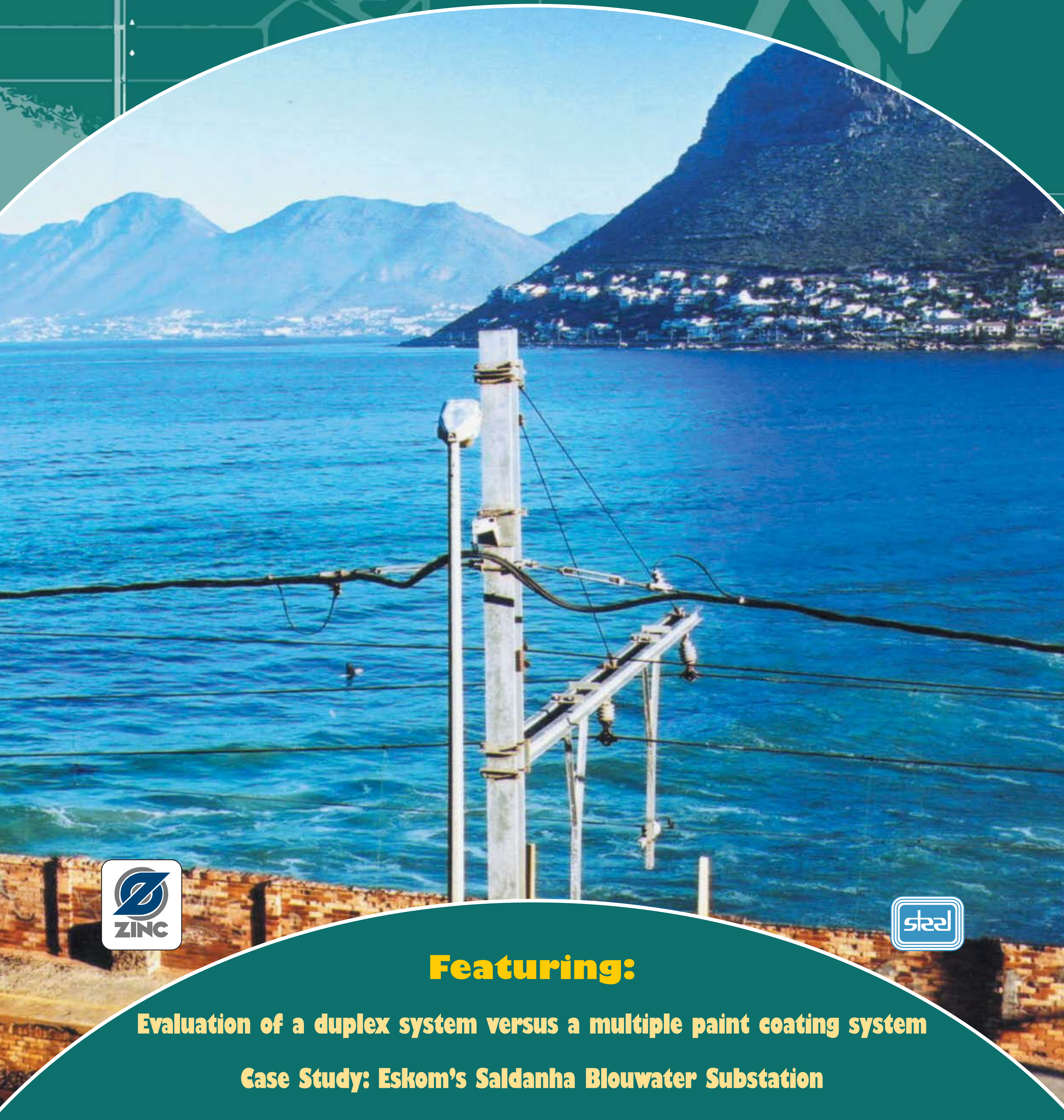
2004 Volume 1 Issue 2

HOT DIP GALVANIZING TODAY

HOT DIP GALVANIZERS ASSOCIATION Southern Africa



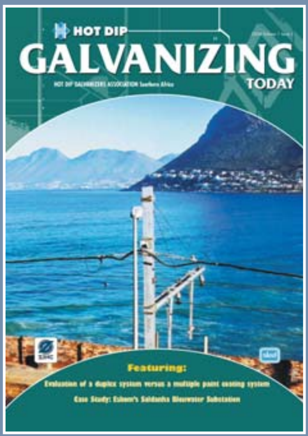
ZINC

steel

Featuring:

Evaluation of a duplex system versus a multiple paint coating system

Case Study: Eskom's Saldanha Blouwater Substation



The Association is a technical information centre established for the benefit of specifiers, consultants, end users and its members

PUBLISHED BY:
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Front Cover:
Protection of electric railway masts at Muizenburg by a duplex coating.

HOT DIP
GALVANIZING TODAY

Official journal of the Hot Dip Galvanizers Association Southern Africa • 2004 Volume 1 Issue 2

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Note from the Editor

What's in a word?

Specifying the word **"galvanizing"**, can lead to inappropriate coatings being used when **"hot dip galvanizing"** is desirable.

An **"electro-plated"** coating, often referred to as **"galvanizing"**, is deposited by an electrolytic process and the coating thickness although smoother and more shinny than a hot dip galvanized coating, is generally up to 10X thinner. Bearing in mind that the life of a zinc coating, no matter how applied, is more or less proportional to its thickness in a given environment, it goes without saying that for a reasonable life, a **"hot dip galvanized"** coating should be specified.

The designation **"cold galv"** has been legally tested in Germany. Zivelsenats des Bundesgerichthof said in a verdict of 12 March 1969 that **"cold galv"** was an illegal product description.

There is no such thing as a cold galvanizing process but because many refer to a zinc rich paint as a **"cold galv"** and in order to set the two processes apart we decided to make all future references to the metallurgically bonded zinc coating as **"hot dip galvanizing"**. It was felt that the alternative products could not use the same name as they were applied at room temperature.

Making use of the full name in all applications, in particular when writing a specification would provide benefits to all role players involved in this industry and the HDGASA would welcome assistance with this regard.

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Incidentally, the name "galvani**s**ed", although grammatically correct in terms of some reference books, is in fact spelt with a **"z"** in our copy of the Oxford reference dictionary and similarly, in all national and international specifications.

The **"z"** is also the first letter of **zinc**, the material used to do the coating.

Executive Director's Comment

Staff, at the Association, are often asked, by their members, "What does the Association do for us?"

In order to address this question, I thought that some appropriate comments as to our two major objectives would be constructive. Our function can be grouped under two major headings, viz. Technical Marketing and Technical support to members, as well as to the users of hot dip galvanizing and duplex systems for corrosion protection.

The Association provides end users, consulting engineers, interested parties such as professional institutes, as well as the membership, with technical design assistance, publications, case histories, success stories relating to the appropriate and cost effective application of hot dip galvanizing and duplex coating systems, for the corrosion protection of carbon steels.

Aspects, such as, metallurgy, properties of coating systems, performance within given environments, economics and service life expectations, designing for hot dip galvanizing as well as product quality inspections, for and on behalf of clients and members, are regularly discussed.

The Association also conducts, on request; free marketing seminars and technical presentations on various aspects, use and application of hot dip galvanizing and duplex coating systems. Such presentations are approached in terms of corrosion protection of carbon steel and service life expectations of steel components in a wide range of corrosive environments.

In addition, for a small fee, we will conduct a two-day inspector's training course for quality control personnel, who act for and on behalf of consultants or the ultimate end user of the steel components. Such courses are designed to provide inspection authorities with the necessary know-how and practical knowledge of hot dip galvanizing and duplex coatings as a viable corrosion protection system.

The Association is a valuable source of information, both technical and marketing, for both external "users requiring cost effective corrosion protection of steel" as well as our various grades of membership.

The Association is dedicated to the service and improvement of the wider industry and as a support organization to its membership.

BOB WILMOT
Executive Director
Hot Dip Galvanizers Association
Southern Africa

Quality control of hot dip galvanized coatings

The Association is sometimes invited to comment on what is perceived to be "bad quality" hot dip galvanizing. Although there are occasions where this does exist, most often, once the customer understands the process and the mechanism by which the coating occurs, and the surface, if necessary is cleaned up, the coating is acceptable and will satisfy the specification requirement of corrosion protection.

However, when a "bad quality" coating has incorrectly been dispatched to a customer and the Association has been invited to comment, an unbiased report is normally written and sent to all parties involved and a non-conformance report, (NCR) is issued on the member by the Association.

Because of these reports and the general feedback from the market over the last two years, and in the interests of all stakeholders of the industry, the Association sent out a letter highlighting the situation and invited all members to participate in a workshop to discuss the issues of "bad galvanizing".

"Bad quality" coatings might include, excessive amounts of ash at significant surfaces; drainage spikes or protuberances; excessive amounts of dross in the coating, particularly at significant surfaces; over cleaning, leading to bare spots; touch or jigging wire marks; uneven drainage or lumps or coating unevenness at mating or significant surfaces.

A *significant surface can be defined as*, "*A surface, which impacts on the performance of that article*".

Other things such as the cleaning of clogged threads on male fittings; selection of repair materials and the identification of significant surfaces and whether the component is to be painted after hot dip galvanizing, etc. cannot be considered to be "bad quality" and must, in addition to reference to the specification SABS ISO 1461, be set out by the customer on the order or in the form of a sketch, for the galvanizer's attention prior to the order being placed.

Fabrication inadequacies such as incorrect positioning of vent holes, leading to air traps and consequently possibly uncoated areas; stains caused by weeping of acid salts from porous welding; uncoated areas caused by marking with incorrect materials such as oil based paints; welding slag and weld spatter and most distortion related problems, can be eliminated by

Product double dipped and no post process cleaning. The job was urgent. The customer said he would clean the product on site, but the net result was never the less a complaint from the architect.

Should the customer not wish the product to be presented in terms of normal quality standard, a non-conformance report should be raised and the customer agree in writing that a variance from the standard quality, is acceptable.

