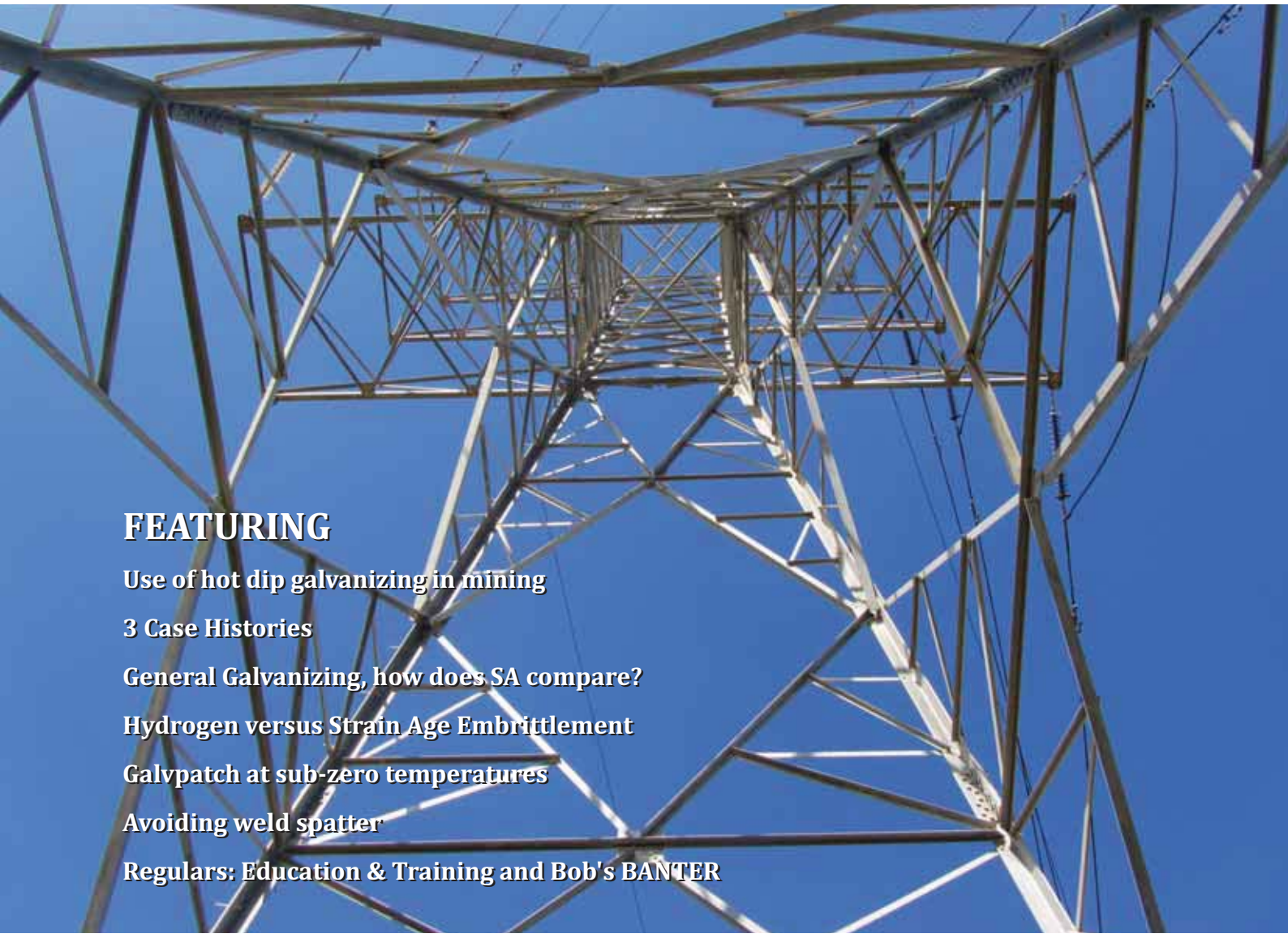
HOT DIP Galvanizing TODAY 57
Hot Dip Galvanizers Association Southern Africa 2014 Volume 11 Issue 1



FEATURING

Use of hot dip galvanizing in mining

3 Case Histories

General Galvanizing, how does SA compare?

