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HOT DIP GALVANIZING TODAY 69

The Official Publication of the Hot Dip Galvanizers Association Southern Africa

CORROSION CONTROL OF STEEL

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EXECUTIVE DIRECTOR'S Comment

CREATIVE, INNOVATIVE AND THE DISCIPLINE OF STAYING TO STANDARDS

South Africans are known for their "can do" attitude and the ability to get the job done. This ability is often displayed in the field of engineering. Whilst innovation and creativity in design and execution of projects must be encouraged, engineers are also bound by the laws of physics. This factor and also, I suspect, to promote safety and to prevent accountants and lawyers from squabbling over interpretations or opinions related to the veracity of goods and services has led to the development of standards for many products and even some technologies or process outcomes.

In the main, our South African bureau of standards often use international standards, such as ISO standards, as a platform for deriving our own standards or SANS for short.

As the hot dip galvanizing fraternity two challenges exist:

- SADAC countries should adopt a universally understood and accepted set of standards related to steel, steel structures and the various downstream value added activities related thereto.
- Designers, fabricators and the down stream value adders from the formal sectors should be familiar with the standards. Also, education of the informal sector should continue to be a priority.

As an example of this, ISO 14713-parts 1 and 2 deal specifically with the design requirements that are to be followed when fabricating steel to be hot dip galvanized. These standards are not compiled to be restrictive but set down some rules that promote a successful outcome. The ability to vent and drain sub-assemblies and properly finished welds will all enhance both the aesthetics and corrosion control characteristics of a hot dip galvanized item.

Hot dip galvanized articles themselves must comply to standards and the evaluation of the finished products are to be assessed against these standards. Some standards, to name a few are:

- SANS 121:2011-ISO 1461:2009 – Batch type galvanizing of iron and steel articles
- SANS 32 – EN 10240:1997 – Pipe and tube hot dip galvanized in an automatic process
- ISO 10684:2004 – Friction grip fasteners

Standards also exist for hot dip galvanized wire, steel coil, rates of corrosion of metals in various environments etc.

The Association allocates a fair percentage of its time to providing technical advice, guidance and formalized training in the understanding and application of these standards.

In conclusion, knowledge of standards and the rigorous application of standards ensures good alignment of expectations, the promotion of sound designs without stifling creativity.

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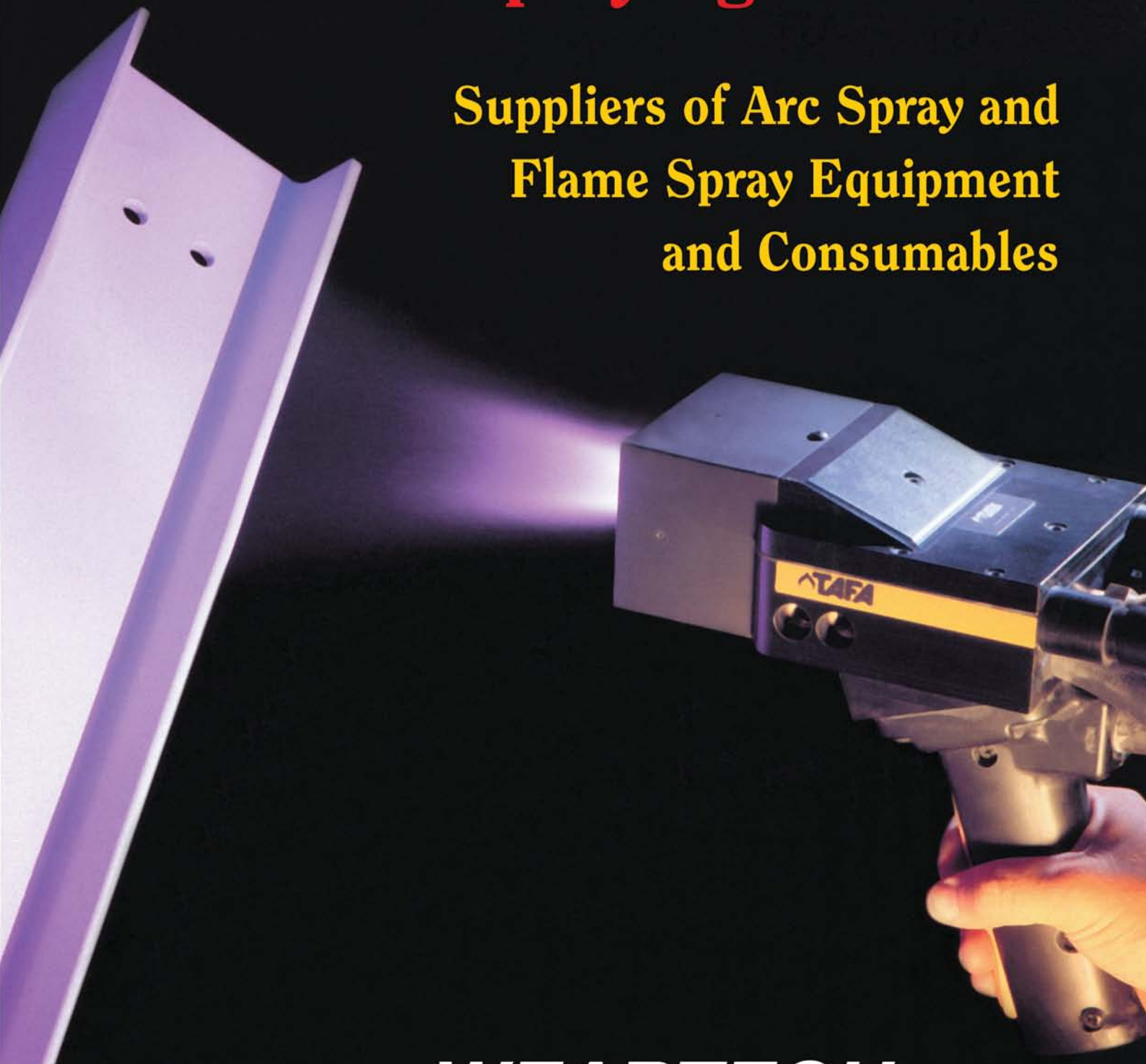

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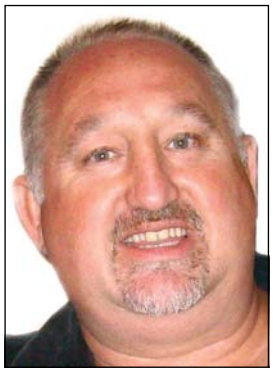

EDITORIAL COMMENT
in this issue

The electrical genius Voltaire, stated in the seventeenth century that "Common sense is not that common" and it seems that over time and even into the twenty first century we rely on others more than our own intellect to deal with the challenges we face each day. It seems evident that when we decide to apply any technology that we should at least have a general understanding of the extent and limitations to which such can be applied. Yet in this era of information and access to data we still rely on others to manage our expectations regarding the technology of our choice.