The old problem of excessive phosphorous in steel resulting in a surface finish called the "tree bark" effect. Not suitable for architectural quality. Raise a non-conformance before galvanizing the total job and prevent the customer or the end-user developing the idea that HDG does not provide a smooth uniform finish. If architectural quality is required the correct quality of steel must be specified.

This coating finish in the market place, no matter how or why it got there is unacceptable when we talk about architectural quality and the growth of the industry.

Such product is detrimental to our industry and should never ever get to a site.

(The coating in terms of corrosion protection for mining or industrial use, is acceptable but if used in an architectural application, is unacceptable.)

Black Spots

Uncoated areas where no remedial work has been undertaken, due to the fact that the job was urgent. At the end of the day the perception and question, left in our customer's mind, "is this what hot dip galvanizing is all about"?

Ash inclusions and in some cases weld slag had not been removed.

Questions of inadequate incoming or black steel inspections for the materials to be hot dip galvanized as well as the final exit inspection.

following certain guidelines and indulging in upfront discussions with the galvanizer.

All articles that have not necessarily been correctly designed to prevent the incidence of distortion, that arrive at the galvanizers plant with an order to hot dip galvanize, the galvanizer must first contact the customer and highlight the possibility of distortion and only once the customer has been informed in writing and accepted this risk, should the articles be galvanized. This is of particular importance when items arrive from out of town and the customer is expecting the articles to be galvanized over night.

The Association is fully aware of the problem with reactive steels that can lead to quality problems. However, it is not sufficient to simply say that we as galvanizers cannot do anything about this problem. If we are to protect ourselves as well as grow the industry we **must** do something about it as well as any other quality issue. We cannot allow our customers to develop the perception that hot dip galvanizing is a difficult process with potential for quality and service complaints.

Where a quality problem is first detected a non-conformance report should be raised in terms of the company's quality management system, the customer advised and corrective actions agreed. To simply continue processing and dispatching product into the market place knowing full well that it is substandard, is detrimental and counter productive. There is an old saying that is always used when dealing with this type of issue, "we do not have time to do it right the first time, but we have time to redo it the second and maybe a third time".

The examples shown on this and the previous page highlight some of the problems, but are by no means exceptions.

The objective behind the original letter to the members was not meant to criticise but to illustrate the urgent need to ensure that all the quality management systems are operative and not be allowed for whatever reason to be compromised.

The letter urged members to respond.

The following letter was received from Rob Southey of Voigt and Willecke, one of the Association's members in Durban:

Thank you for the letter received in Dec 2003, regarding quality control. We however, would like to make some comments.

Regarding quality, most galvanizers are acutely aware of any short comings in their *quality systems and also the subsequent lapse in allowing sub-standard work back into the market place. However, we do not believe that the entire burden of poor quality should be laid at the door of the galvanizer or that it is his problem alone.*

We in KZN have in recent years noticed an alarming trend in the steel industry among steel suppliers and manufacturers, in that adequate time is no longer available to the galvanizer to do the pre and post galvanizing checks. Let alone enough time to process the work. We are not talking about garden gates, burglar bars or piece metal work but major contracts and it is not unknown for tonnages to arrive one day and demands for delivery on the next. Any inspection and subsequent cleaning systems that you have in operation are now redundant.

Failure to comply with the above, elicits the standard retort, "don't you want our work", or worse, that the client switches to a more "user friendly" galvanizer, who says he accepts and then overlooks the quality aspects.

To alleviate most of the problems encountered in the industry, we believe that we need to reinvent the word "time", obtain a commitment from major role players that they will allow sufficient time for galvanizing and take it from there. All galvanizers should stand firm on this one. With respect it is suggested that the topic of your letter also be circulated to Architects, Engineering Consultants, Quantity Surveyors, Steel Merchants and Manufacturers (steelwork contractors), to emphasize what happens when sub-standard steel and workmanship is dumped at the galvanizer, invariably late and who in turn is now left with the problem.

Any mention of non-conformance is frowned upon, as most suppliers have the simplistic view that any steelwork, which does not come out of the galvanizing bath in pristine form is purely the galvanizer's fault and any cost of rectification somehow falls upon his shoulders. Once again, any protestation from the galvanizer, the customer says, "I will switch to another galvanizer". Again we need the work and therefore bow down to these excessive and unjustified demands.

The problems encountered over the years in the galvanizing industry are still there, a snag list, which was probably relevant when galvanizing was first applied to steel is still relevant today and worth repeating.

- *Insufficient time i.e. Urgent. The main culprit.*
- *Contaminants – oils, grease, oil based paint, labels and welding slag.*
- *Material unsuitable for galvanizing i.e. reactive levels of silicon and inordinately high levels of phosphorus.*
- *Inadequate and inappropriately positioned vent and drainage holes.*
- *Design unsuitable for hot dip galvanizing.*
- *Sub-standard fabrication.*
- *Lack of pre-manufacturing consultation.*

We believe we play an integral part in the steel industry and have somehow been sidelined by the major role players in the areas of consultation and would certainly like to be part of the consultative pre manufacturing stage.

Editor's Note: ***In order to adequately address pre and post inspection by the galvanizer, a lead time of about 7 days is recommended. This lead time may be negotiated with the specific galvanizer.***

Evaluation of a duplex system versus a multiple paint coating system

Introduction

Following discussions, during 2003, with a well known corrosion consultant and a mining company, it was decided to conduct a comparative evaluation of a number of paint coating systems together with a series of "so called" Duplex coating systems.

Duplex coating system is defined in the following terms:

Duplex protective coating systems employ paint over a base (primer) comprising hot dip galvanizing, with its superior metallurgical bonding to steel, plus two or three coats of specified paint, selected to suit particular environmental conditions. From the early introduction of the duplex coating concept by the well-known corrosion authority, Jan van Eijnsbergen, who unfortunately has recently passed on, a simple formula indicating the synergistic effect one derives from this system has been derived. This is set out below:

Duplex Service Life

= Factor x (HDG Life + Paint Life)

= 1.5 x (21years + 10years)

= 46 years to 5% red rust

Factors applied in the formula for different environmental conditions are listed below.

Table No.1 – Multiplication factors for different environments

◆ Extreme marine	1.4 to 1.6
◆ Industrial + marine	1.8 to 2.0
◆ Sea water (immersion)	1.5 to 1.6
◆ Non-aggressive climate	2.0 to 2.7

Evaluation Objective

A series of twelve sample panels were prepared, as per the sample list, and subjected to salt spray testing over a period of 4 000 hours, being evaluated at 1 000, 2 000, 3 000 and finally at 4 000 hours. The objective of the test was to compare the corrosion protective performance of the various samples within the defined salt spray environment.

The testing was carried out in accordance with the requirements of the ASTM B117-85 *Standard Method of Salt Spray Testing*. No specific failure criterion was specified as the testing was for long-term comparison purposes. Details of the test (*as per the method requirements*) were as follows:

Salt:	reagent grade NaCl
Water:	Rand Water Board
Solution Concentration:	5%NaCl
Test Temperature:	34 to 36°C
Fog Volume:	2.63ml per hour (for 80cm² collection area)
Solution pH:	6.9 to 7.0
Solution SG:	1.016 to 1.033

Sample List

1. Hot dip galvanizing + polyurethane paint sealer
2. Hot dip galvanizing + epoxy primer + epoxy MIO + polyurethane acrylic enamel
3. Hot dip galvanizing + epoxy primer + polyurethane
4. Hot dip galvanizing + acrylic resin primer + 2 x coats of Acrylic polymer
5. Hot dip galvanizing + galvanized iron primer + UV resistant water based acrylic
6. Abrasive blast + thermal aluminium spray + polyurethane paint sealer
7. Abrasive blast + aluzinc (15% Al & 85% Zn) spray + polyurethane paint sealer
8. Abrasive blast + inorganic zinc + epoxy primer + polyurethane
9. Abrasive blast + 3 x coats of acrylic polymer
10. Abrasive blast + 2 x coats of epoxy tar
11. Abrasive blast + inorganic zinc primer + modified aluminum epoxy mastic + cross-linked epoxy + aliphatic acrylic polyurethane
12. Abrasive blast + "ZincFix" repair material

Note:

1. *All coating thickness measurements are for the total coating system, i.e. hot dip galvanizing plus the paint coatings. Generally the hot dip galvanized coating thickness on these sample plates measured between 60µm to 75µm.*
2. *All cross scribing penetrates through to the steel substrate.*

EVALUATION AND DISCUSSION

Sample No. 1: Hot dip galvanizing + polyurethane paint sealer

Sample No. 1: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

Minimum	93.8µm
Mean	103µm
Maximum	108µm

Sample No. 1 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	84.5µm
Mean	87.8µm
Maximum	92.9µm

It is interesting to note that the zinc is fully intact with the formation of zinc hydroxide ($ZnOH_2$) "white rust", which has developed through the porous and thin polyurethane sealer.

Sample No. 1 at 250 salt spray hours.

Sample No. 1 at 1 000 salt spray hours.

Sample No. 2: Hot dip galvanizing + epoxy primer + epoxy MIO + polyurethane acrylic enamel

Sample No. 2: Panel as supplied at the commencement of the test.
Coating thickness (3 x readings):

Minimum	190µm
Mean	212µm
Maximum	224µm

Sample No. 2 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	205µm
Mean	246µm
Maximum	292µm

After 4 000 salt spray hours the barrier protection is fully intact. Where the coating has been cross scribed, the underlying hot dip galvanized coating is reacting through cathodic protection and thereby providing corrosion protection to the steel. No red rust is apparent on the damaged crosshatched surfaces. No corrosion creep has developed.

Sample No. 2 at 250 salt spray hours.

Sample No. 2 at 1 000 salt spray hours.