Hydrogen versus Strain Age Embrittlement

Galvpatch at sub-zero temperatures

Avoiding weld spatter

Regulars: Education & Training and Bob's BANTER

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Front Cover: An Eskom transmission tower from below; A duplex coated corbel on a concrete bridge; Hot dip galvanized radiators at a coastal sub-station and the Bellville Transport Interchange.

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

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Executive Director's Comment

Designing steel fabrications to be hot dip galvanized

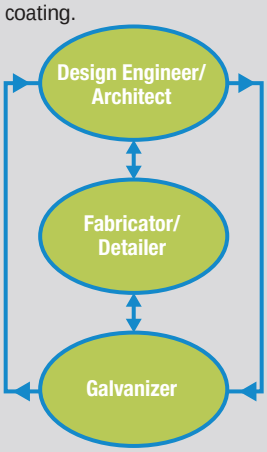
As the name implies, steel is dipped into a bath of molten zinc during the hot dip galvanizing process. While the process is inherently simple, hot dip galvanizing is different to that of painting or other corrosion protection coating systems. The process presents unique requirements during the design stage in order to ensure a high quality metallurgically bonded zinc coating.

ISO 14713:2011 specifies design recommendations that should be followed when fabricating steel to be hot dip galvanized.

Communication

The unique process of dipping steel into a bath of molten zinc requires unique design elements. Your galvanizer or the Association have the knowledge and experience with these design considerations. Galvanizers and/or the Association represent a valuable resource for architects, fabricators, and designers working with steel to be hot dip galvanized.

Opening up the lines of communication early in the design process can eliminate costly problems later on. Fabricating steel with the design considerations for hot dip galvanizing in mind will produce the best results in turnaround time, costs, and quality of the coating.



Communication for quality galvanizing

Acknowledgement

American Galvanizers Association

Bob Wilmot

Note from the Editor

Hot dip galvanizing is one of the most widely used methods of protecting steel from corrosion. As a final step in the process, the hot dip galvanized coating is inspected for compliance with specifications. Interpretation of inspection results should be made with a clear understanding of the causes of the various conditions which may be encountered and their effects on the ultimate objective of providing corrosion protection.

"Practical Guidelines for the Inspection and Repair of Hot Dip Galvanized Coatings", was introduced several years ago to assist in testing, inspection, and the interpretation of test results. It dealt with numerous surface conditions, their origins, and their effects on protection from corrosion.

The manual also considered undesirable design and fabricating features as well as unacceptable hot dip galvanizing practice.

While minimum specified standards must be satisfied, their relative importance varies according to the end use of the product.

For example, the aesthetic appearance of hot dip galvanized structural steel in an obscured application is different from that where a product is used as an architectural feature. An awareness of the end use of the product and the capability of the hot dip galvanizing process is essential for good inspection.

We are busy compiling an updated version of this manual, which we hope to launch mid-year. The booklet addresses most of the surface conditions encountered over the past few years demystifying the acceptance and rejection criteria of hot dip galvanizing so that its final appearance is acceptable for its intended use. The title of the booklet will most probably be something like *"Demystifying the surface appearances of new and weathered hot dip galvanizing, for the benefit of end users"*. While the number of surface conditions created by the steel type; designer, fabricator and galvanizer have substantially increased, very few of the highlighted surface conditions have a negative influence on the coatings durability, which in most instances is the objective of using hot dip galvanizing. The manual will again include appropriate coating repairs.

The main feature for this edition is the first part of a paper presented to Latingalva, hosted by IZA in Santiago, Chile in mid November 2012, entitled *"The roll of the HDGASA in the direct or indirect promotion and use of hot dip galvanizing in various mining applications, including gold, platinium, iron ore and coal and future motivation of its use in the Petro Chemical Industry, in South Africa."*

We also include three case histories, Duine Sub-station (built in 1977), the duplex coated steel corbels at Liesbeeck Parkway Intersection (erected in 2000) and Bellville Transport Interchange Upgrade (built in 2002).

General galvanizing in SA, how does it compare to other parts of the world, by Rob White of IZASA.

We introduce a successful anti-spatter product supplied by Shield Technologies and provide the results of a coating repair by "Galvpatch" subjected to sub-zero temperatures for about 8 months.

Regulars include our single and 3 day hot dip galvanizing course as well as *"Positive defiance"* in Bob's BANTER.

