite length of relevant experience within the industry.

By the end of May the Chamber Board for Corrosion would have settled on a deadline date for grading targets to be set for companies which are Corrosion Members to have complied with, and been assessed by CorrISA, the Trade Association, for the Professional Designation of the majority of their existing staff compliments.

By the end of August we will have awarded a pilot group of recipients in each of the Technician, Operator and Chartered Professional Practitioner categories of Designations, with the appropriate designation which will last for 3 years.

During that time those recipients will have been required to participate in appropriate linked and endorsed Continuous Professional Development activities offered by CorrISA and other Endorsed Training Providers, Suppliers and Manufacturers of product used within the corrosion industry. CPD is earmarked to commence in October 2018.

***Being a member of a Professional Body, fully designated and therefore accountable to that body, is a lifelong pursuit and that is the excitement of this project... where we begin is very different to where we end up. That will be completely up to the industry of corrosion, within the Sector of Coatings, Corrosion and Applications, to decide upon.***

## South African Institute for Non-destructive Testing (SAINT) – The Cornerstone of Engineering National Conference & Exhibition

Corrosion Institute of Southern Africa (CorriSA) was invited as an exhibitor at the SAINT – The Cornerstone of Engineering National Conference & Exhibition by Keith Cain (President of SAINT). The conference and exhibition took place on the 7th and 8th of February 2018 at the Accolades Conference Centre.

On the 7th of February 2018, Brenda Maree and Mboneni Muravha were manning CorriSA stand at the while on the 8th of February 2018, Mboneni Muravha and Nomagugu Mthimunye were manning CorriSA stand.

The event was well organized and most if not all delegates (exhibitors, attendees, organizers and speakers) were in an exuberant mood and also friendly. The organizers showed very good hospitality and took care of everyone's needs. Delegates and exhibitors came in numbers.

The main focus of the conference was non-destructive testing (NDT), however most delegates also showed an interest in corrosion throughout the duration of the conference. A number of delegates visited the CorriSA stands asking different types of questions (i.e. how does one join the organization, what are the benefits of joining, where can they get more information, what is the correlation between corrosion and NDT, which courses are they offering and etc.). Some of the delegates indicated that they already have a membership.

CorriSA exhibitors handed magazines, pamphlets and application forms to all delegates who visited their stand. One of the people who visited the CorriSA stand was a professor from Vaal University of Technology Non-destructive department, he was informed about Corrosion Institute of Southern Africa - Young Professionals (CorriSA-YP) and seemed keen to know more. He indicated that he would like the CorriSA-YP committee to visit Vaal University of Technology and offer a presentation to students.

In conclusion, it can be said that the conference and exhibition was a success from both SAINT and CorriSA perspective. CorriSA played its role and left a footprint in most individuals. We anticipate to see a moderate number of delegates/individuals applying for CorriSA membership and also participates or attend our future events. The conference also aid in consolidating the relationship/association between CorriSA and SAINT, which will help bridge the gap between corrosion and NDT as they both work hand in hand.


## NACE CIP 1 TRAINING COURSE: Johannesburg

## NACE CIP 2 TRAINING COURSE: Johannesburg

## TECHNICAL EVENT: Gauteng

## THE CORROSION INSTITUTE OF SOUTHERN AFRICA
### COURSE SCHEDULE 2018

**Introduction to Corrosion Engineering Course**
12th – 16th March 2018 — The CORē, Midrand
23rd – 27th July 2018 — The CORē, Midrand

**Economics of Corrosion**
23rd – 24th April 2018 — The CORē, Midrand
13th – 14th August 2018 — The CORē, Midrand

**Not Just Rust**
28th March 2018 — The CORē, Midrand
30th May 2018 — The CORē, Midrand
25th July 2018 — The CORē, Midrand
26th September 2018 — The CORē, Midrand
28th November 2018 — The CORē, Midrand

**ECDA – External Corrosion Direct Assessment**
21st – 22nd May 2018 — The CORē, Midrand

**CITWI – Corrosion in the Water Industry**
25th – 28th June 2018

**NACE CIP 1 – Coating Inspector Program**
5th – 10th March 2018 — The CORē, Midrand
14th – 19th May 2018 — The CORē, Midrand
9th – 14th July 2018 — The CORē, Midrand
1st – 6th October 2018 — The CORē, Midrand