EVALUATION AND DISCUSSION

Sample No. 3: Hot dip galvanizing + epoxy primer + polyurethane

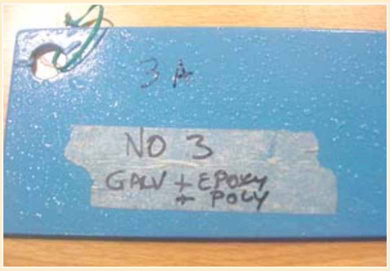
Sample No. 3: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

Minimum	156μm
Mean	163μm
Maximum	170μm

Sample No. 3 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	128μm
Mean	145μm
Maximum	155μm

After 4 000 salt spray hours the barrier protection provided by the paint layers was showing "spots" of porosity with the underlying hot dip galvanized coating having developed its protective zinc carbonate layer and thereby providing corrosion protection to the steel. No red rust is apparent within the damaged crosshatched surfaces. No corrosion creep has developed.



Sample No. 3 at 250 salt spray hours.

Sample No. 3 at 1 000 salt spray hours.

Sample No. 4: Hot dip galvanizing + acrylic resin primer + 2 x coats of acrylic polymer

Sample No. 4: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

Minimum	711μm
Mean	796μm
Maximum	854μm

Sample No. 4 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	627μm
Mean	676μm
Maximum	728μm

After 4 000 salt spray hours the barrier protection provided by the paint layers was in good condition, but with a few "spots" of porosity not yet through to the underlying hot dip galvanized coating. No red rust is apparent within the damaged crosshatched surfaces. No corrosion creep has developed.

Sample No. 4 at 250 salt spray hours.

Sample No. 4 at 1 000 salt spray hours.

EVALUATION AND DISCUSSION

Sample No. 5: Hot dip galvanizing + galvanized iron primer + UV resistant water based acrylic

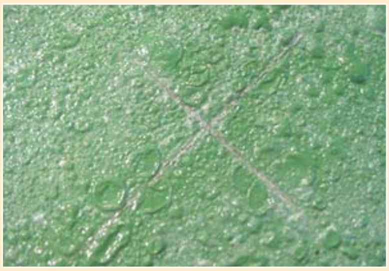
Sample No. 5: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

Minimum	122µm
Mean	134µm
Maximum	164µm

Sample No. 5 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	108µm
Mean	120µm
Maximum	136µm

After 4 000 salt spray hours the barrier protection provided by the paint layers was in an advanced state of breaking down. However, due to the corrosion protective properties of the underlying hot dip galvanized coating no red rust is apparent on the overall surface. Within the damaged crosshatched surfaces a small amount of red rust staining has started to develop, without any form of corrosion creep.



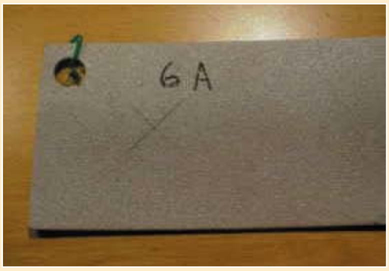
Sample No. 5 at 250 salt spray hours.

Sample No. 5 at 1 000 salt spray hours.

Sample No. 6: Abrasive blast + thermal aluminium spray + polyurethane

Sample No. 6: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

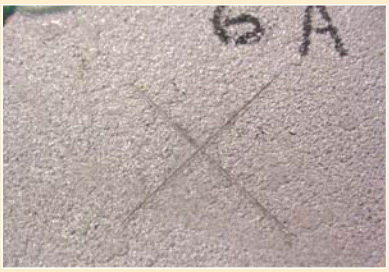
Minimum	423µm
Mean	461µm
Maximum	510µm



Sample No. 6 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	501µm
Mean	509µm
Maximum	523µm

After 4 000 salt spray hours the barrier protection provided by the paint layers and thermal spray is fully intact and providing good corrosion protection to the steel. No red rust is apparent on the overall surface. Within the damaged crosshatched surfaces no red rust has developed, and no corrosion creep has occurred.

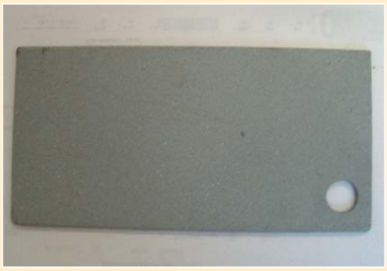


Sample No. 6 at 250 salt spray hours.

Sample No. 6 at 1 000 salt spray hours.

EVALUATION AND DISCUSSION

Sample No. 7: Abrasive blast + aluzinc spray + polyurethane



Sample No. 7: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

Minimum	128μm
Mean	157μm
Maximum	190μm

Sample No. 7 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	146μm
Mean	149μm
Maximum	153μm

After 4 000 salt spray hours the barrier protection provided by the paint layers and the aluzinc spray is fully intact and providing good corrosion protection to the steel. No red rust is apparent on the overall surface. Within the damaged crosshatched surfaces corrosion products (ZnO & AlO) have developed without any signs of red rust or corrosion creep.

Sample No. 7 at 250 salt spray hours.

Sample No. 7 at 1 000 salt spray hours.

Sample No. 8: Abrasive blast + inorganic zinc + epoxy primer + polyurethane

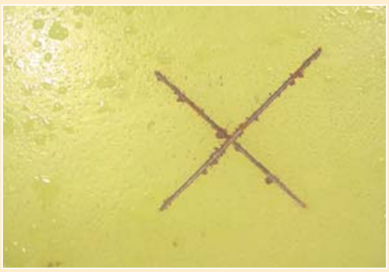
Sample No. 8: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

Minimum	180μm
Mean	195μm
Maximum	213μm

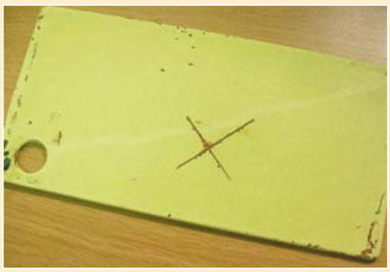
Sample No. 8 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	254μm
Mean	267μm
Maximum	278μm

After 4 000 salt spray hours the barrier protection provided by the 3 layers of paint is providing good corrosion protection to the steel, but is also exhibiting signs of "cracking" together with porosity. The inorganic zinc is providing no significant cathodic protection. Red rust is apparent within the damaged crosshatched surfaces. Little or no apparent development of corrosion creep is in evidence.



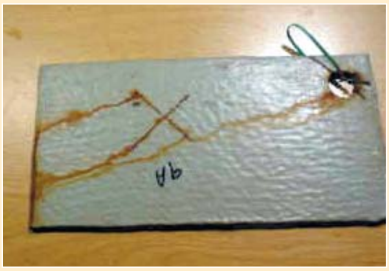
Sample No. 8 at 250 salt spray hours.



Sample No. 8 at 1 000 salt spray hours.

EVALUATION AND DISCUSSION

Sample No. 9: Abrasive blast + 3 x coats of acrylic polymer

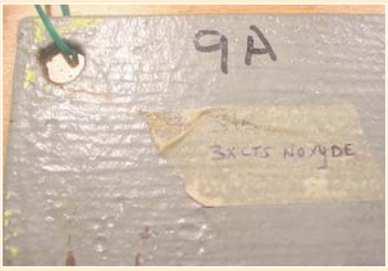

Sample No. 9: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

Minimum	697μm
Mean	811μm
Maximum	884μm

Sample No. 9 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	557μm
Mean	636μm
Maximum	677μm

After 4 000 salt spray hours the barrier protection provided by 3 coats of "Noxyde" is very thick and provides adequate corrosion protection. However, it is also evident that porosity has developed, but due to the coating thickness the barrier has not been compromised. Red rust is clearly apparent within the damaged crosshatched surfaces. Little or no corrosion creep is in evidence.




Sample No. 9 at 250 salt spray hours.

Sample No. 9 at 1 000 salt spray hours.

Sample No. 10: Abrasive blast + 2 x coats of epoxy tar



Sample No. 10: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

Minimum	153μm
Mean	184μm
Maximum	221μm

Sample No. 10 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	192μm
Mean	211μm
Maximum	231μm

After 4 000 salt spray hours the barrier protection provided by 2 coats of epoxy tar is very impressive and provides adequate corrosion protection. The coating develops a film that is easily removed, but is believed to contribute to barrier protection. Red rust is clearly apparent within the damaged crosshatched surfaces with slight tendency for corrosion creep.


Sample No. 10 at 250 salt spray hours.

Sample No. 10 at 1 000 salt spray hours.

EVALUATION AND DISCUSSION

Sample No. 11: Abrasive blast + inorganic zinc primer + modified aluminum epoxy mastic + cross-linked epoxy + aliphatic acrylic polyurethane

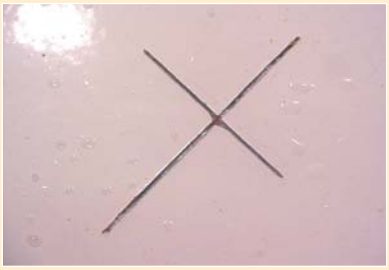
Sample No. 11: Panel as supplied at the commencement of the test.
Total coating thickness (3 x readings):

Minimum	376µm
Mean	399µm
Maximum	435µm

Sample No. 11 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	292µm
Mean	347µm
Maximum	423µm

After 4 000 salt spray hours the barrier protection provided by this coating is very impressive and provides adequate corrosion protection. The coating has not developed porosity, is not easily removed and will provide very good corrosion protection. Red rust is clearly apparent within the damaged crosshatched surfaces with minimal or no tendency for corrosion creep.



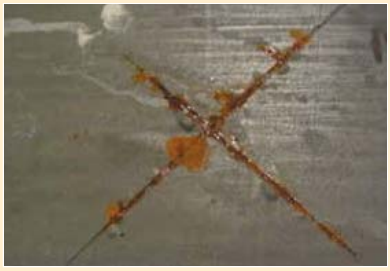
Sample No. 11 at 250 salt spray hours.

Sample No. 11 at 1 000 salt spray hours.