We are delighted to present to our readers our new face of Hot Dip Galvanizing Today, which we believe is a lot cleaner and more professional than the previous cover. We would welcome your comments on the change, either way?

Enjoy the "magazinc".

Terry Smith

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The use of hot dip galvanizing in mining in Southern Africa PART 1

The role of the HDGASA in the direct or indirect promotion and use of hot dip galvanizing in various mining applications, including gold, platinum, iron ore and coal and future motivation of its use in the Petro Chemical Industry, in South Africa.

Author: Terry Smith Technical Marketing Director – Hot Dip Galvanizers Association Southern Africa.

Abstract

This paper introduces deep level mining and its corrosivity in South Africa. It reflects on the history of mining in South Africa over the last 50 years and then introduces a number of case histories including Platinum Concentrator Plants, Collieries and an Iron Ore Benefication Plant. The prospect of using hot dip galvanizing in future Petro Chemical Plants is also motivated.

The paper introduces the Hot Dip Galvanizers Association Southern Africa (HDGASA) and the direct or indirect role that the organisation has played in the development and acceptance of hot dip galvanizing and duplex coating systems in the mining industry.

While the Association's drive has included most mining companies, Anglo American, Anglogold Ashanti, Anglo Coal, Amplats and Kumba Iron Ore particularly, have specified and extensively made use of the coatings with extremely successful results.

Deep level mining includes Gold and Platinum, etc. while open cast mining includes Coal, Iron Ore, etc.

The paper concludes with references on the use of hot dip galvanizing from Anglo Platinum, Anglo Coal and Kelloggs Brown and Root (KBR), from Houston, Texas.

Due to length of the paper which was delivered on the occasion of LatinGalva in Santiago Chile in November 2012, it has been divided into three parts to be published over the next few editions of "Hot Dip Galvanizing Today".

Overview

- Introduction.
- Historical information of Mining in SA and hot dip galvanizing and duplex coating systems.
- The Hot Dip Galvanizers Association Southern Africa and its members.
- Some case histories including two Platinum Smelters, several Collieries and an Iron Ore Beneficiation Plant.
- Evidence of hot dip galvanizing's performance in a coastal Petro Chemical Plant and its possible future use.
- References from Amplats (Anglo Platinum Management Services), Anglo Coal and Kelloggs Brown and Root (KBR) on the use and benefits of hot dip galvanizing in Petro Chemical Plants.
- Conclusion.

Introduction

South African gold and platinum mines generally utilise single to multiple stage vertical shafts, extending to depths of between 500m and 4 000m below ground *(photos 1 & 2)*. In shallow mining, inclined shafts are more typical extending to lengths of 1 000m and depths of between 200 to 600m below ground. Irrespective of the type of shaft used, environmental conditions encountered are usually highly corrosive and become even more so the deeper one proceeds (*photos 3 & 4*). These conditions are due to the presence of corrosive fissure waters, high levels of humidity, corrosive fumes and gases, as well as corrosive and abrasive ores. In addition, thriving corrosion cells develop due to the accumulation of debris at catch points and crevices including internal surfaces of various hollow steel components.

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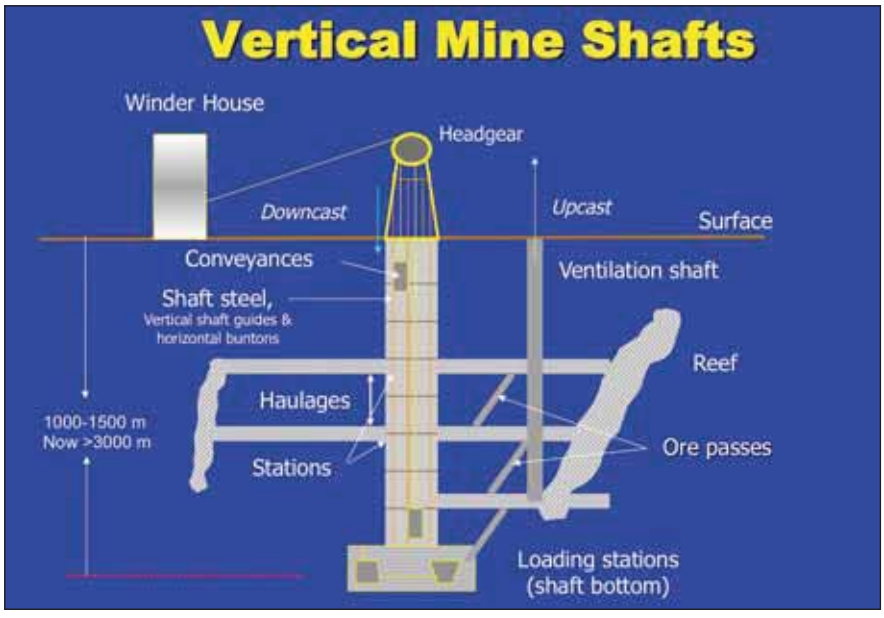