**NACE CIP 2 – Coating Inspector Program**
4th – 9th June 2018 — The CORē, Midrand

**NACE CIP 3 – PEER Review**
11th – 13th April 2018 — Garden Court, Sandton

**NACE CP 1 – Cathodic Protection Tester**
9th – 13th April 2018 — The CORē, Midrand

**NACE CP 2 – Cathodic Protection Technician**
9th – 13th April 2018 — The CORē, Midrand

**NACE PCA – Pipeline Coating Applicator Training**
20th – 24th August 2018 — The CORē, Midrand

**NACE Basic Corrosion**
18th – 22nd June 2018 — The CORē, Midrand

**NACE – Corrosion Control in the Refining Industry**
3rd – 7th September 2018 — The CORē, Midrand

**NACE PCS 1 – Protective Coating Specialist (Basic Principals)**
15th – 17th October 2018 — The CORē, Midrand

**NACE PCS 2 – Protective Coating Specialist (Advanced)**
18th – 20th October 2018 — The CORē, Midrand

**NACE O-CAT – Offshore Corrosion Assessment Training / ICDA / AC Mitigation**
5th – 9th November 2018 — Belmont Conference Centre, CPT

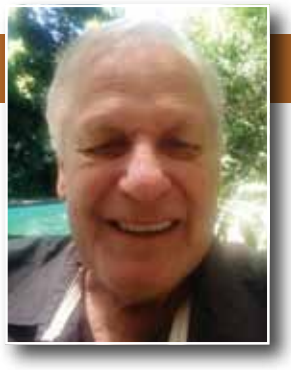
REGISTRATION LINK: https://docs.google.com/forms/d/1e9ZGDsMO1Sd8aXuCvys2bstXr5SrpVBxuqEQPK9lfUM /viewform?c=0&w=1

## TECHNICAL EVENT: Presentation by Terry Smith, Western Cape, January 2018

## TECHNICAL EVENT: Presentation by Hennie de Clercq, Western Cape Region, February 2018

# The RUST Spot...

## in conversation with Bob Millenaar



### Briefly explain your background

I matriculated in 1957 at CBC Boksburg, spent my 17th year in the SAAF gymnasium. Spent 3 years doing Chemical Technology at the Technical College and the same time was employed in various laboratories where a couple of years in the electroplating/ anodising industry, stood me in good stead for my later paint industry career. No metal will plate out on a surface even slightly contaminated! In many instances I observed inspectors from the client or 3rd party inspectorate, handling blast cleaned steelwork without the appropriate kit just before paint application.

In the early 1970's I joined Prolux paints, later to become the well-known Dulux Paint company in their Technical Services Department, under Ken Russel. I had already had some 10 years under the belt in the paint manufacturing industry employed by Wardkiss Paints at their industrial paint manufacturing plant under Don Aiken in their control laboratory.

My first project was the new Boeing 747 aircraft hangars at Jan Smuts airport (now OR Tambo). To the best of my knowledge (my memory is now a forgettery), it was painted with the then SAR & H specification for inland steel – seven coats of alkyd paint consisting of a couple of coats of red lead primer followed by undercoats and high gloss topcoats; all distinctly different colours. The problem of not achieving a specific DFT was archaically sorted out using a PIG gauge, demonstrated at my desk on my stapler by our technical manager, Tom Edwards. The unfortunate contractor had not taken into account that only white painters were permitted on state contracts; as a result his team of skilled applicators now consisted of truant playing schoolboys and "ganja" soaked hobos. The then suitably attired coating inspector, wearing a felt hat, shorts and knee length socks (acceptable PP of the day) accepted further coats of alkyd topcoat to make up for the lack of film thickness.

Many, incidents followed; fellows applying paint by holding their brush like a stabbing knife while performing the action of a salute that Hitler would be proud of.