Sample No. 12 Abrasive blast + "ZincFix" repair material

Sample No. 12: Panel as supplied at the commencement of the test.
Coating thickness (3 x readings):

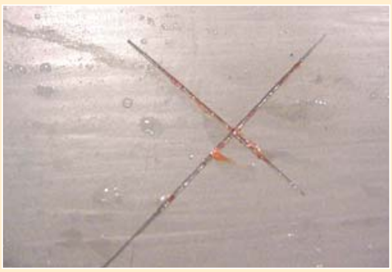
Minimum	71.4µm
Mean	101µm
Maximum	123µm



Sample No. 12 at 4 000 salt spray hours. Coating thickness (3 x readings):

Minimum	127µm
Mean	152µm
Maximum	179µm

After 4 000 salt spray hours the barrier protection provided by "ZincFix" repair material (2 part epoxy + zinc metallic powder) provides adequate corrosion protection. "ZincFix" is a repair material that will easily achieve a DFT of at least 30µm greater than the specified hot dip galvanized coating in all instances in a single application. The additional 30µm DFT requirement is laid down by the specification SABS ISO 1461. There is an indication of some corrosion creep, clearly indicating the absence of long term cathodic protection from a zinc rich paint or epoxy.



Sample No. 12 at 250 salt spray hours.

Sample No. 12 at 1 000 salt spray hours.

Discussions and Conclusions

For purposes of discussion and comparison we have selected four specific coatings as indicated below. In these comparisons we wish to highlight the benefit of using hot dip galvanizing, with it's metallurgical bonding to steel, as a superior form of primer for the subsequent paint coatings.

2. Hot dip galvanizing + epoxy primer + epoxy MIO + polyurethane acrylic enamel

compared to

11. Abrasive blast + inorganic zinc primer + modified aluminum epoxy mastic + cross-linked epoxy + aliphatic acrylic polyurethane

and

3. Hot dip galvanizing + epoxy primer + polyurethane

4.

compared to

8. Abrasive blast + inorganic zinc + epoxy primer + polyurethane

The discussion that follows will examine coatings 2 and 11 and 3 and 8. These specific coatings have been chosen on the basis that they will be used in corrosive conditions, classified in terms of ISO 9223, for class C4 and C5 type environments. The descriptions of these two classifications are as follows:

Class	Description of ISO 9223 Environments
C4	Interior: swimming pools, chemical plant, etc. Exterior: industrial inland or urban coastal
C5	Exterior: industrial with high humidity or high salinity coastal

EVALUATING THE "TOP RANGE" OF COATINGS THAT ARE LIKELY TO BE EMPLOYED IN A C5 ENVIRONMENT.

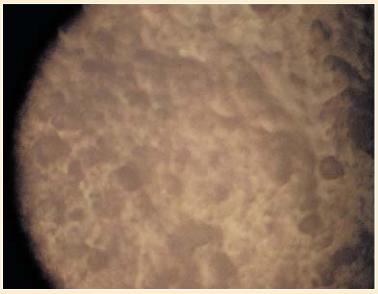
Comparison No.1 (Sample Nos. 2 and 11)

2. Hot dip galvanizing + epoxy primer + epoxy MIO + polyurethane acrylic enamel

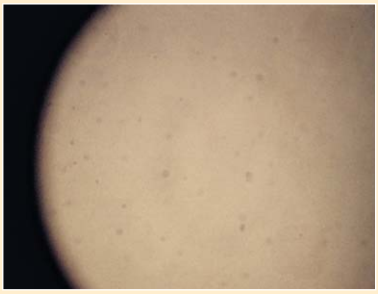
compared to

11. Abrasive blast + inorganic zinc primer + modified aluminum epoxy mastic + cross-linked epoxy + aliphatic acrylic polyurethane

SURFACE FINISH AT A MAGNIFICATION OF x100 AFTER 4 000 HOURS SALT SPRAY

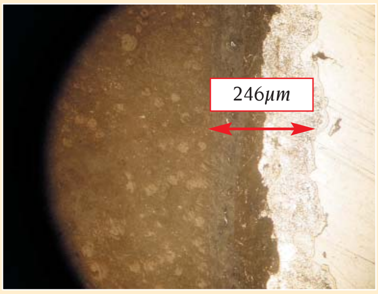


Sample No. 2

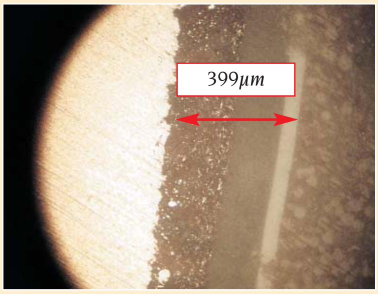


Sample No. 11

MICROGRAPH OF CROSS SECTION AT A MAGNIFICATION OF x100 AFTER 4 000 HOURS OF SALT SPRAY



Sample No. 2



Sample No. 11

CROSS SCRIBING AFTER 4 000 HOURS SALT SPRAY EXPOSURE

Sample No. 2

Sample No. 11

Where the two samples have been scribed and exposed for 4000 hours in a salt environment, one can see the effect of corrosion. In the case of the hot dip galvanizing (sample 2, on the left), the exposed steel is being protected by the cathodic protective properties of zinc, i.e. zinc is electro-negative to steel, and where the zinc products of corrosion have the tendency to seal the scribing with no red rust in evidence. With sample 11, on the right, where an inorganic zinc rich primer has been used as the base coat, little or no cathodic protection is in evidence and the exposed steel has developed red rust.

EVALUATING THE "TOP RANGE" OF COATINGS THAT ARE LIKELY TO BE EMPLOYED IN A C4 OR C5 ENVIRONMENT.

Comparison No.2 (Sample Nos. 3 and 8)

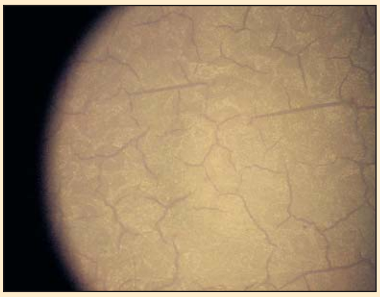
3. Hot dip galvanized + epoxy primer + polyurethane

compared to

8. Abrasive blast + inorganic zinc + epoxy primer + polyurethane

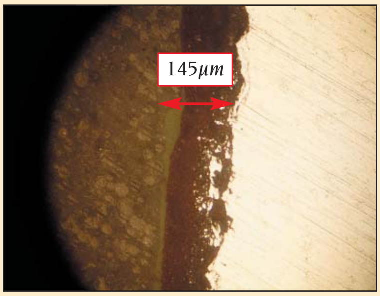
SURFACE FINISH AT A MAGNIFICATION OF x100 AFTER 4 000 HOURS OF SALT SPRAY

Sample No. 3

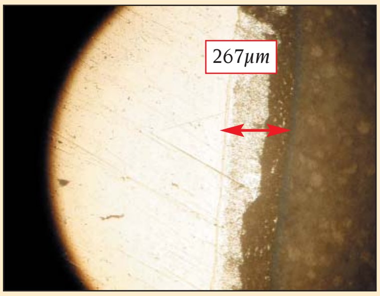


Sample No. 8

MICROGRAPH OF CROSS SECTION AT A MAGNIFICATION OF x100 AFTER 4 000 HOURS OF SALT SPRAY



Sample No. 3



Sample No. 8

CROSS SCRIBING AFTER 4 000 HOURS SALT SPRAY EXPOSURE

Sample No. 3

Sample No. 8

Again where the two samples have been scribed and exposed for 4 000 hours in a salt environment, one can see the effect of corrosion.

In the case of the hot dip galvanizing (sample 3, on the left), the exposed steel is being protected by the cathodic protective properties of zinc. The zinc products of corrosion have the tendency to seal the scribing and hence no red rust is in evidence.

With sample 8, on the right, where inorganic zinc has been used as the primer, little or no cathodic protection is in evidence and the exposed steel has developed red rust. In addition there is significant indications of the top paint coating becoming porous and developing cracking.

Estimated Cost Comparison
(Based on 8mm steel at 31,85m^2/ton)

2. *Hot dip galvanizing + epoxy primer + epoxy MIO + polyurethane acrylic enamel*

Hot dip galvanizing	
R1 900/ton	R59,65/m^2
Epoxy primer	
R640/ton	R20,09/m^2
Epoxy MIO	
R800/ton	R25,12/m^2
Polyurethane acrylic enamel	
R960/ton	R30,14/m^2
Totals	
R4 300/ton	R135,00/m^2

11. *Abrasive blast + inorganic zinc primer + modified aluminum epoxy mastic + cross-linked epoxy + aliphatic acrylic polyurethane*

Abrasive blast	
R960/ton	R30,14/m^2
Inorganic zinc	
R960/ton	R30,14/m^2
Modified aluminum epoxy coating	
R960/ton	R30,14/m^2
Cross-linked epoxy	
R640/ton	R20,09/m^2
Aliphatic acrylic polyurethane	
R960/ton	R30,14/m^2
Totals	
R4 480/ton	R140,66/m^2

Estimated Cost Comparison
(Based on 8mm steel at 31,85m^2/ton)

3. *Hot dip galvanizing + epoxy primer + polyurethane*

Hot dip galvanizing	
R1 900/ton	R59,65/m^2
Epoxy primer	
R640/ton	R20,09/m^2
Polyurethane	
R960/ton	R30,14/m^2
Totals	
R3 500/ton	R109,88/m^2

8. *Abrasive blast + inorganic zinc + epoxy primer + polyurethane*

Abrasive blast	
R960/ton	R30,14/m^2
Inorganic zinc	
R960/ton	R30,14/m^2
Epoxy primer	
R640/ton	R20,09/m^2
Polyurethane	
R960/ton	R30,14/m^2
Totals	
R3 520/ton	R110,51/m^2

The conclusions reached as a result of these tests are not intended to detract from the undoubted durable performance of a correctly applied paint system incorporating an inorganic zinc rich primer.