Photo 1: A cross section through a vertical mine shaft of depths greater than 3 000m.

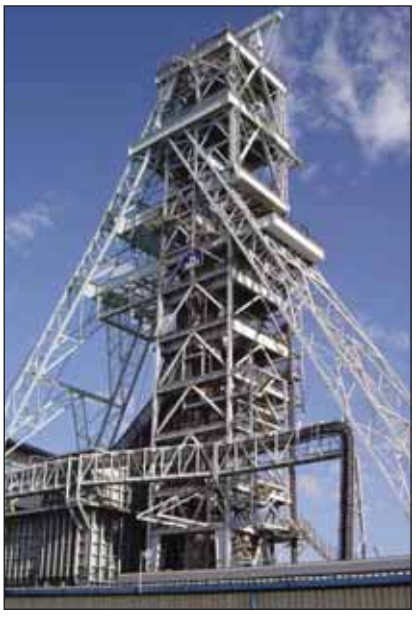

Photo 2: A typical deep level mine headgear.

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Photos 3 – 4: Typical environmental conditions in a shaft, which become more corrosive the deeper ones descends.

The shaft provides continual access for men, materials, machinery and ore, maintenance free performance of upwards of 25 years and is required to minimise routine downtime allowances. Photos 5 and 6 show hot dip galvanized shaft guides (left) and buntons and connections (right). Note the additional paint coating at crevices and over the fasteners.

A major design requirement applicable to all mine shafts (which provides continual access for men, materials, machinery and ore) and all tertiary support steelwork, irrespective of environmental conditions or type of corrosion control system employed, is the need for a safe extended service life, maintenance free performance of 25 to 30 years with minimum routine down time allowances *(photos 5 & 6)*.

Historical overview

The first mine to hot dip galvanize shaft steel was President Brand in the Free State in about 1957. This was a duplex system consisting of hot dip galvanizing and coal tar epoxy paint which proved singularly successful. Apart from this, the use of hot dip galvanizing was mainly confined to high pressure pump columns and medium to small bore piping.

In about 1972, an active approach was made to promote hot dip galvanizing in the gold mining industry particularly for use in applications below the surface.

The first success was Kinross No. 2 shaft where the lower half of the shaft was duplex coated.

This was soon followed by other mines with an encouraging breakthrough into the Anglo American Gold mining industry where shaft steel components were galvanized for amongst others President Brand, President Steyn, Freestate Geduld, Elandsrand and Vaal Reefs No. 8 shaft.

Johannesburg Consolidated Investments (JCI) soon after became converts with the new shafts at the Randfontein Estates complex and Joel Mine.

The next phase was to introduce hot dip galvanizing to the Platinum Mines where considerable resistance and scepticism was encountered. Rustenburg Plats were the first converts (Amandabult No. 2 shaft and Spud Shaft are two examples). Impala Platinum and a host of other mining applications, including Platinum Concentrator Plants, Collieries, Iron Ore Beneficiation Plants, then followed.

The performance of the selected coating system in a number of these deep mining applications has, unfortunately due to lack of time and personnel from the Association's perspective, not been closely monitored. However, Moab Khotsong a gold mine south east and about 120km from Johannesburg was equipped with about 6 700 tons of hot dip galvanized steel down a shaft of over 3km deep and has been monitored relatively well over the last 20 years since inception, with good results. These results have been documented in two papers see References and Acknowledgements.

Hot Dip Galvanizers Association Southern Africa and its members

Reasons for the Association's existence

The Association's primary mission is to develop and expand the demand for hot dip galvanizing and duplex systems as viable and

Photo 7: Interviews, presentations, plant tours and technical courses are vital in the promotion of hot dip galvanizing and duplex coating systems.