Hot dip galvanizing has been around for centuries and has a documented scientific history that dates back at least 150 years. The technology is well documented and has proven itself as a core corrosion control technology for iron and steel. These facts are supported by the plethora of organizations that specify hot dip galvanizing for corrosion control. Here lies the rub, apart from a historical standard handed down from generation to generation the engineering and fabrication fraternity consistently have expectations of hot dip galvanizing that have no foundation in fact or even common sense. It is to this end that we as the Hot Dip Galvanizers Association provide training and access to information in both print and electronic format at no cost to the specifier, engineer, architect or other interested parties regarding hot dip galvanizing. In this issue we cover the following:

- Variation in colour of hot dip galvanized coatings
- Case studies relating to wet storage staining or 'white rust'
- Training in Hot Dip Galvanizing and Inspection thereof
- Africorr 2018 – Corrosion Control Conference

The need to drive investment relies on a combined effort of all industry players to provide the market with proven opportunities for investment as highlighted in the following articles:

- Innovation in the building industry – the use of hot dip galvanized steel structures
- Solar energy review report on Kathu and Bokpoort CSP's

The industry is dynamic and specialists are key to best practices available to the stakeholders, see our Personality Profile of Darelle Janse van Rensburg, a leading scientist in the Corrosion Control Arena.

It is incumbent upon each individual to make the best use of the knowledge we have and to use it sensibly. As Tom Peters, author of the best seller IN SEARCH OF EXCELLENCE, states "Almost all quality improvement comes via simplification of design, manufacturing... layout, processes, and procedures "

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COATINGS & CHEMICALS

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A FEW RECENT FIELD QUERIES HAVE BEEN RELATED TO QUESTIONS ABOUT VARIATION OF COLOUR ON HOT DIP GALVANIZED ARTICLES. THE ASSOCIATION HAS TRAVELED TO INSPECT AND ASSIST WITH THESE QUERIES. A FEW EXAMPLES ARE ILLUSTRATED PICTORIALLY IN THIS ARTICLE.

HOT DIP GALVANIZED surface finishes

The surface finish of hot dip galvanized carbon steels is strongly related to the chemistry of the components or article being galvanized.

In the first instance carbon steels are broadly classified into

- Aluminium killed steels <0.03%
- Silicon killed steels >0.03 %

The term "killed steel" relates to de-gassing of molten steels during the production of steels.

Aluminium killed steels are less reactive to molten zinc and normally form bright silvery coatings in the range of 40µm to 70µm. Over time these bright coatings will migrate to a matt grey finish as the zinc reacts with the atmosphere to create a zinc carbonate film.

Silicon killed steels with a chemical composition of Si 0.15% to 0.25% and a very low Phosphorous content tend to produce coating thicknesses in the range of 100µm to 200µm.

Silicon killed steels outside of this Silicon range on the other hand can have a wide range of reactivity when immersed in molten zinc. Often the Phosphorous can combine with the Silicon content to amplify the reactivity. Coating thickness of 150µm to over 350µm can be generated with some variation in texture and colour. Such variations are a direct result of the coating morphology resultant from:

- The actual Silicon or Silicon/ phosphorous content of the steel
- The rate of cooling after galvanizing

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1- 4 Colour variation on hot dip galvanized articles.

- The design of the article, in particular any concentration of a mass of steel that retains heat.

Simplistically, the coating generated in Silicon killed steels by the hot dip galvanizing process will continue to develop at 330°C (or hotter) if molten zinc is available to react with the carbon steel. The molten zinc is transformed into a Zinc/Iron alloy (the Delta layer) of about 88.5% to 93% Zinc and 7% to 11.5% Iron. There may be some development of a Zeta alloy with about 6% Iron content. The exact composition and surface distribution of these alloys will vary dependent on the amount of Silicon in the carbon steel as well as the availability of molten zinc and the length of time the reaction is allowed to take place for.

Therefore, the occurrence of darker of lighter areas (e.g. cellular pattern or dark grey area) across an article does not represent poor quality of hot dip galvanizing but is a natural phenomenon most strongly related to the chemical composition of the steel. This phenomenon of colour variation is specifically addressed within the SANS 121:2011-ISO 1461:2009 standards as not giving cause for rejection, since the variation in alloy development does not detract from the corrosion control characteristics of the coating

AND

all surfaces will react with the atmosphere to form a zinc carbonate layer. The formation of this dull matt grey layer over time will ultimately result in a uniform color across the article.

INTERNATIONAL RECOGNITION OF THE BENEFITS OF 'CLEANER' ENERGIES IS GAINING TRACTION AND DESPITE CERTAIN CHALLENGES SOUTH AFRICA IS ALSO BUYING IN TO THE TREND

SOLAR FLASH – hot dip galvanizing's role

A variety of technological options exist and two large solar plants delivering electricity into our national grid are doing so from Concentrated Solar Power (CSP) plants.

The science behind CSPs can be explained simply. The curved mirrors, supported on hot dip galvanized steel frames, concentrate the suns energy onto a receiver. The receiver carries liquid, usually molten salts through heat exchange systems. This is then used to produce steam in a controlled manner to drive the generators to produce electricity.

In December 2017 Bokpoort CSP broke a solar thermal energy production record by delivering 1009.31 MWh in a single day. While solar energy has been the subject of robust debate the success at Bokpoort CSP proves the all-round potential of the technology.

1 Upington CSP Plant.


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2 Bokpoort CSP Plant.

Galvanized steel plays a key role in ensuring the long-term service life of these plants by ensuring a low cost maintenance of the support structures through corrosion control. The supports are expected to last well over 80 years from installation.

Kathu Solar Farm CSP aka Xina Solar One, has proven its salt, pun intended. The plant uses molten salts as a thermal energy storage system. The 100MW turbines are driven through the focus energy delivered to the central tower by heliostats.

Heliostats are at the core of the equipment for CSP receiver plants. Each heliostat is comprised of curved mirror segments supported by hot dip galvanized steel structures. With heliostats varying from 1m^2 to 120m^2 the necessity for certainty of the support structures' corrosion control is critical. Hot dip galvanizing provides the proven, repeatable and reliable benefits of both barrier type and cathodic protection in one technology. The hot dip galvanized skeleton is designed to provide 80 years plus corrosion control to the steel. A vast tonnage of steel was hot dip galvanized in the support structure to ensure corrosion control of the frames in both soils and the atmosphere.

Photovoltaic systems also require steel support structures and some of the recent successful projects implemented will be showcased in the next issue of Hot Dip Galvanizing Today.

KROME

THE ELEMENT OF PERFECTION

THREE DECADES OF EXPERIENCE HAS TAUGHT US A THING OR TWO

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OUT & ABOUT

GALVANIZING EVALUATION after leaving the custody of the galvanizer

HOT DIP GALVANIZING IS THE FOREMOST PROVEN CORROSION CONTROL TECHNOLOGY FOR STEEL AND IRON. IT HAS A PROVEN RECORD OF MORE THAN 150 YEARS OF RELIABLE, PREDICTABLE AND REPEATABLE APPLICATION.