The results obtained do however highlight the significant benefits that can be derived by applying a hot dip galvanized coating beneath a similar heavy-duty organic paint system. Use is made of the metallurgical bonding of hot dip galvanizing to the steel, the barrier and cathodic protection of zinc and the barrier protection of paint.

In terms of C5 and some instances C4 environments, hot dip galvanizing has a limited service life potential, as does a paint system when used separately.

The two systems of hot dip galvanizing and an appropriate paint, however, combine together to provide a tremendous synerigistic effect on the overall performance of the corrosion protection coating system.

ERRATUM

2004 Volume 1, Issue 1

Award Entries: bosal House of Irrigation.

In the previous issue (Volume 1, Issue 1) it was erroneously recorded that 750 tonnes of steel had been used in an above-ground irrigation system in Mozambique. The entry was not for a specific project but for the galvanized above-ground irrigation systems supplied by bosal Afrika in general.

Eskom Hot Dip Galvanizing Awards Evening 2004

It is unfortunate that the photographs recording the receipt of the 'Value Adding and Research and Development' categories were unable to be reproduced. The project team who won the 'Prominant Projects' award were unable to attend the awards function.

Thabo Ncombolo of Eskom and Geoff Brandt of Alcatraz Security Systems. Innovation Category Winner for the Alcatraz Security System Project.

Thabo Ncombolo of Eskom and Dirk Stofberg of Morhot, the galvanizer of the Innovation Category Winner for the Alcatraz Security System Project.

Thabo Ncombolo of Eskom and Yashoda, Latha and Desere of Phoenix Galvanizing (Pty) Ltd. Empowerment Category Winner.

Anni Ramkisson of Phoenix Galvanizing (Pty) Ltd and Walter Barnett of the Association. Overall winner of the 2004 Awards and of the WGS Barnett Trophy for uShaka Marine Park project.

Thabo Ncombolo of Eskom and Iain Dodds of Cape Galvanising (Pty) Ltd. Sustainable Performance Category Winner for the Storms River Project.

Honorary Life Members

The Association has over the last 20 odd years awarded three honorary life members. The first being, Jan van Eijnsbergen the father of the duplex concept; Walter Barnett the Association's Executive Consultant and Bob Andrew a retired corrosion consultant and friend of this Association for many years.

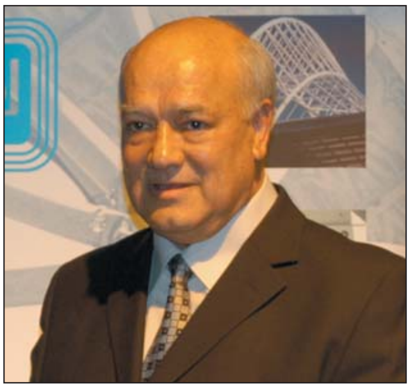
Prior to the last Awards evening, the Association's Executive, felt that it was opportune to award two further persons as Honorary Life Members.

Both individuals are viewed as ambassadors to this Association and our industry by their long-term involvement in the industry, and as a valued asset in the marketing and promotion of hot dip galvanizing, and duplex coating systems, for long-term corrosion protection of carbon steel.

Dave Scott

Dave Scott is the Managing Director of Scott Steel Projects, a structural steel design, fabricating and erection company based in Cape Town.

Scott Steel Projects, under Dave Scott's management, has, over many years, been a valued customer of the Galvanizing Industry and as such has employed hot dip galvanizing for corrosion protection on many and varied structural steel structures. He has clearly demonstrated that by the use of innovative design and appropriate applications, extensive use of hot dip galvanizing as the preferred corrosion protection system has been used on numerous structural steel projects. He understands the inherent value of the product and the beneficial advantages and economics that are available to contractors and end users.



Dave Scott.

It is known and acknowledged, that due to his influence, numerous structures have been re-designed in order to utilise hot dip galvanizing to improve not only the corrosion protection system, but to use the system to improve the competitive position of his bidding process.

A few of Dave's projects where hot dip galvanizing and/or a duplex coating has been used to great effect, are listed below:

- Athlone Stadium Cape Town, which has won a number of project awards.
- 50m span x 10m high-triangulated girder structure on the Cape Town docks.
- SA Breweries project in Port Elizabeth
- New Ore Tipping facilities at the Saldana Bay Iron Ore Terminal
- Maydon Wharf Fruit Terminal project won against paint as the specified corrosion protection system.
- Portnet Saldana
- Food Distribution Centre Milnerton
- Cape Town Civic Centre

Professor Denis Twigg

Professor Denis Twigg served as the first Executive Director of the Hot Dip Galvanizers Association Southern Africa from 1983 To 1988.

Prior to joining the Association he was directly associated with the galvanizing industry from his position as head of metallurgy at the SABS. It was Denis' responsibility to administer and monitor the quality mark scheme for our industry.

After leaving the Association he moved to Port Elizabeth and become a professor at the Port Elizabeth University. He has for a number of years lectured students on metallurgy and corrosion science in particular. In his so-called retirement, he continues to conduct workshops at the Port Elizabeth Technicon, which includes numerous aspects of corrosion science.

The Association's continuing contact with Denis has impressed us with his commitment towards the promotion of Hot Dip Galvanizing as a corrosion protection system. His lectures to students include and highlight hot dip galvanizing as an effective and economical corrosion protection system. He has over the years, and in his own way, been an asset to the industry.

We sincerely thank Dave and Denis for their long term and hopefully continued support of our industry.

On behalf of our Executive, membership and staff of the Association, it gives us much pleasure in awarding this honour to these two champions of our industry.

Professor Denis Twigg.

Steel is also environmentally sustainable

The acceptability of any material based on its environmental impact is generally measured by the amount of energy required to produce it and its ability to be ultimately recycled and, again, the amount of energy required to recycle it.

Steel is a major building material used in an almost infinite variety of building applications. Its low relative cost compared to all other metals, its high strength-to-weight ratio, and its ease of forming and joining, make it attractive to designers. However, it cannot be used by itself for most applications, because of its propensity to rust when exposed to air and moisture.

After hitting a worldwide production peak in the mid-70s of around 600 million tonnes of steel being produced annually, this has declined considerably, because in most developed countries where steel making capacity was once seen as the measure of a country's industrial might, today it is no longer deemed to be so.

Since the energy crises of the 70s and the international concern about greenhouse emissions, there have been positive moves in the steel industry to deal with its problems. For example, the following would be typical of a current steel mill in the USA:

CO_2 *emissions appear to have been reduced on an annual basis by nearly 1.5 million tonnes – a drop of more than 28%.* SO_2 *emissions have fallen by more than 198 000 tonnes, a drop of nearly 95%. Solid waste has been reduced by around 2.9 million tonnes, a reduction of about 84%. Energy requirements to produce a tonne of steel has dropped more than 40% over the past 20 years.*

Labour requirements have decreased by more than 50% in integrated steel mills **(6-12 *man hours per tonne in* 1975 *to* 3-4 *man hours per tonne in* 2001)** *and mini-mill labour costs are around one man hour per tonne.*

The application of industrial ecology to the materials cycle allows the energy requirement to be optimised and the waste streams to be minimised. The classic form of the materials cycle in industrial production is an incomplete cycle and comprises a sequence such as:

- mining
- extraction
- refining
- utilisation
- redundancy

and at every stage of this operation various levels of waste are generated that are deemed to have a value lower than their cost of recovery.

However, these days every element of the materials cycle is the subject of environmental audit and the cost of compliance has resulted in almost all waste products having a value that justifies their recycling. Energy is also an important part of this process, and improving energy efficiency has its own rewards in lowering the cost of production.

Steel is by far the most widely used metal and second only to aluminium in its Gibbs Free Energy rating – which is a measure of the energy required to convert materials from their ores to the metal.

This free energy makes all metals unstable as it is stored in the metal, constantly looking for the opportunity to get out, and all materials seek their lowest energy level over time. In the natural environment, most materials have reached their lowest energy levels, which is why natural materials like stone are so durable.

Unfortunately for steel, it lacks the refractory oxides that assist in isolating aluminium from its environment, and rapidly surrenders its free energy in the presence of oxygen and moisture. The measure of environmental sustainability for steel products is thus inexorably linked to their maintenance-free life.

The application of a protective coating is in itself an energy input that is also metastable. The coating itself has the same natural tendency to return to its lowest energy level as quickly as possible. The periodic maintenance of steel structures also adds energy input to the overall requirement for the steel.

Breaking the energy cycle by preventing the loss of stored energy through decay is the task of protective coatings. The management of corrosion is simply the efficient retention of the Gibbs Free Energy stored within a steel component.

Where materials are to be rated for their environmental sustainability, their maintenance-free life is thus the most important measure of their performance in this respect.

For this reason, the 'self-finishes' offer the most reliable performance. Stainless Steel, aluminium, hot dip galvanizing and other metallic coatings are well placed to break the energy cycle, and by correct selection of materials, very long service life can be achieved with these models.

It is the metastable nature of these materials that initiates their degradation to their stable, low energy oxidised forms that happen to adhere strongly to the surface of these models, and thus they use their own energy to arrest their decay.

With hot dip galvanized coatings in particular, this phenomenon is used in a most efficient manner, which is reflected in the relatively low cost of the composite material – hot dip galvanized steel. A relatively small mass of zinc is used to encapsulate a relatively large mass of steel – 5kg of zinc is sufficient to encapsulate 100kg of steel.

In addition, the Gibbs Free Energy of zinc is less than half that of steel. The slow energy release of the zinc in the galvanized coating because of the stable oxide film allows a coating of 85µm a maintenance-free life of the structure in most atmospheric exposure conditions. 85µm is the required mean coating thickness for structural steel in terms of SABS ISO 1461, now known as SANS 121.

This coating thickness will provide a service life greater than 50 years in 90% of South Africa.

This means that no energy input is required over this lifespan and the steel's Gibbs Free Energy is effectively embalmed for the duration of the life of the hot dip galvanized coating.