Then Tom Edwards introduced Inorganic Zinc into South Africa. Holy Moly. I came to the conclusion that very few painters were capable of applying the "new generation" of heavy duty coatings. This was brought home to me when the owner of a small but very professional company of rubber liners phoned me one day and offered me a job paying an enormous salary with all the bells and whistles; selling for him. When I told him that I was a useless salesman and knew nothing of rubber linings to boot, he replied that if I could sell that "rubbish inorganic zinc; then I could sell anything". After about 14 years with Dulux Paints I joined a large paint contracting company by the name of Gordon Bennett (Pty) Ltd (GB). This company was sufficiently interested in the performance of protective coating systems to run a very meaningful exposure program at Oranjemund; a large diamond mine on the West coast. Exposure panels were always prepared under site conditions as opposed to those prepared under laboratory conditions. GB also had the supply and manufacturing rights for Steuler gmbh: a German company chiefly specialising

## Zinc in concrete

When zinc comes in contact with fresh concrete (or mortar) it is passivated by the formation of an adherent layer of calcium hydroxyzincate (CaHZn) (Andrade and Alonso, 2004). At around pH 12.6 the zinc surface is totally covered with a dense and compact layer of CaHZn crystals though as the pH increases the individual size and distribution of the CaHZn crystals also increases. Typically, most modern concretes have a pH around 13.1 and in these conditions passivation readily occurs.

When bright galvanized coatings react with wet cement, about 10 microns of zinc from the outer layer of the coating is consumed by the passivation reaction. This occurs through the initial set of the concrete (about 1-2 hours) though once the concrete starts to harden the reaction at the surface diminishes as the passive film forms and blankets the zinc surface. Once the passive film has formed it will remain intact even if the pH increases to about 13.6.

*Extracted from Corrosion Protection for Steel Reinforcement in Concrete: The Case for Galvanizing by Dr Stephen R. Yeomans. University of New South Wales, Canberra, ACT Australia.*

**THE INSTITUTE WOULD LIKE TO ACKNOWLEDGE THE ADVERTISERS AND THANK THEM FOR THEIR SUPPORT**

in the protection of both concrete and steel, under severely corrosive conditions. Again, the application and quality control of these systems was of paramount importance.

At this point other captains of the industry became very concerned regarding the lack of skills in applying these new coatings and many long hours were devoted by a dedicated few setting up courses, assessments, etc.

### What in essence did SAQCC Corrosion offer members of the Corrosion Institute and are these courses still available to members today?

The SAQCC (South African Qualification and Certification) was born and is today run through the Corrosion Institute. This entailed teaching and qualifying applicators, supervisors and inspectors. Many thousands of applicators have been certificated and the inspection courses are now very successfully run by the Corrosion institute through the NACE organisation.

The applicators assessment papers have been translated into Portuguese and many learners have been certificated in Angola for the Oil industry labour requirements.

The success of upgrading the industry lies in the end user demanding that only qualified staff be employed on their projects.

As far as I am aware these courses are still available today via CorrISA.

### What was the state of the industry then?

In 1962 sandblasting was practically unknown and if used, the operator was poorly protected. "Silicosis" what's that? Many died a very painful premature death in order to feather somebody's nest.

### If you could go back, what things would you do differently?

More recognised training and qualification of applicators and supervisors.

### Who played leading roles in your life in coatings?

My "mentors" to name a few are: Don Aiken; Basil Spargo; Braam Vlotman and above all Tom Edwards.

### What advice do you have for the industry going forward?

The Corrosion Institute was then known as the Corrosion Council and was more of an Old Boys Club.

The Institute's prime function now is education and the handful of dedicated people involved are doing a remarkable job at furthering this cause.