The Hot Dip Galvanizers Association is frequently requested to evaluate hot dip galvanized articles that have been released from the galvanizer and are on site. These requests vary from concerns over wet storage staining to rejection of galvanizing previously accepted at time of delivery. In every case the evaluation is done against the standards and specifications appropriate to the hot dip galvanizing application. This methodology ensures an impartial and referenceable adjudication approach. In the South African context the majority of cases are evaluated against SANS121:2011(ISO1461:2009(E)). The HDGASA also evaluates hot dip galvanizing against other South African and international standards that are appropriate to the type and contracted standard being used.

The standard is the primary reference document. Further specifications by the purchaser are also referenced when undertaking an evaluation. In some instances the standard and specifications are referred to only in the technical drawings and it is expected that the fabricator and galvanizer take the responsibility to acquired and apply the standard(s) and specification(s) rather than these being included in the contract documentation or order. Without being fully informed of the content of these documents the designer, fabricator and galvanizer are in a precarious position when it comes to the type of queries that have the HDGASA conducting evaluations.

When called upon to evaluate work done on hot dip galvanized articles, the HDGASA will always request the following:

- A copy of the order placed on the hot dip galvanizer.
- The standard against which such an order has been placed.
- Any customer specification or additional requirements for the hot dip galvanizing of the article(s).
- The certificate-of-conformance issued by the hot dip galvanizer.
- A non-conformance notification or report by the party querying the hot dip galvanizing of the article(s).
- It is always recommended that the relevant person(s) be in attendance when such an evaluation is arranged.

To illustrate the situations being discussed a few examples are included.

CASE STUDY 1: Road Guard Rail

Following an inspection before final handover several 'defects' were alleged by the client and their consulting engineering practitioner. The alleged defects included, white rust, pitting corrosion, surface unevenness and variation in colour of the galvanizing.

The hot dip galvanized guard rails had been installed in situ alongside a national road. The project had been running for a couple of years and the hot dip galvanized guard rail had been delivered to site several months prior to it being installed.

At the meeting on site the alleged 'defects' were discussed in a meeting prior to the inspection of the installed material. The contractor and other contracted parties were not trained in evaluating hot dip galvanized materials and had a rudimentary, albeit reasonable, understanding of hot dip galvanizing. The documentation and copies of the standards and specifications while being referenced were not on site. No non-conformance report was available for review.

The standard specified in the contract documents for Hot Dip Galvanizing was SABS 763. SABS 763 is obsolete and has been superseded by SANS 121: 2011 (ISO 1461: 2009(E)). Certification and or use of the SABS Mark is only applicable in terms of SANS 121:2011 (ISO1461:2009(E)).

A brief discussion of the SANS 121:2011 (ISO1461:2009) Standard was held and the attendees were made aware that:

- Although the Standard is specific to inspection of Hot Dip Galvanizing

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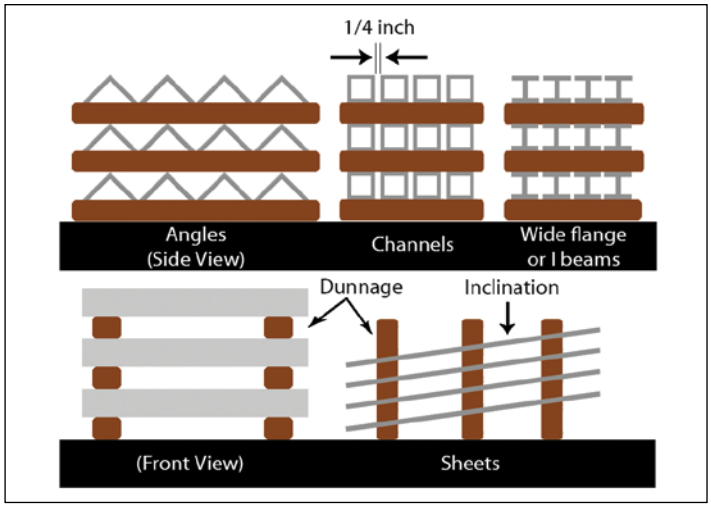
1 Stacking practice: Nested stacking with insufficient airflow between individual articles and stored in the open are highly susceptible to the formation of excessive wet storage staining ("white rust").

2 Diagram of recommended storage layout.

"while in the custody of the galvanizer" [SANS 121: 2011 (SO 1461:2009); Paragraph 5 Acceptance inspection and sampling], it would be applied in evaluation at this time to accommodate the customer's intent in specifying a standard for hot dip galvanizing.

- The standard was referred to regarding Coating Properties particularly paragraph 6.1 Appearance. Firstly it was explained that the coating roughness was a relative term and that roughness would be evaluated against the criteria of "if it would cause harm". It was also noted that "The occurrence of darker or lighter areas or some surface unevenness shall not be cause for rejection". It was advised that "The development of wet storage staining... shall not be cause for rejection, providing the coating thickness remains above the specified minimum value" In such cases the Minimum Mean Coating Thickness appropriate to the guardrail is 55µm when consulting Table 3 of SANS 121:2011 (ISO1461:2009)
- It was recommended that when ordering hot dip galvanizing to SANS121:2011(ISO1461: 2009(E)) that the 'Appendix A' in the standard be completed with at least the 'essential information' for provision by the purchaser viz. A.1 - The number of the international standard, i.e. SANS 121:2011 (ISO1461:2009(E)), be supplied by the purchaser to the hot dip galvanizer.



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A visit was then made to the site office laydown area. Here several guardrail sections which had been removed from service had been stacked. The stacking practice was of concern. The potential for development of wet storage stain with 'un-weathered' product was noted. Applicable literature was handed out to the attendees which recommendations of appropriate methods for packing to prevent wet storage staining arising.

The group was then taken to a section along the national roadway where

TABLE B: COATING THICKNESS (µm)				
	Batch 1	Batch 2	Batch 3	Batch 4
n	20.00	20.00	20.00	19.00
$\bar{x}$	342.00	167.80	120.20	78.06
≤	83.10	84.10	78.70	68.60
≥	1194.00	397.00	200.00	106.00

KEY: n = number of individual readings.
$\bar{x}$ = mean minimum coating thickness.
≤ = lowest individual reading.
≥ = highest individual reading.

guardrail had been installed. Along this and other similar sections of installed guardrail, several areas of the material were seemingly 'out of condition'. In these areas the concern was that corrosion control may have been compromised and that the guardrail may have to be replaced.

Several areas were indicated where the material was perceived as 'unacceptable' Photos of these are shown in pictures 3 through 5. Additionally coating thickness measurements were made to determine the 'representative' coating thickness in these areas and results obtained are shown in *Table B*.

It was recommended that:

- All contract documents be reviewed and where appropriate that the specification be updated from reference to SABS 763 to SANS 121:2011(ISO 1461: 2009(E)) and consistently applied.
- That training of all personnel responsible for inspection and/ or needing a working knowledge of hot dip galvanized material in accordance with SANS 121:2011 (ISO1461:2009(E)) be considered.
- That all hot dip galvanized guardrail not covered in this sample survey be

3 Uneven surfaces.

4 Products of Zinc corrosion vis Zinc Oxides and Zinc Hydroxides are necessary for the development of the Zinc Carbonate surface patina. These will be evident in the initial stages of the weathering process and are not considered as significant in reducing the corrosion control of hot dip galvanizing.