In addition, if the steel item can be removed from service at the completion of its design life and remains in a serviceable, maintenance-free condition, the application of an additional 5kg of zinc by regalvanizing will again ensure that the steel's original energy investment is preserved.

As awareness of environmental sustainability increases, and concepts of what may become recognised as industrial ecology influence the specification and selection of materials, it is obvious that materials in universal use like steel need to be considered in the context of their life cycle costs. Doubling the maintenance-free life of steel products obviously halves their energy cost to the environment.

Acknowledgement and thanks are due to the Industrial Galvanizers Corporation of Australia for information contained in this article.

Hot Dip Galvanizing and the Environment

Substantial discussion continues to take place with respect to environmental issues in our Industry, as a contributor to pollution and waste management.

Actions are being implemented to co-operate and work with the authorities in setting up guidelines for our industry with a view to the control of pollutants and waste management, generally referred to as "waste minimization", "energy conservation" and "cleaner air production". Much work has already been undertaken by a number of our members with numerous programmes aimed at the improvement and control of effluent and emissions.

It is purely a question of time before we shall have increased controls and the propagation of stricter laws in terms of our environmental statutes. In order for such "new" laws and regulations to be workable, as well as meaningful, we require the appropriate authorities to police and enforce compliance by ALL concerned. Vague insinuations, that emerge from time to time, need to be addressed in order to ensure that the "playing fields are level for all parties" and that no individual or organization will be allowed to avoid compliance with such regulations. As a minimum requirement such organizations must be able to provide a programme and a track record that indicates progress towards full compliance. No new operations should receive approval from the authorities without due consideration and inclusion of capital equipment necessary to control waste and emissions.

The argument is too often put forward as to; "Why must I or my organization incur the capital cost of environmental controls, while my competitor, down the road, can get away with it?" This argument will remain valid as long as we lack the authority, resources or resolve to enforce, without favour, compliance with whatever regulation is enforced.

As an Association we are in the process of approaching selected authorities with a view to the compilation of realistic targets for the control of liquid waste and emissions. As a starting point we have reviewed the existing "guidelines" for our industry. These guidelines are listed below for members to review and to check where they are positioned in terms of compliance. This is a voluntary exercise, with staff at the Association being available and willing to assist with any review and or discussion.

Hot dip galvanizing does not need to be a dirty operation.

NB: These "guidelines" are quoted verbatim directly from the current regulations.

"*Basic Information*

1.	$ZnCl_2$ fumes	1mg/m^3
2.	ZnO fumes	5mg/m^3
3.	$H2SO_4$ fumes	1mg/m^3
4.	HCl fumes	7.5mg/m^3

Acid Baths

1. Preferably H_2SO_4 plus an inhibitor.
2. If HCl is used, sufficient inhibitor to be used – check records. HCl concentration not to exceed 14%. Baths to be cleaned regularly – no sludge which could result in the release of gasses to be left at the bottom of the bath. Side extraction with a high stack is recommended.

Zinc Baths

1. Wet method, i.e. with flux layer on the surface of the bath should only be allowed if the plant is equipped with side extraction. Only palletized flux, and preferably low fuming flux should be used.
2. Dry method, i.e. pre-covering with flux followed by drying should preferably also be provided with an efficient fume extraction system with emission through a stack.
3. No hand dusting to be allowed. If black spots do develop a powder spray gun is to be used.
4. Side extraction recommended for jobbing works. Extraction rate 5 000 – 7 000m^3/hour/m^2 of bath surface and slot velocity of not less than 10m/sec.
5. Overhead extraction: 3 500m^3/hour/m^2 of bath surface."

In conclusion the photograph to the left was taken in what can be described as a typical hot dip galvanizing plant somewhere in Europe. This particular plant has been in operation for 9 years prior to the photograph.

Gabion Cottage walls at Kwandwe Game Reserve

Some innovative work was undertaken recently by Speyers Construction of Port Elizabeth, using gabions to construct the walls of cottages at Kwandwe Game Reserve near Grahamstown.

This site was visited by Louis Cheyne, MD of Land Rehabilitation Systems, and his local East London agent Des Thompson. In a letter to Terry Smith, Technical Marketing Director of the Hot Dip Galvanizing Association of South Africa, Louis afterwards remarked that he was "really impressed with the sheer beauty of the gabion cottage walls".

"The contractor had used a stone mason to build the walls using rock supplied from quite a distance, due to the scarcity of rock on site. The rock had been broken to facilitate a very near vertical face with a small percentage of voids, and no bulging that could be visually noticed. I have included a few photos for all to see what can be achieved if you have the time, patience and enthusiasm, as apparently progress was slow due to not having done gabion work before".

Gabion walls at the pool and dining room.

Gabion walls in the shower of one of the rooms.

The photos show gabion walls at the pool and the dining room and also the shower wall in one of the rooms at Kwandwe Lodge.

Louis Cheyne's letter continues, "The gabions were tied to the newly built brick walls with a sand/cement mortar to enhance the adhesion of the gabion baskets to the wall. During the erection of the brick wall, steel wire had been placed at approximately 1m centres and the grouting of the rock was anchored using this method. It is a sight to see and must be viewed personally to be appreciated".

Cape Gate, a major supplier of wire to the gabions industry, is a shareholder of Land Rehabilitation Systems. Dawie Oberholzer, Operations Director, Wire, explains how gabions are made. "Gabions are baskets made of hexagonal woven wire mesh, commonly referred to as double twist wire as per SANS 1580:2001. The wire is produced to SANS 675:1997.

Gabions are filled with rock at the project site to form flexible, permeable, monolithic structures such as retaining walls, channel linings and weirs for erosion control projects.

The steel wire used in the manufacture of the gabions is heavily zinc coated (30 - 40µm). If required, a 0.5mm PVC coating is extruded over the galvanized wire, to provide added protection for use in more aggressive environments.

In order to reinforce the structure, all mesh panels are selvedged with a wire having a greater diameter than the mesh wire. The gabion is divided into cells by means of diaphragms positioned at approximately 1m centres".

Walter's Corner

Some thoughts on corrosion and corrosion protection

Simply defined, corrosion is the undesirable deterioration of a material through a reaction with its environment. The corrosion process is electro-chemical by nature. It occurs in what is commonly referred to as a corrosion cell which is made up of four constituents i.e. an anode, a cathode, an electrolyte solution and a connecting path between the anode and the cathode in order to complete the electrical circuit.

In simple terms, the anode surface corrodes, while the cathode, while contributing to the corrosion mechanism, is not attacked. The electrolyte solution is the medium that causes the corrosive chemical reaction. If any one of these four requirements is eliminated, corrosion ceases. The purist would question this latter statement since there is a corrosion process which occurs without moisture (electrolyte). This is referred to as high temperature oxidation which is a specialised subject.

Corrosion science is a subject of considerable complexity and a study of this subject reveals that there are some 15 different forms of corrosion. The cause of degradation brought about by the corrosion mechanism is a natural phenomenon over which we have no control. Steel is a man-made material which contains several elements. When it corrodes, the iron is merely reverting back to its stable state as found in nature. We can, however, reduce if not eliminate, the deleterious impact of corrosion which results in expenditure amounting to several billion Rand annually in Southern Africa. This includes maintenance and replacement costs not to mention the impact of structural failures resulting in both injury and disruption of productivity.

How then can we combat the ravages of corrosion? Corrosion prevention of steel is generally provided by way of a surface protective barrier which insulates the metal component from the environment in which it is situated. Paint is the most frequently used material for this purpose in moderate and even aggressive applications.

Barrier protection by certain metals and alloys also provided by nature in the form of a stable protective surface film which develops on the metal surface when it is exposed to the atmosphere. Probably the best example is the range of stainless steels which form a transparent, yet protective, surface oxide film. If this surface film is breached, corrosion will occur.

Other metals which provide their own barrier protection include the copper bearing Cor-ten steel. This material develops a dense and compact rust film which protects the underlying steel in a relatively benign atmosphere such as that encountered in Gauteng, but to use it in a chloride contaminated environment could be a recipe for disaster. A good example of the durability of Cor-ten is the guardrail installed on both the M1 and M2 highways in Johannesburg. These surface rusted rails were installed some forty years ago. There is, however, an ironic twist in that where negligent and reckless drivers have destroyed the rails; they have been replaced with hot dip galvanized steel.

3CR12 is another material that provides its own barrier protection. Strictly speaking, it is not a stainless steel and when it is exposed to corrosive conditions, it develops a surface red rusted appearance that does not necessarily indicate that the steel substrate is being attacked. 3CR12 is, however, prone to insidious pitting corrosion in the presence of high chloride levels.

The third and extremely effective concept which is successful in most environments is to provide barrier protection by way of another metal which is deposited onto the steel surface. The most commonly used metal is of course zinc, which provides an impervious protective layer of zinc and zinc/iron alloys if applied by way of the hot dip galvanizing process.

Zinc is one of the most intriguing metals available to man. Without it, plant, animal and human life would not exist. It is an extremely reactive metal which prompts the question, why use it for corrosion prevention? The explanation is simply that when zinc reverts back to its stable state, it forms a relatively impervious barrier on a hot dip galvanized coating surface where zinc, carbon dioxide and oxygen combine to provide a basic zinc carbonate film which ensures the corrosion protection required by the underlying zinc coating. In other words, zinc protects itself with the aid of its own corrosion product.

Zinc is, however, somewhat temperamental in that it objects to conditions where low pH ($<$ pH 5) levels prevail and also where extremely high alkaline conditions are encountered ($>$pH 12.5). A metal with these characteristics is said to be amphoteric. Aluminium is also amphoteric. It can tolerate acid conditions down to about pH 3.5 but it is not tolerant to conditions where pH is above pH 8.5. Apart from its ability to provide effective barrier protection, Zinc possesses another somewhat paradoxical attribute. As we have considered, for corrosion to occur, four components are essential i.e. an anode, a cathode, an electrolyte and an electrical circuit. When zinc is in electrical contact with steel in the presence of moisture, the zinc constitutes the electronegative anode while the steel is the electropositive cathode. Since it is the anode that corrodes while the cathode is protected, small defects in a galvanized coating will not result in corrosion or for that mater, corrosion creep underneath the coating surface. This is frequently referred to as sacrificial or cathodic protection whereby the concept of the corrosion cell is in fact harnessed in order to provide protection.