### Something about yourself: your family, sports, hobbies, pets, travel, passions...

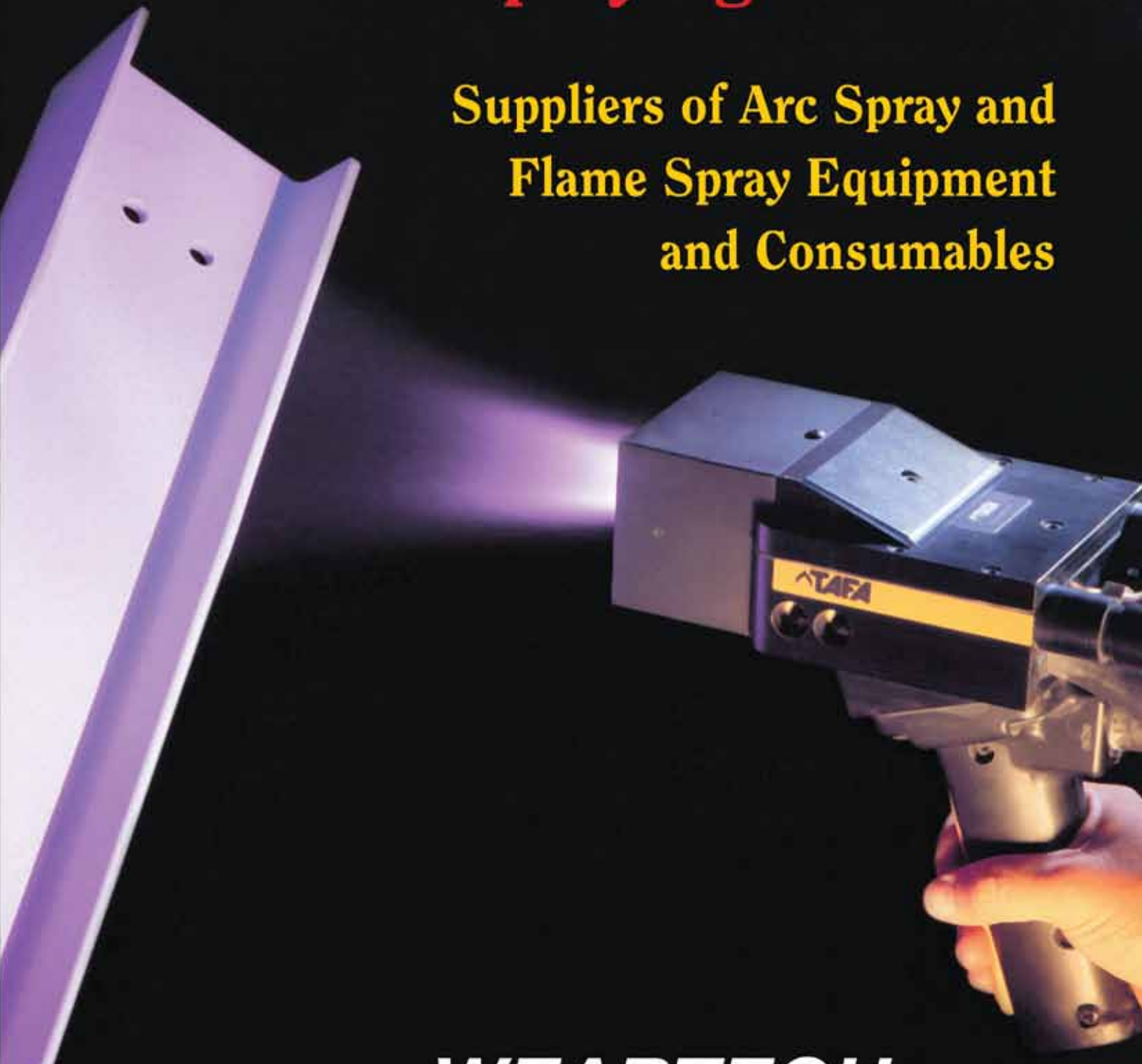
I retired some years ago and enjoy painting, cartooning etc. (NOT ON BUILDINGS).

Old cars: MGTD 1950 (could never afford a new car). Mercedes Benz SLK 1998 – tours, outings etc. Giving school kids a laugh – Noddy does exist!

Cycling (fall off occasionally) – walking my four dogs – live on a 5 acre small holding with the usual array of motley farm animals and birds; including a couple of donkeys – card evenings (still in contact with six of my school chums).