Photo 8: The Hot Dip Galvanizers Association publishes promotional literature including a quarterly magazine, "Hot Dip Galvanizing Today". This information is freely available in hard copy format or from www.hdgasa.org.za.

Photos 9 – 10: The galvanizer plays a vital role of good quality coatings and good service.

economical corrosion protection systems. Our main objective is to SELL the concept of hot dip galvanizing directly to end users and decision makers to the benefit of members, end-users and all other stakeholders.

Interviews, presentations, plant tours and technical courses

Initial interviews with individuals within a company will generally result in a follow up technical presentation and possibly a plant tour to other technical staff of that company. Frequent follow up visits to these companies generally instil confidence and trust.

Presentations can be extremely valuable if directed at the correct audience e.g. decision makers and specifiers. The success of a presentation is normally gauged by the time spent with questions and discussion, not necessarily only the formal presentation.

Follow up training courses in this regard are also extremely valuable (*photo 7*).

Technical expertise

The technical staff of the Association must have an in-depth knowledge of corrosion technology and how to reduce its impact. They must be technically qualified to be able to discuss competitors' products, but not knock the opposition. They must possess an intimate knowledge of hot dip galvanizing and its corrosion resistant properties, both strengths and weaknesses. To recommend hot dip galvanizing where it is inappropriate is a recipe for disaster.

Membership

Membership of the HDGASA includes general or batch type, centrifuge, tube, continuous sheet and wire hot dip galvanizers, Associate members who buy and sell to the industry as well as Affiliate Company, Professional, Individual and International members who have a vested interest in the industry as a whole.

The Association plays the role of unbiased back up to members in situations of dispute, where possible.

All members of the Association undertake to provide customers with a committed, reliable and professional encounter and subscribe to the Code of Ethics of the Association. The Code of Ethics Statement encompasses good business practice among members and their customers.

The Association publishes promotional literature such as the Steel Protection Guide, Practical Guidelines for the Inspection and Repair of Hot Dip Galvanized Coatings, Design Wall Chart and the quarterly "Hot Dip Galvanizing Today" a self-supporting magazine sent to specifiers, users and members of the Association. The Association also adminis-

continued on page 8...

ters an informative web site www.hdgasa.org.za. (*photo 8*).

The role of the galvanizer

With the utmost respect, it is necessary to emphasise the vital importance of good service and good coating quality. Failure to achieve this by a single galvanizer with a single consignment of steel can nullify months and even years of intensive promotional effort by the Association. In developing markets such as South Africa there are numerous sceptics who remain to be convinced of the merits of hot dip galvanizing (*photos 9 & 10*).

CASE HISTORIES

Bafokeng-Rasimone (Platinum Concentrator Plant)

The use of hot dip galvanizing for structural steel and equipment in metallurgical plants is far less common than its use in deep and inclined mining shafts, due mainly to concerns regarding its long-term performance in the perceived 'chemical' environment of a metallurgical plant. Metallurgical plants in the mining industry are diverse in nature, including, for example, gold CIP plants that use hydrochloric acid, copper and platinum group metals (PGM) smelters and gas handling plants with rich sulphur dioxide gas environments, sulphuric acid plants, and base and precious metal refineries that use either sulphuric or hydrochloric acid. In these types of plants, the choice of hot dip galvanizing would not be deemed appropriate on account of the expected rapid attack of the zinc coating in acidic conditions. The environments of many other types of metallurgical plants could, however, be regarded as being benign as, apart from some acidic and alkaline reagents, generally in small quantities, their processing streams are at near to neutral pH values. PGM concentrators are typical examples of these types of plants. One of the problems in the development of markets for hot dip galvanizing has been that owners and specifiers have tended to classify all types of metallurgical plants as having the same sort of chemical environment and have thereby unrealistically elevated the risk of using galvanizing in many of these applications.