5 Where wet storage staining has been removed the underling surface shows the conversion barrier coating of Zinc Carbonate. Eventually the entire surface will develop this surface patina. This is considered hot dip galvanizing's first line of protection in corrosion control of steel.

evaluated by a suitably certified third party hot dip galvanizing inspector. That in the event that wet storage staining is identified it be attended to in accordance with the criteria and in light of the additional information given below.

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Wet storage stain: description, prevention, cure and evaluation

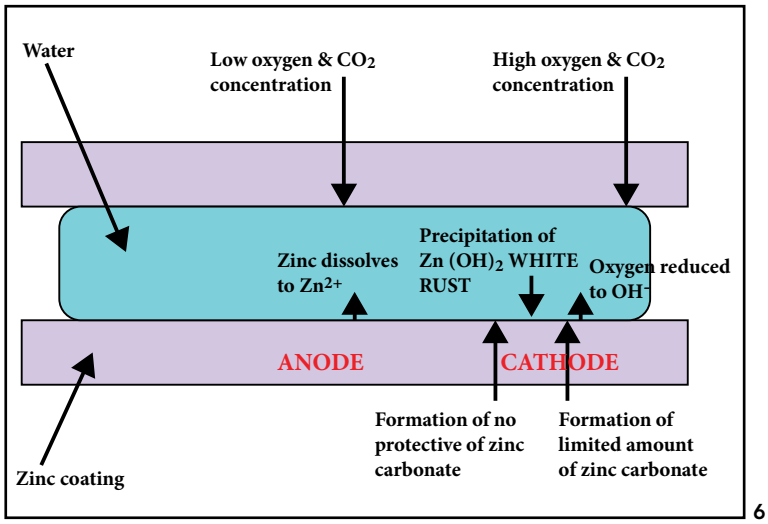
Galvanized steel is protected from corrosion by the formation of a protective zinc carbonate film over the zinc surface. In order to form, exposure is required to free flowing air. Freshly galvanized articles that are stacked in contact with one another so preventing the free circulation of air may, in wet or humid conditions, start to show "white rust". This is a white powdery covering of a mixture of zinc oxide and zinc hydroxide. As this is unable to stabilise, in poorly ventilated packing, the protective zinc carbonate film does not form and the reaction on the zinc surface continues. White rust is voluminous and, as a result, often looks worse than it actually is. However, conditions which encourage its formation should not be allowed to persist.

Prevention

Wet storage stain is easily avoided by storing galvanized articles off the ground. If stacked, articles should be separated from one another to provide free circulation of air. It is recommended that stacking be at an angle to provide for drainage of water which may otherwise become trapped.

Treatment

Normally, light staining is not serious and is arrested after affected areas are dried and exposed to the atmosphere. In time, the colour of the affected area will



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6 The formation of 'white rust'.

age to match that of normally weathered galvanized steel.

Where more stubborn deposits are evident, these are easily removed using a stiff bristle (not wire) brush and, if necessary, a cleaning solution can be used. Typical solutions would be ammonia (2%) or acidified sodium dichromate (2% sodium dichromate with 0.1% sulphuric acid). In both instances, the cleaning solutions should be thoroughly rinsed off after treatment and the article allowed drying.

Evaluation

As per SANS121:2011 (ISO1461:2009(E)) Paragraph 6.1 after removing the deposits of wet storage stain check coating thickness (mean minimum average as per Table 3). Providing the measured mean minimum average thickness exceed the standard's stipulated parameter there shall not be cause for rejection. Should the mean minimum average thickness not be achieved it is recommended that remediation or replacement of the affected unit be undertaken.

Further information is available on the HDGASA website: *http://www.hdgasa.org.za/wp-content/uploads/2015/12/HDGA-Info-Sheet-No2-White-Rust.pdf*

CASE STUDY 2: Bearing plates (anchor works)

An intervention by the HDGASA was requested from a fabricator regarding galvanized bearing plates, for a Dam Raising Project that had been rejected as "...not conforming to the required standard."

The project had been running for three years prior to the request made for evaluation of the hot dip galvanized bearing plates by the HDGASA. More than seventy bearing plates were sent for hot dip galvanizing to two separate galvanizers. The galvanizers completed all hot dip galvanizing in the latter half of the second year of the project. All hot dip galvanized articles were accepted and delivered at that time by the contractor who took custody of the articles. The articles were warehoused on site. The project stalled for a substantial period of time due to reasons unrelated to the bearing plates. Notwithstanding the delays a majority of the galvanized bearing plates were placed into service in the meantime.

Two years after delivery to site and following a site inspection, of several not-yet-installed bearing plates, the articles were rejected allegedly due to the hot dip galvanizing not complying with the requirements of the standard. The contractor was advised of this decision although a Non-Conformance Report was not issued and the standard against which the inspection had been carried out by the resident engineer was not specified.

The galvanizers had finalized and released all batches almost a year prior to the HDGASA's receipt of a request for evaluation from the contractor. Certificates of compliance to SANS 121:2011(ISO 1461:2009(E)) had been issued for each batch collected by the contractor. Furthermore the galvanizers had, over the intervening period, assisted the contractor with renovations to the galvanized coating, on an adhoc basis. These renovations were predominantly undertaken to repair coating damage which had arising from 'rough' handling at the storage site and rework such as drilling and tapping by the contractor after the galvanized bearing plates were delivered.

The evaluation primarily focussed on gathering data. The inspection of the 'rejected' articles was initially undertaken in accordance with SANS 121:2011(ISO461:2009(E)) notwithstanding the fact that the articles had previously been accepted after inspection prior to leaving the custody of the galvanizers and again on site at

1 Bearing plate: A typical bearing plate with bolts and some refurbished areas. Note the colour variation as the hot dip galvanizing coating weathers from a light to dull grey patina.

2 Patched area: An over enthusiastically patched zone appeared to exceed the allowable area for renovation. The patch was however not applied to renovate the coating but rather as a means of improving the aesthetics of the article by the fabricator.

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the site storage facilities. All the articles had been delivered to site well within the critical path time frame for the project.

The contractors understanding of hot dip galvanized coatings, the applicable standards and testing methods was rudimentary. Some site personnel exhibited a better understanding of SANS121:2011(ISO1461:2009(E)).

The mechanisms of barrier protection by, the weathered, Zinc Carbonate film and sacrificial Cathodic Protection of the steel by the hot dip galvanized coating was discussed with all parties at the site. The principle of a 'minimum' specified coating thickness rather than any single reading or 'required' thickness was explained. The concept of coating thickness readings being taken so as to be "as representative as possible of mean coating thickness" was clarified.