# Zinc Metal Spraying?

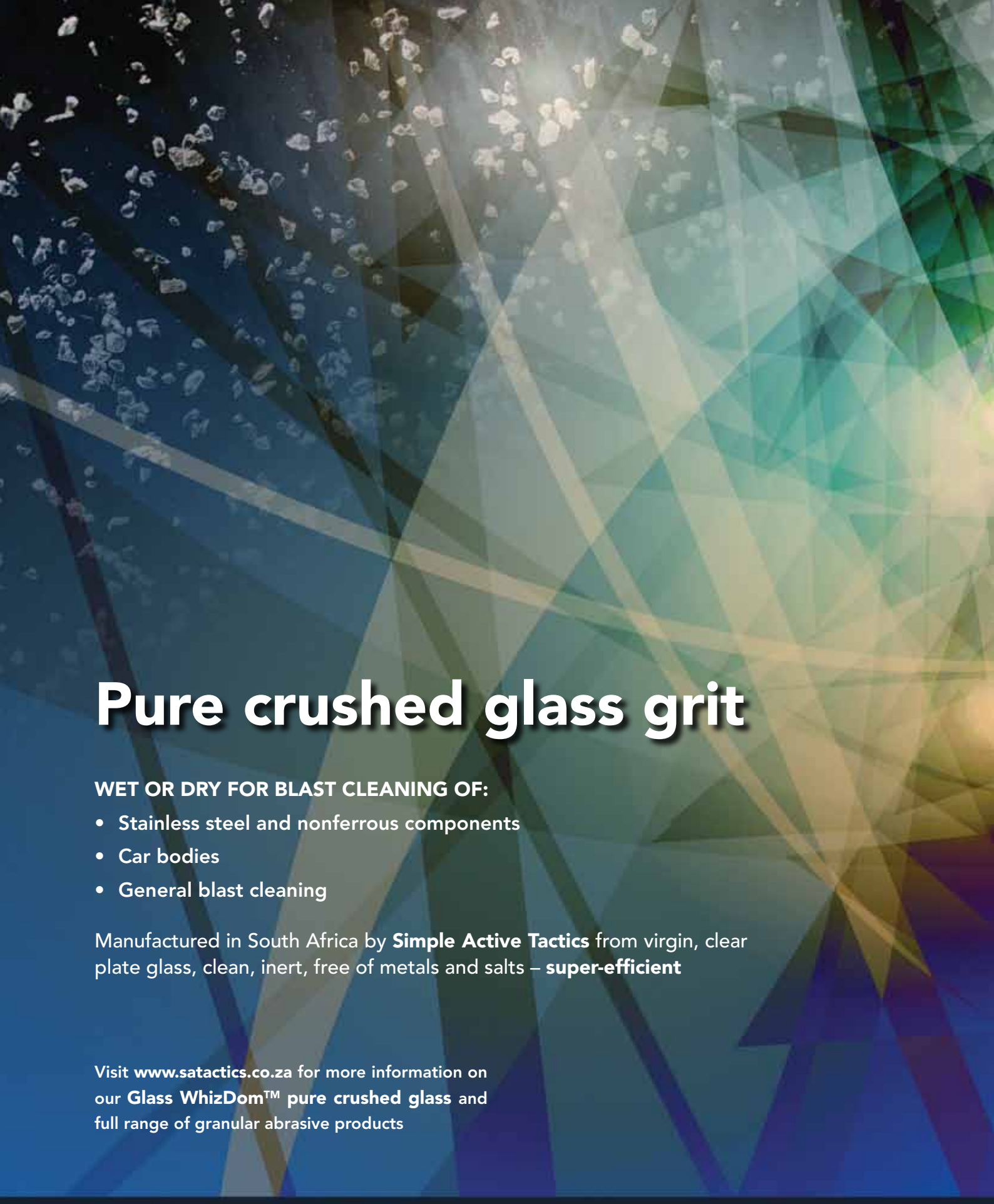
## Suppliers of Arc Spray and Flame Spray Equipment and Consumables




# WEARTECH (Pty) Ltd

THERMAL SPRAY DIVISION

187 Galjoen Street, Wadeville
P.O. Box 14125, Wadeville 1422
Gauteng, South Africa
Telephone: (011) 824-6010/2/3/4/5
Fax: (011) 824-6090
CAPE TOWN - Telephone: - (021) 447-4728
E-mail: sales@weartech.co.za
Website: www.weartech.co.za



# Pure crushed glass grit

**WET OR DRY FOR BLAST CLEANING OF:**

- Stainless steel and nonferrous components
- Car bodies
- General blast cleaning

Manufactured in South Africa by **Simple Active Tactics** from virgin, clear plate glass, clean, inert, free of metals and salts – **super-efficient**

Visit **www.satactics.co.za** for more information on our **Glass WhizDom™ pure crushed glass** and full range of granular abrasive products

SAT
SIMPLE ACTIVE TACTICS SA (PTY) LTD

**Simple Active Tactics SA (Pty) Ltd:**
P O Box 59, Noordhoek, 7979, Cape Town, South Africa
Tel: +27 (0)21 7891884 • Fax: +27 (0)866685136 • Email: sales@satactics.co.za • Web: www.satactics.co.za