During investigations to characterise the parameters for using hot dip galvanizing in underground conditions, Anglo Platinum also investigated the feasibility of using galvanizing for platinum concentrator plants. Hot dip galvanized steel was gradually introduced as a material of

Map showing the location of the Case Histories in South Africa.

construction for cable racking, flooring, stair treads and hand rails for new, maintenance and replacement projects, with their performance being closely monitored. Alternative corrosion protection options like epoxy and vinyl paint coatings on steel; epoxy powder coatings and the corrosion resistant alloy 3CR12 were also studied. In all of these investigations it was apparent that hot dip galvanized steel was the superior option in terms of cost-effectiveness over the life cycle of the plant. The measured and evaluated success of hot dip galvanizing in these investigations provided the required degree of confidence for the specification of this method of corrosion protection for numerous new projects being undertaken by Anglo Platinum as

Photos 11 – 14 from top left clockwise: After 5 years of service at Bafokeng-Rasimone PCP – The appearance of the 3 coat paint system; a damaged hot dip galvanized coating; coating thickness on a hot dip galvanized water pipe (59µm) (tube hot dip galvanized to EN 10240) and coating thickness at the damaged area (61µm).

part of their expansion drive, the first of which was the construction of the Bafokeng-Rasimone Platinum Mine situated 25km North of Rustenburg in North West Province, in 1997.

The following paragraphs outline the performance of the hot dip galvanizing used at Bafokeng-Rasimone over a five-year service period.

Overall performance

In general terms, the performance of the installed hot dip galvanized steel in both the underground and plant environments, has been exceptionally good. Apart from complete protection of the steel, the rate of deterioration of the zinc coating has been extremely low. Thickness measurements have been unable to detect any removal of zinc and the steel is virtually in the same condition as when it was installed. While the design life of the hot dip galvanizing was set at 25 years, it is apparent that apart from any unforeseen circumstance arising in the future, the future life of the hot dip galvanized steel is well in excess of the design life.

The reagent area

Because of the concerns and possible doubts, as well as a lack of data, regarding the long term performance of hot dip galvanized steel in the reagents area on account of the presence of relatively small quantities of various alkaline and acidic reagents, the specification for steel in this area excluded the use of galvanizing and selected instead the use of a conventional organic paint system (a three-coat vinyl co-polymer system over a SA 2½ surface preparation grade was used), (*photos 11, 12, 13 and 14*), the performance of the paint system has been marginal and will require replacement or maintenance, at best about every second year. Although hot dip galvanizing was not used in this area, certain small items, like water pipes and hand rails were galvanized and these serve to provide some performance data on galvanizing in this area. It is interesting to note that these small items of galvanizing have performed extremely well and indicate that at the BRM plant, the use of hot dip galvanizing would have been a better option than the painting system that was used. Since metallurgical reagents are often changed or modified, as process parameters change, it would be more prudent to use a Duplex system in these areas. It must also be noted that different platinum concentrators often make use of a different suite of reagents and accordingly, for a specific plant, trials should first be conducted to confirm the suitability of hot dip galvanized steel.


Photos 15 – 16: Early photos of the 6 500 tons of superstructure hot dip galvanized steel at Bafokeng-Rasimone Platinum Concentrator Plant.




Photos 17 – 20: A number of views of Marula Platinum Smelter and the hot dip galvanized structural steel, including conveyor steelwork from an inclined shaft to varying process plants at the mine.

A similar evaluation of the hot dip galvanizing was undertaken after 10 years and the results were almost identical to the earlier inspection. (photos 15 & 16).

Marula Platinum Smelter

Brief background

Marula Platinum Limited (Marula) is 73% owned by Implats and is one of the first operations to have been developed on the relatively under-exploited eastern limb of the Bushveld Complex in South Africa. It is located in the Limpopo Province, some 50 kilometres north of Burgersfort.

The establishment and development of the mine, requiring considerable investment from Implats in both infrastructure and environmental protection measures, commenced in October 2002.

Current mining activities target the UG2 Reef only which is accessed via two declines, Clapham and Driekop, which are situated 1.3 kilometres apart. The declines were sunk on-reef from the outcrop at a minor dip of 9.5 degrees, each with three portal entries.

The metallurgical plant which was commissioned in February 2004, consists of a concentrator and a dense media separation plant (DMS) *(photos 17, 18, 19 and 20).*

To be continued in magazines no. 58 & 59.

Hot Dip Galvanizing Awards 2014

CALL FOR SUBMISSIONS

We have pleasure advising you that the Call for Submissions to the 2014 Hot Dip Galvanizing Awards is now open. The objective of these awards is to recognise and promote the development, application and use of hot dip galvanizing and related technology as a corrosion protection system.