In the complexity of life that is typical of our existence on this planet, a single recommended solution is not always sufficient to solve a problem while the combined effort of more than one proposal could provide outstanding results. A good illustration of this theory is the combination of a heavy-duty protective paint coating applied onto a hot dip galvanized coating. This is conventionally referred to as a "duplex system". This term was originally introduced by the qualified paint chemist and renowned hot dip galvanizing authority, J.F.H. van Eijnsbergen who recently passed on at the age of ninety years.

Duplex coatings have provided outstanding maintenance free protection both in Southern African and elsewhere for many years. As a rule of thumb, the predicted separate lives of the galvanized coating and that of the paint coating can be added together and then increased by at least 50% in order to estimate the overall maintenance free life of a duplex system.

Finally, and in a philosophical vein, both the paint industry and the hot dip galvanizing industry are fighting a common enemy, namely corrosion. By combining our efforts, we can achieve excellent results which perhaps may not be achievable without a joint and united approach.

Guest Writer

Managing companies with heart and head

The University of Washington's School of Business Administration now offers an executive program on Emotional Intelligence, which it defines as "the ability to regulate emotions in a way that enhances communication and co-operation". Emotional Intelligence, or EI as it is now being referred to, has its roots in the concept of "social intelligence" first identified in 1920 by EL Thorndike who defined it as "the ability to understand and manage men and women, boys an girls, to act wisely in human relations". EI goes a bit further: it involves the ability to monitor one's own and others emotions to guide one's thinking and actions.

Psychologists have often informed us that, in a sense we have two brains, two minds and two different types of intelligence: rational and emotional. How we proceed in life is determined by both, not acting separately but acting together. Many decisions that we make in our lives are based both on rationality and emotion. Thus the old paradigm of using your head and not your heart, when important decisions have to be made may not be possible: perhaps it would be better to harmonise head and heart.

As for individuals, if they want to lead better lives, businesses also need to recognise that having emotionally intelligent employees is necessary for greater prosperity. This is possibly why EI is now being taught at business schools. Emotionally healthy individuals have a high level of self-awareness: they are able to observe themselves and to recognise feelings when they happen. Businesses should strive to develop this ability. Self-motivation helps to channel resources and strengthen character in the service of a goal. Businesses that encourage people to have empathy and sensitivity to other's feelings and concerns, and to appreciate their perspective, are well on their way to being emotionally intelligent. Those of us that work in groups or teams fully appreciate how emotional synergy between diverse people achieve the best results. Managing emotions in others, is essential for handling relationships and resolving disputes.

Businesses need also to foster a high level of corporate EI. The corporate culture should reflect an awareness of the direction the company wishes to move in and show an appreciation and acceptance of changing market forces and environments. An emotionally intelligent company will communicate honestly both internally and externally and be sensitive to the needs of employees and customers. Corporate systems and procedures will be elegant, yet simple and encourage innovation, not stifle it.

An emotionally intelligent organisation will not have lost its pioneering spirit and will thrive on adventure. This sort of company will tell the world, in the words of an old Carolina mountain proverb: "We ain't what we want to be, and we ain't what we gonna to be, but we sure as hell ain't what we wuz".

Bob Andrew, our guest writer, is a consulting value engineer and Honorary Life Member of this Association.

Training of hot dip galvanizing plant operators

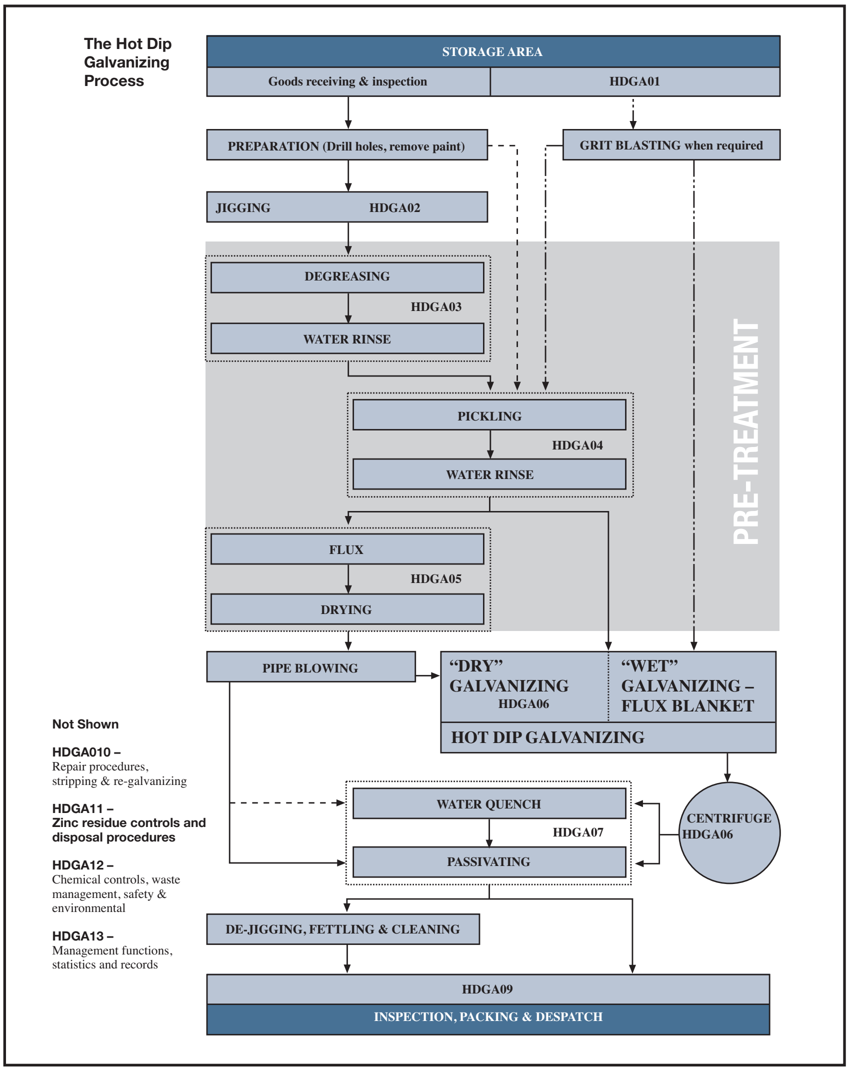
It has generally been agreed that training and re-training is required within our industry. Such training will include plant operators, coating inspectors as well as sales staff. One of the Association's prime objectives is to provide education and training, and it is to this end that the coating inspector's course was implemented. In addition, we are active, on a continual basis, with formal and informal technical marketing presentations to specifiers, consultants and end users.

The implementation of our Skills Development Training material should be commenced, with or without MERSETA's participation. In order to accomplish this objective we need a programme whereby we employ our limited Association personnel to train the trainers. To this end, we again call for suitable candidates to indicate their availability for an initial one-week full time course at the Association's offices during which time we shall instruct them on the use and implementation of the "Skills Development Training Course". For members not familiar with this training material, it consists of a 13 modular course that is designed to train an inexperienced labourer, through all the skill levels within a hot dip galvanizing operation, including the requirements for a hot dip galvanizing plant manager.

The following list and diagram is an extract from our Skills Development Training course material.

The programme deals with each of the following modules separately:

- HDGA01 – Goods Receiving and Inspection
- HDGA02 – The Jigging Process
- HDGA03 – The Degreasing and Rinsing Process
- HDGA04 – The Acid Pickling and Rinsing Process
- HDGA05 – The Flux and Drying Process (Dry and Wet Methods)
- HDGA06 – The Hot Dip Galvanizing Operation
- HDGA07 – The Water Quench, Passivating and Air-cooling Process
- HDGA08 – The De-jigging, Fettling & Cleaning Process
- HDGA09 – The Inspection, Packing & Despatch Process.
- HDGA10 – Repair Procedures, Stripping & Re-galvanizing.
- HDGA11 – Zinc, Zinc Residues and Chemical Controls.
- HDGA12 – Waste Management, Safety & Environment.
- HDGA13 – Management Functions, Statistics and Records



Coating inspector's courses are available throughout the year. Contact Saskia Salvatori on (011) 802-5145 for further details.

MISCONCEPTIONS

Miss Conception puts it "straight"

"Miss Conception" rectifies incorrect impressions concerning hot dip galvanizing.

Hot dip galvanized surfaces are extremely difficult to overcoat with paint whether for aesthetic reasons or for additional protection.

True or False?

The successful painting of any surface is determined by the correct cleaning and surface preparation of the material onto which the paint is to be applied. If hot dip galvanized surfaces are adequately cleaned to remove all traces of oil and other contaminants, there is no reason why most paint types cannot be applied directly onto the galvanized surface. The secret to success is thorough cleaning. The surface of a hot dip galvanized coating differs somewhat from the texture of a steel surface. Adequate cleaning is, if anything, more important when paint is to be applied onto galvanized steel.

The processes of sweep blasting of the zinc or the provision of a zinc phosphate conversion coating are frequently implemented where heavy-duty paint systems are applied. In the case of normal decorative paints, these special requirements are not needed. Acrylics and vinyls will provide excellent adhesion on galvanizing that has been adequately cleaned. An exception is the application of alkyd enamel paint directly onto a galvanized surface. Alkyd based paints can cause a chemical reaction which leads to saponification at the paint and zinc interface. If alkyd enamel paint is preferred, a prime coat must be applied prior to the application of the enamel paint. Among the best primers is the trusted and reliable calcium plumbate which adheres extremely well to zinc. Overcoating of this primer should take place as soon as possible after it is applied since it is very sensitive to UV attack.