Cognisance of several factors was taken that may have contributed to the need for current evaluation long after the materials were delivered to site. Changes in authorized decision making personnel occurred after the articles had been accepted and delivery to site. The extended period over which the articles were warehoused exposed the articles to additional and uncontrolled handling with consequential damage to the coating. Work conducted by the naïve contractor to 'improve' the aesthetics of the bearing plates using epoxy and bright 'galvanized' coloured aerosol paint also contributed to an easily avoided need for evaluation.

The remaining bearing plates were stowed on pallets in the open at the site

3

3 Reference areas: The above mentioned patched area covered roughly 16 times the refurbishment area allowed of 10cm^2 and <0.5% of surface area of the article hot dip galvanized [SANS121:20011 (ISO1461:2009(E))] However readings showed that the coating thickness once the patch material had been removed, was well in excess of the required coating thickness specified in the standard.

laydown area. A visual inspection by the HDGASA was undertaken and two of the lot showed exposed substrate with some red rust evident. In these instances the affected areas requiring renovation exceeded the 10cm^2 stipulated by the standard. Numerous areas of 'oversized patching' were evident on all articles. The rejection of these articles was based primarily on these large 'repair' zones covered with epoxy and bright 'galvanized' paint. It was reasoned that these large areas, >0.5% of surface area, were suspected of being renovated areas where the galvanized coating had not formed or where the coating was found to be <85 µm across an area >10cm^2.

It was stated by the contractor that the large zones had been 'worked' to enhance the aesthetics of the articles to ensure approval by the client. This work was carried out at the contractor's workshop who requested assistance from one of the galvanizers in the preparation, mixing and application of the reworking products.

One article in particular showed two excessively large 'patched' zones. The zones were then carefully cleaned of the paint and denuded of the epoxy with light wire brushes and hydrocarbon wash down. Each zone was then divided into several reference areas of approximately 10cm^2 each across the face of the zone so as to be as representative of the coating across the 'worked' areas as possible.

While some renovation was required the hot dip galvanizing was capable of providing corrosion control of the bearing plates beyond the minimum requirement of the standard (85µm) by up to 8 times. In a majority of the cases the damaged coatings arose predominantly due to poor methods of handling and storage over an extended period of time. Attempts by the contractor to submit aesthetically pleasing articles for inspection, paradoxically, resulted in concerns regarding the extent of renovation of the coating and subsequently resulted in the rejection of the 'as-yet-uninstalled' articles by the client.

Several other issues were raised. The traceability of the bearing plates and the specific readings associated with each unit were not in place and traceability as to which galvanizer had galvanized a particular plate was of concern.

It was recommended that:

- At least one member of the construction team should be duly qualified as a competent hot dip galvanized coating inspector. Acceptance inspections should be undertaken in accordance with SANS 121:2011 (ISO 1461:2009(E)) on behalf of the contractor.
- Acceptance inspection must be undertaken while articles are in the custody of the galvanizer.
- Articles for galvanizing should be permanently marked to enable traceability of the article and reference to the relevant articles.
- All small damaged areas <10cm^2 could be repaired on site using Galvpatch or equivalent as per SANS 121: 2011(ISO 1461:2009(E)) paragraph 6.3 Renovation.

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INNOVATION IN THE BUILDING INDUSTRY – the use of hot dip galvanized steel structures

IN 2003 DUBLIN CITY COUNCIL ISSUED A BRIEF AND LAUNCHED A COMPETITION TO SECURE A JOINT VENTURE PARTNERSHIP THAT WOULD BUILD AFFORDABLE HOUSING ON A 4 HECTARE COUNCIL OWNED SITE TO THE NORTH WEST OF THE CITY.

Similar housing and development challenges in South Africa have suggested that we look beyond our borders and seek proven opportunities for investment in developments that will provide South Africa with the vehicle necessary for growth.

The Dublin development became known as the Cedar Brook development.

Innovative techniques and practices were deployed on the project to facilitate speedy erection and deliver quality dwellings that would require low maintenance. These innovative techniques resulted in the delivery of 376 units. By clever design and variation of layout of both 3 and 2 storey buildings, a density of 94 units per hectare was achieved. Most impressive however was that building times were 35% quicker than traditional methods and at no additional cost.

The use of hot dip galvanized steel throughout the development stands out as a significant feature and also contributed significantly to attaining the project brief of fast construction. Since the hot dip galvanizing process occurs in a controlled factory environment the steel can be delivered on site complete and ready for erection. No other finishing was required. With well specified steels, the coating characteristic of the zinc and zinc-iron alloy layers are that of tough abrasion resistance ideally suited to onsite handling and erection.

Fourteen years on, the estate is surrounded by mature trees and shrubs. The development displays all the evidence of meeting the original design brief of longevity with a requirement of low maintenance. Measurements of hot dip coating thicknesses confirms that the steelwork is probably coated to exceed a further 50 years of maintenance free performance.

This article is a summary of a case study published in Hot Dip Galvanizing International magazine and acnowledgements are due to:

I Johal – editor

O'Mahony Pike Architects, and photos by Jerry O'Leary and Galco Steel Ltd.

UNDERSTANDING THE OPTIONS regarding corrosion control of steel fasteners

Regrettably the term HOT DIP GALVANIZING is frequently adopted to benefit a broad range of 'zinc-associated' corrosion control technologies, by association with hot dip galvanizing, in order to manipulate the perception of the specifier. It is therefore not uncommon to see the term GALVANIZING being associated with product descriptions such as "cold galv" for zinc suffused paints and /or "galvanized fasteners" for zinc plated nuts and bolts.

There are several methods of applying a zinc coating to fasteners in order to establish a corrosion control coating. These include electroplating, mechanical plating, sherardizing, and hot dip galvanizing. All provide some degree of corrosion control. The most commonly used are hot dip galvanizing and zinc electroplating (or possibly cadmium electroplating) which is frequently and misleadingly described as 'electro-galvanized'.

Two essential factors to consider in selecting the most effective corrosion control technology for fasteners are:

- The corrosion control coatings resistance to mechanical damage during assembly and tensioning
- The long-term corrosion control lifespan of the coating.

Incidentally, cadmium electroplating is frowned upon by environmentalists due to the toxic properties of this metal, particularly when the coating is cut or welded. This has resulted in cadmium coatings being banned in many countries.

The resistance to mechanical damage and adhesion properties of both electroplating and hot dip galvanizing are far superior to those provided by the vast

majority of organic coatings. The hot dip galvanized coating has the added benefit of consisting of a series of hard zinc/iron alloys within the coating structure. This characteristic, alone, reduces the possibility of coating damage during tensioning of the fastener.

As far as corrosion control is concerned, the thickness of a zinc coating determines its service life. The thickness of a zinc coating applied by the electroplating process is distinctly limited to around a thickness of about 10µm. In contrast, the hot dip galvanized coating achieves between 50 µm and 60 µm. Thus service life of a hot dip galvanized fastener is at least five times that of a typical zinc electroplated fastener.