Many so-called experts recommend that a galvanized surface should be allowed to weather before a paint coating is applied. This concept can be successful in a benign environment where the degree of atmospheric corrosion is low, but the best results are achieved if a compatible paint coating is applied onto adequately cleaned hot dip galvanizing shortly after the galvanized coating has been applied.

While a total paint system, applied immediately after hot dip galvanizing, will provide the best results where ultimate exposure is required in an aggressive environment, the primer coat, at the very least, should be applied in factory conditions in order to ensure adequate zinc surface preparation, and also to prevent subsequent contamination of the galvanized coating.

AISI Promotes Galvanized Steel Roof Shingles

The American Iron and Steel Institute (AISI), at its annual meeting in May, said the steel roof market could be a 12 million ton market per year. The industry is making about 800 000 tons worth of metal roofing shingles per year, but expects that amount to double in the next three years to 1.6 million tons a year by 2007. AISI is now promoting steel roofs for homes as a way to prevent damage from wildfires in the Western states of the USA. AISI said it wants galvanized steel shingles to become the material of choice for residential roofing, particularly in the wildfire-prone Western states. Dan DiMicco, vice chairman of AISI and chief executive of Nucor Corp., said "a steel roof typically lasts 50 years, is more durable, resistant to high winds, fire retardant and can be recycled rather than buried in landfills". AISI says that steel costs more than other shingle materials, but hopes local governments will modify local building codes to require steel roofs in fire prone areas. Showing photos of neighbourhoods struck by wildfires in California, DiMicco said "The steel roof houses are the ones left standing." Steel companies in the US are promoting the idea with television ads that focus on home improvement shows. A survey found that 93% of women between the ages of 18 and 54 favour a steel roof.

Eskom's Saldanha Blouwater Substation

The Application

For many years, Eskom has used hot dip galvanizing as their corrosion protection system for transmission towers and the exterior sub-station steelwork. This equipment is distributed throughout Southern Africa and consequently many varied and differing environments are encountered.

Environmental Conditions

The environmental condition selected is that of the Cape West coast, approximately 130km north west of Cape Town. The area is routinely subjected to early morning mists that last well into mid-morning. The location of the site selected is well within 20km of the coast with the prevailing winds being either South Easterly or North Westerly. Steel structures exposed to these conditions are therefore subjected to high levels of moisture as well as coastal saline atmospheres.

The Site

Eskom's Saldana Blouwater Sub-Station

Blouwater Substation lattice steel structures were examined in order to establish the condition of the hot dip galvanized coating after 34 years in service.

Our Findings

In general, the coating is in remarkably good condition despite misleading surface contamination. Interestingly, some of the bolts and nuts showed signs of distress. This appeared to be limited to fastener assemblies underneath the lower end of the inverted diagonal angle bracings. The reason for this is due to an extended period of accumulated wetness and being shielded from the sunlight.

The use of zinc-electroplated fasteners (electro-galvanizing) is unacceptable due to the extremely thin zinc coating obtained (normally < 10μm, compared to 55μm of hot dip galvanized fasteners). The

General View of a section of the Blouwater Substation that was inspected on 22 July 2004.

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following photographic analysis of the survey illustrates our findings.

Conclusion

After approximately 35 years of service, the hot dip galvanized coatings on steel components installed at the Blouwater sub-station will continue to provide adequate and effective corrosion protection for at least another 35 years.
There is no doubt that hot dip galvanizing can and does provide a cost effective solution to the vexed question of steel corrosion protection, not only within 20km of the coast, but also in the more aggressive areas experienced within Southern Africa.

For the more aggressive corrosive environments, the use of duplex protection systems (hot dip galvanizing plus a heavy duty organic paint) is recommended. Information in this regard is readily available from the Association.

PS. *It is interesting to note that even where the hot dip galvanized steel appears to exhibit "red rust", once the contaminated surface has been cleaned a substantial amount of zinc and zinc iron alloys remain. It is an established fact that the zinc iron alloy layers provide approximately 30% greater corrosion protection than that of pure zinc on its own. However, as the zinc iron alloys corrode, speckles of red rust appear due to the iron content within the alloys. This is sometimes seen as representing a potential failure of the structure, but in reality the steel remains unaffected and capable of performing the functions for which it was originally designed.*

Despite the apparent "rust" contamination of the galvanized surface, once removed the galvanized coating measured 126μm.

Condition of the "upper" and "lower" fastener assembly illustrating the differential rate of corrosion due to the "Time of Wetness".

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Contribution from County of Victoria Memorial Trust

Letter sent from one of our readers.

Hot dip galvanizing is integral to our standard of corrosion protection in respect of our barrow, pictured in operation right. The half drum pans of these barrows were sand-blasted and dipped by Voigt and Willecke and a non-member galvanizer, dipped the wheel-plates. Various duplex finishes, including epoxy and oil-based paints, were all satisfactorily achieved by scouring the fresh-dipped zinc and priming with "Dulux Galvanized Primer." Now, after 10 years of weathered usage, the paint finishes are still more or less good and we know that our barrows are effectively rust-proofed by this method.

It may be interesting to know that we have complete, No's 1 to 17 of "Galvanizing Today", but, since receiving No 17, we seem to have slipped off your mailing list. We very much value this journal as a well edited way of keeping up with the developments in the galvanizing industry and should much appreciate it if you will continue to send it to us and catch us up on any issues missed.

Yours sincerely

JMP Sherratt

County of Victoria Memorial Trust.

Thank you for the contribution, we have duly updated your information on our database and posted copies of outstanding journals based on our stock in hand. Ed.

Monetary prosperity is dependent on trade, and trade in turn is largely dependent on the efficient movement of goods in quantities large enough to be commercially viable.

GALVANIZING MEMBERS

GALVANIZER	LOCATION	TEL.NO.	SPIN	NO. OF LINES	BATH SIZES (l x w x d) (m)
GAUTENG					
ABB Powerlines	Nigel	011-739-8200		1	11.5 x 1.3 x 1.8
Armco Galvanizers	Isando	011-974-8511		1	13.2 x 1.5 x 2.0
Armco Galvanizers - Dunswart	Dunswart	011-914-3512	●	3	5.2 x 1.25 x 2.0
Barloworld Galvanizers (Pty) Ltd	Germiston	011-876-2900		3	13.5 x 1.25 x 2.25
					7.0 x 1.8 x 1.8
Cape Gate (Pty) Ltd	Vanderbijlpark	016-980-2270		#	Wire galvanizer
Chevron Engineering (Pty) Ltd	Barberton	013-712-3131		1	Ø 0.7 x 1.2d
ConGalv (Pty) Ltd	Benoni South	011-746-9500		3	7.5 x 1.7 x 3.3
			●		4.5 x 1.5 x 2.0
Crystal Galvanizing	Klerksdorp	018-469-1060		1	4.0 x 1.2 x 1.2
CWI (Pty) Ltd	Vanderbijlpark	016-980-3111		#	Wire galvanizer
DB Thermal SA (Pty) Ltd	Nigel	011-814-6460		#	In-line galvanizer
Galvadip (Pty) Ltd	Waltloo	012-803-5168		1	7.2 x 1.5 x 1.8
GEA Air Cooled Systems	Germiston	011-861-1571		#	In-line galvanizer
Iscor Ltd	Vereeniging	016-889-8816		#	Sheet galvanizer
Lianru Galvanisers cc	Nigel	011-814-8658		2	7.2 x 1.3 x 1.6
Pro-Tech Galvanizers (Pty) Ltd	Nigel	011-814-4292	●	2	3.2 x 1.1 x 1.5
Robor Tube	Elandsfontein	011-971-1600		#	Pipe galvanizer
Supergalv	Alrode	011-908-3411		1	6.0 x 1.0 x 1.8
Witbank Galvanizers	Witbank	013-656-3011		1	3.6 x 0.85 x 1.2
WESTERN CAPE					
Advanced Galvanising Corp.	Bellville	021-951-6242		1	7.5 x 1.5 x 2.8
Cape Galvanising (Pty) Ltd	Parowvalley	021-931-7224		1	14.0 x 1.6 x 2.6
Galvatech (Pty) Ltd	Bellville	021-951-1211		1	7.5 x 1.5 x 2.6
Helderberg Galvanizing	Strand	021-845-4500		1	5.5 x 0.8 x 2.4
South Cape Galvanizing (Pty) Ltd	George Industria	044-884-0882		1	3.7 x 0.9 x 2.4
Zincgrip Galvanizers & Coatings	Stikland	021-949-7630		1	4.5 x 1.0 x 2.5
EASTERN CAPE					
Galvanising Techniques cc	Port Elizabeth	041-486-1432		1	12.4 x 1.4 x 2.6
Galvaspin (Pty) Ltd	Port Elizabeth	041-451-1947	●	1	1.8 x 1.2 x 1.4
Morhot (Pty) Ltd	East London	043-763-1143		1	6.0 x 1.2 x 2.5
KWAZULU/NATAL					
A&A Galvanisers	Pietermaritzburg	033-387-5783	●	1	3.3 x 0.9 x 1.85
Bay Galvanisers (Pty) Ltd	Richards Bay	035-751-1942		1	5.0 x 1.1 x 2.5
Phoenix Galvanizing (Pty) Ltd	Phoenix	031-500-1607	●	3	14.0 x 1.4 x 2.5
					7.0 x 1.0 x 3.0
Skema Holdings (Pty) Ltd	Mandini	032-459-1364		1	4.5 x 1.3 x 2.5
Voigt & Willecke (Pty) Ltd	Durban	031-902-2248		1	9.0 x 1.2 x 2.5
ZIMBABWE					
Tube & Pipe Industries Ltd	Harare	092634-611721		1	7.0 x 1.2 x 1.2

 # Sheet, wire, pipe and other in-line galvanizing members dedicate their plants to the galvanizing of their own products.

Note:

- *Where more than one galvanizing line is available, the number of lines and the significant bath dimensions are listed, ie. widest, longest and deepest.*
- *For specific contact names (eg. sales or production personnel) and mobile telephone numbers, contact company receptionist.*