A hot dip galvanized centrifuged coating is typically around 60µm. The centrifuging process used for hot dip galvanizing of fasteners does not allow for the formation of 'extra-thick' coatings. Hot dip galvanized coatings of Structural steel produces coating thicknesses of more than 85µm and cases where a 'heavy-duty' coating is required an additional 25% coating thickness may be specified. To ensure that the corrosion service life of a hot dip galvanized fastener is congruent with that of the hot dip galvanized coating of the structure, an additional barrier protection layer in the form of a suitable paint may be used. Most paints will adhere to well to degreased galvanized surfaces. However alkyd type enamel paints should not be applied directly onto zinc.

Hot dip galvanized coating of bolts is available for size M8 and upwards. In principal the internal nut threads are tapped oversize to specified limits in order to accommodate the coating thickness provided by hot dip galvanizing. There is no a loss of mechanical properties regarding tensioning of these fasteners.

With hot dip galvanized fasteners, the internal nut thread is not coated. The absence of a hot dip galvanized coating on the internal nut thread does not affect the service life of the hot dip galvanized fastener; as the threads are effectively corrosion controlled through cathodic protection by the hot dip galvanized coating on the bolt threads (sacrificial protection). Contrary to 'popular' belief high tensile bolts and nuts up to class 10.9 (1000 MPa) are suitable for hot dip galvanizing without concern for the fasteners mechanical integrity.

While zinc plated fasteners have their place it is critical that the marked difference between them and hot dip galvanized fasteners be understood. The specification and use of either plated or hot dip galvanized fasteners lay in the application. Specifiers must ensure that they receive the correct fasteners as specified during the design stage.

EDUCATION and training

SAIMECHE
LECTURE AT UKZN

The Association was invited by Mr. Brian Cockwell to address the Durban branch of the South African Institute of Mechanical engineers regarding the technology and benefits of hot dip galvanizing in providing corrosion control.

The topic of corrosion control is particularly pertinent in the corrosive coastal environment in Durban and the opportunity was taken up with the Association Director, Robin Clarke to adress the attendees at the UKZN campus – Mechanical Engineer faculty on 7 March 2018.

Approximately 35 attendees comprising Professional Engineers as well as Engineers in training and a few students attended the presentation which covered the following:

- Basic elements of corrosion
- Zinc and zinc/iron alloys that form during the hot dip galvanizing process
- How does zinc protect
- Different environments and estimates of service life
- Broad overview of Duplex coatings

The Institute sponsored a finger supper after the presentation and this facilitated further networking opportunities.

1 Ashnil Doorjan, Mzwandile Mthimkhulu, Emmanual Govender, Buhle Nxiwa.

1

HDGASA LEVEL 2 INSPECTORS COURSE
VOIGT AND WILLEKE

Five delegates attended the Level 2 course presented in the first week of May 2018. Two days of lectures, covering steel making, understanding Zinc coatings, the requirements for design, fabrication and inspection before galvanizing as well as the hot dip galvanizing process itself.

Thereafter a practical exercise aimed at exercising full compliance to the inspection regime as stipulated in SANS 121:2009 was carried out.

An excellent outcome was that all 5 course candidates passed the course with averages across the three exam papers in the order of 80%.

Well done to all!

HDGASA LEVEL 2 INSPECTORS COURSE
DURBAN GALVANIZERS AND PINETOWN GALVANIZING

Four people attended the course in the period 13 to 17 May 2018. Again, the format consisted of lectures, practical training related to the physical inspection of some hot dip galvanized samples as well as 3 exam papers.

The course was favorably reviewed by the delegates and the Association was also very happy with the active participation of those attending.

The results were three higher grade passes with two Galvanizing Inspector accreditations.

S.A. BOLT MANUFACTURERS – a one stop shop

"SA Bolt Manufacturers is a one stop shop for all industrial fastener requirements and serves the local and international market. Its range of bolts, nuts, studs, cap screws and associated products from M6 to M120 diameters are manufactured to all standard specifications as well as customer specific requirements. SA Bolt have always carried an extensive range of stock in plain hexagon mild steel and high tensile fasteners, which has now extended to include hot dip galvanized bolts and nuts, to provide clients with a quicker delivery on these products. Fastener users are invited to contact the SA Bolt management and sales team to discuss their specific fastener requirements."

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

RENOVATION OF HOT DIP GALVANIZED STEEL

GALVPATCH® Zinc Rich Epoxy Paste

Paragraph 6.3 of SANS 121:2011 and ISO 1461: 2009(E) states that the total uncoated areas for renovation by the galvanizer may not exceed 0.5% of the total surface area of the component. Furthermore, each uncoated area for renovation shall not exceed 10cm². Unless it is agreed between the galvanizer and the purchaser, items with larger uncoated areas should be re-galvanized.

The standard recognises three repair medium:

1. Zinc thermal spraying
2. Suitable Zinc paste products
3. Suitable Zinc rich paint where the zinc dust pigment conforms to ISO 3549

The above repair medium should achieve a minimum coating thickness of 100µm on the renovated areas, unless the purchaser advises otherwise.

Under the guidance of the Hot Dip Galvanizes Association Southern Africa Galvpatch® was developed to comply with SANS 121:2011 and ISO 1461:2009(E) standards for renovation of hot dip galvanized coatings. The development started in early 2007, by mid-2007 pilot tests were being done. After undergoing and passing the ASTM B117 corrosion test, test samples were given to selected consumers for further testing and feedback. In mid-2008 Galvpatch® was registered and successfully launched. Ten years later Galvpatch® is a recognized repair medium for hot dip galvanized coatings by a number of state owned enterprises as well as privately owned entities. Galvpatch® is often the choice product for site renovation as it is easy to apply and can achieve 100µm in a single application.

Galvpatch® is a two part, solvent free organic epoxy paste, containing 100 % solids of which >80% is micronized zinc by mass. The 100g squish pack allows for convenient application and storage of the product. No specialised equipment is needed to apply Galvpatch® and easy to follow instructions with illustrations are printed on each squish pack. Each squish pack has a batch number for full traceability. To comply with Quality Assurance standards, Material Safety Data Sheets (MSDS), Technical Data Sheets (TDS), and Batch Certificates are available for data packs.

ENJOY THE MARKETING BENEFITS OF PROFILING AT THE

HOT DIP GALVANIZING AWARDS 2018

Several of the finalists of the SAISC Steel awards included a galvanizer as part of the team. The same submission may be entered to the HDGASA 2018 Awards Gala Evening to be held in the last quarter of 2018. The awards need a critical mass of submissions for the event to be undertaken. The prestige of being a contender and more so of receiving laurels for the work done is a perfect opportunity to maximize your organizations professionalism and excellence in the field of corrosion control. By submitting a project or application the profile of the team involved is highlighted, a marketing benefit for any professional galvanizer in these highly competitive times.

CATEGORIES:

The categories for the 2018 awards are:

Architectural:
All forms of architectural endeavour where hot dip galvanizing has be used to facilitate the structure in its corrosion protection or as an integral element of the aesthetics is welcomed. From Sculptures to facades and integrated building elements the use of Hot Dip Galvanizing technology can be shown as a key component of the submission

Infrastructure:
This category focusses on the 'Traditional' role of Hot Dip Galvanizing. From mining infrastructure to bridges and towers using galvanized elements integrated into the structure or as stand-alone features. To the use of hot dip galvanizing in the road and transport arenas as well as at ports and harbours, airports and for reticulation of utilities and energy projects.

Duplex:
The exceptional corrosion protection of duplex systems in any application to provide essential benefits to projects where challenging corrosion environments; legal requirements or pure aesthetics is used to the benefit of the client.

Rejuvenation:
In these times, the rejuvenation of existing environments for repurposing or upgrading using hot dip galvanizing is highlighted. The reestablishment of a former historically significant structure or similar projects showing how hot dip galvanizing and /or duplex systems are integral to each project.

SUBMISSIONS:

Submissions open and there is no entry fee for submissions. Each submission must conform to a prescribed format and be accompanied by at least five (5) high resolution (> 300 dpi) colour photographs of the entry. The submission format and T's & C's of the event may be downloaded from the Hot Dip Galvanizers Association website at www.hdgasa.org.com.

SPONSORSHIP:

The event offers a superb opportunity for effective marketing as a sponsor for the event. Sponsorships are available in three primary categories. *The Platinum Sponsor* is key to the event with a negotiated sponsorship opportunity delivering outstanding value. Sponsorships as *Gold and Silver sponsors* are also available with excellent marketing benefits. Additional sponsorships for specific elements of the event can also be discussed with our team.

The challenge has been made and the champions will be rallied to once again compete for the laurels in the 2018 Hot Dip Galvanizing Awards.

THE QUESTION REMAINS... *do you have what it takes?*

Should you require any further assistance or clarification please contact Lara Teixeira at our offices on +27 (0)11 456 7960 or by email to hdgasa@icon.co.za

HDGASA
Annual Golf Day

The Waterkloof Golf Course hosted the HDGASA's annual golf day on 10 April 2018. The day started with sunny skies and a slight breeze. Due to a lighting warning in the late afternoon, play was suspended for a little less than an hour. While the rain may have dampened the course, spirits definitely were high at the 19th. Play resumed and all four-balls finished with some time to see the spectacular sun set over the Groenkloof Nature Reserve.

The day featured some fun activities of which 'Beat the Pro' received the most attention from the players and our photographer. Tandi Mc Callum, our female pro golfer dressed in pink, showed our players what it means to 'hit like a girl'. The other 'Pink Lady' sponsored by Transvaal Galvanisers was no less challenging, with only two teams bringing her home.

The Association along with Transvaal Galvanisers, Krome Metal Chemicals and South African Galvanizing Services kept players well hydrated at various watering holes. Krome Metal Chemicals threw in a quick game of 30 seconds and shooter penalties to warm players up at the 18th tee. Even in their absence Lianru Galvanisers ensured all players enjoyed a delicious meal at the Halfway House.

The Waterkloof team outdid themselves with pork belly and roast beef on the menu. As always Duane Rockwell was a witty MC and kept the party going until the last golfer left for home. Robin Clarke, Executive Director of HDGASA, thanked the

FOR MORE PICTURES OF THE DAY VISIT OUR FACEBOOK PAGE @HDGASA OR www.hdgasa.org.za

sponsors for their valued support and Lara Teixeira for a well planned and executed event.

1st Prize went to Adriaan, Jannes, Gregg and Steve from South African Galvanizing Services for a third year in a row (91).

2nd Prize was taken by Anthonie, Wayne, Justin and Christian from Armco Superlite (87).

3rd Prize was Conrad, Fourie, Eugene and Jacques from SABS (84). Along with 3rd place they also brought home the ***Pink Lady*** (39).

Nearest The Pin was on hole 15 and Anthonie De Wit took it.

Using the ***Giant Catapult***, Marius Du Preez took ***Nearest The Pin*** on hole 6.

The Longest Drive was by Adrian Vaglietie on hole 3, clearly, being rated the third most difficult hole, was not an issue.

Duncan Bladik ***Beat The Pro*** on the 13th.

The Biggest Smile went to Anthonie De Wit, not for second place, nor was it for nearest the pin but for ***A HOLE IN ONE!***

The Longest Day was awarded to Mike, Pat and Dominic.

The HDGASA thanks all sponsors for making this day possible:

Transvaal Galvanisers – Pink Lady, 1st and 9th holes

Lianru Galvanisers – Halfway House

South African Galvanizing Services – 10th hole

Krome Metal Chemicals – 18th hole

We look forward to seeing you at our next golf day in 2019.

HDGASA SPONSORS PRIZE at SAISC's Golf Day

The Hot Dip Galvanizers Association Southern Africa sponsored a prize for the longest drive at the South African Institute of Steel Construction's annual Golf Day held at the Johannesburg Country Club Woodmead.

Lara Teixeira from the Association was there to hand over the prize.

PERSONALITY PROFILE

Darelle Janse van Rensburg

How did you get involved in corrosion control?

I started my career as a high school science teacher, but shortly after joined Eskom's Corrosion Group in 1990. My mentor at Eskom was Ms. Meryl Nixon (who was also the first female President of Corrosion Institute of Southern Africa). I was with Eskom for more than 11 years but left to start my own corrosion and coatings testing laboratory and consulting services company, i.e. Orytech Pty Ltd in January 2002. More info can be obtained from our website *www.orytech.co.za.*

Tell us a little about yourself, your home life, your hobbies and passions

I have been married to Tinus for close to 30 years and we have three children, and one granddaughter. We are a close-knit family and tend to do many things together. I love my two Pekinese dogs, but also enjoy spending time with my other animals, i.e. two cats, several chickens, rabbits, quails and guinea fowl. I love getting together with my family for a braai or just going out for dinner. I love Sushi.

My passion is music. I play the keyboard and have also been writing my own songs for many years.

What professional achievement are you most proud of?

- Establishing Orytech as an independent corrosion and coatings company in South Africa.
- Being admitted as a fellow member by the Corrosion Institute of Southern Africa.

Serving as a judge for the HDGASA awards for several years.

- Doing a PhD in "Atmospheric corrosion mapping of South Africa and the Greater Johannesburg Metropolitan Area, and
- Acting as an expert witness during several national and international coating failure disputes.

What were the key findings related to your research on galvanized steel in aggressive environments?

Galvanizing remains one of the best procedures to provide long-term corrosion protection of mild steel surfaces in South Africa. However, within 150m from the coast, the corrosion rate of hot dip galvanising is high, i.e. >10µm/yr in the first year, and therefore galvanizing should preferably not be used on its own, but rather as part of a duplex system. Between 150m to 1 000m from the coast, although the corrosion rate of HDG is still high, it is ~60% reduced. Between 1 – 10km from the coast, the corrosion rate of galvanising reduces even further to ~about 1 – 1.5µm/yr (during the first 12 months of exposure). This is very similar for the western and eastern coasts of South Africa. The mean corrosion rate for most of South Africa's inland areas is less than 1µm/yr (during the first 12 months) for most inland, non- to low polluted environments. In large city and industrial areas, the first-year corrosion is closer to 1 to 2µm/yr.

Who has had the biggest influence in your life?

My parents. My dad is still alive and probably has one of the biggest music, video/DVD, and record collection in the country. I get my love for music from him. My mother, whom has passed away 14 years ago, worked for the Chemistry Department at RAU (University of Johannesburg) for most of her life. I often accompanied her to work and I later assisted some of the professors with their chemistry experiments during my school holiday. I still use one of RAU's old laboratory chairs in my own laboratory today.

What is your philosophy of life?

Being ethical, compassionate and true in what you do.

What is your favourite reading?

Sophies World.

Do you have any dislikes?

I hate it when people think that they are better than others.

Complete the sentence... Five o'clock on a Friday, you WORK.

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SMT Galvanizers are specialists in the hot dip galvanizing of all types of fasteners including the treating of embrittlement on site. We do offer a wide variety of services to our clients by creating a comprehensive supply chain for all their galvanizing needs. Our expert services are procured by hand railing, flooring, construction, fabrication, civil and general engineering industries for open dipping.

All work is done according to SABS-ISO 1461SANS 121 Specifications. SMT Group is SABS and SATAS accredited and BEE compliant.

SMT Group offers the following services,

- **Hot dip galvanizing** - spinning and dipping;
- **Electroplating** - Barrel work (Yellow and trivalent blue passivating);
- **Electroplating** - Jigging up to 3.5meters;
- **De-embritteling** on site;
- **Fabrication** workshop with certified welding operators;
- **High Tech engineering workshop** - cnc milling, turning and dynamic balancing;
- **Design and building** of machines to customer requirements;
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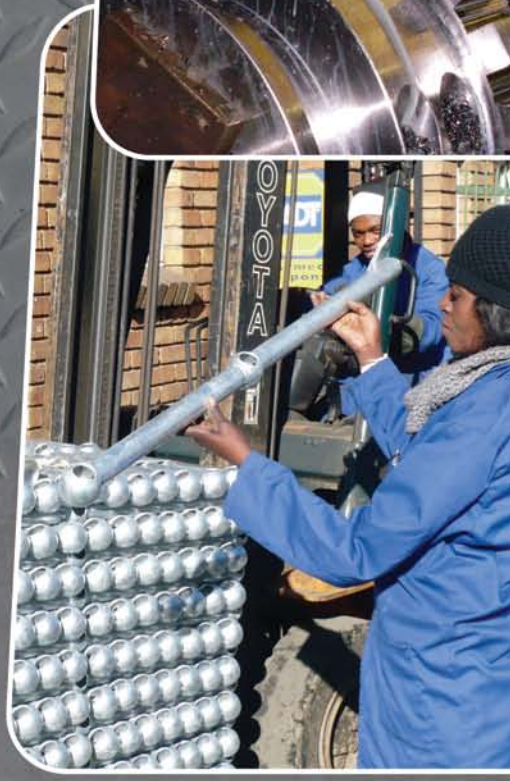

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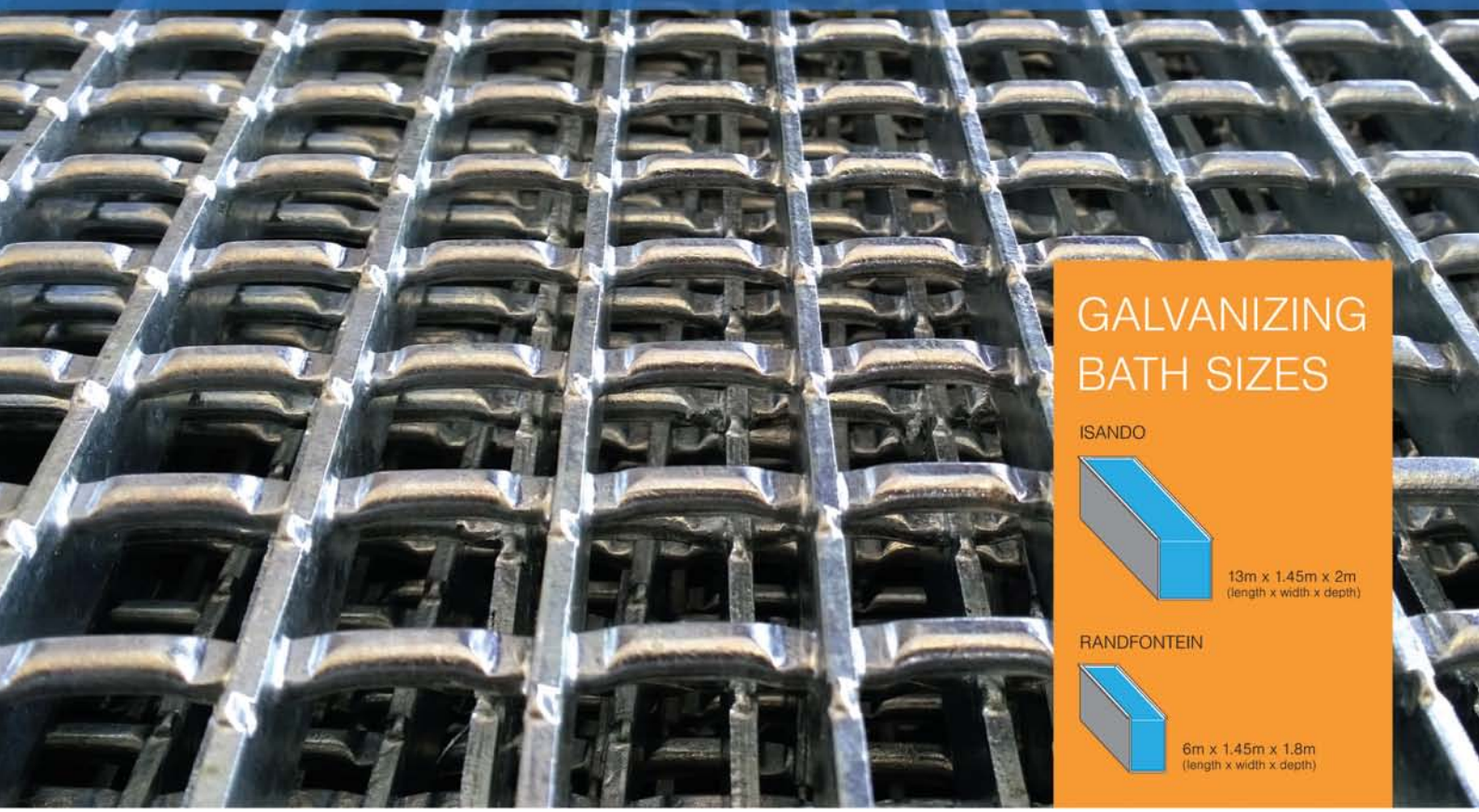

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Armco Galvanizers Randfontein is our second facility based in the Randfontein area. Randfontein has an average output of plus minus 800 tons per month and is geared up to handle light to medium structural steel up and till 6m in length.

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