The submission process for 2014 is as follows:

1. Call for Submissions
2. Form submission of project by completing the submission form and submitting to the Association together with photos.
3. Submission deadline is 30 May 2014.
4. Assessment of Final Entries

Each accepted submission must comply with the following:

- Each winning project should have the potential to be used as a case study in the future
- Every accepted submission should add to market development

The Conditions of Entry are as follows:

- All submissions to be submitted to the HDGASA by 30 May 2014
- The Judge's decision is final and no correspondence will be entered into.
- By submission of an entry, the submitter assumes responsibility for the accuracy of all information and provides the HDGASA with assurance that permission has been obtained and that the information and photos may be used in the magazine, on the Association's website and for promotional purposes.
- Submissions to be completed according to the template (available on website or on request)
- Only new submissions will be accepted, other than previous projects now qualifying as a possible "Vintage" submission.
- The project or product must be complete by the Awards Evening in August 2014.

Material to be submitted:

- A motivation as to why your project should be chosen is essential. Does it have the WOW factor? Will it have an impact on the market by aiding development of the hot dip galvanizing industry? Is it a new application or difficult to galvanize?
- Technical information is extremely important. Motivation, numbers and facts will assist with the adjudication.
- The professional standard of the submission forms an integral part of the judging criteria.
- Submissions should include a minimum of 5 full colour photographs. Please ensure that digital photographs are taken at 300dpi for reproduction purposes.
- Kindly ensure that electronic copies of the digital photographs are supplied with entry.

Please contact the Association for further details or for the template to assist you with completing your submission

(011) 456-7960 or hdgasa@icon.co.za

Letter to the Association

Hi Bob / Saskia

I was shocked and disappointed that a simple and ugly cable and turn buckle bridge was judged to have more wow factor etc. than the complex and historically significant spiral bridge with eco wood decking of our Ncome / Blood river submission.

I can only put it down to politics, it seems that the fact that because the turnbuckle monstrosity created some short term jobs etc. is more important than the product itself, or the technicalities and galvanizing challenges and that Blood River it is still an embarrassment to the politically connected, and our submission never had a chance in the new SA.

I also think that the entrants deserve some kind of feedback on how their entries were judged etc.

Regards
Alan Smith, Managing Member
Steelcom Engineering

Good morning Alan,

I am truly grateful for your e-mail and the comments contained. Please understand that the Association staff does not constitute the judging panel. We invite a team of 6 to 8 industry professionals who constitute an independent judging panel. We invite individuals including a structural engineer, architect, experienced and practical site supervisor, quality control manager, corrosion consultant, marketing practitioner, a representative from SAISC and a professional facilitator. Based on the information that is received, the judges use an "Awards Scorecard" to place each submission into a category followed by a series of itemised ratings. I have attached the Awards Scorecard for 2013 together with the judges' comments.

Generally, we find that the more technical and marketing information, with as much photographic support as possible, we receive; the more the judges have a basis for making an objective and informed decision. To this end we also publish the attached "Awards submission guidelines" that is linked to the judging criteria. The judging processed was developed in 2008 and annually reviewed by our Executive, based on feedback from the market and our members in order to ensure objectivity.
I can assure you that politics has absolutely no part in the process.

The success of our awards dinner is totally dependent on both the quantity and quality of the submissions received.

I trust that you understand the inherent difficulty in judging submissions and that we are very appreciative that you took the time and made the effort to even make a submission. Submissions from the market place are welcomed as they represent an understanding of the value of hot dip galvanizing for corrosion control.

Should you consider a 2014 submission I am available to support you with the drafting of the information in terms of our judging guidelines.

Your comments in regards to the judging process are most welcome.

Best regards,
Bob Wilmot, Executive Director

Hi Bob

I think that the association distancing itself from the judging is problematic. An example would be 2 different projects that staff of the association has been directly involved in, with a clear superior project as far as galvanizing and aesthetics goes. All it takes is for the superior project to have less motivation, and a theoretically weaker submission for it to wrongfully loose.

However the association who are qualified to judge the galvanizing rather than the socio-economic qualities, could/should do their own independent marking separate to the panel, then check the panels decisions to make sure that at the end of the day the galvanizing criteria is justified in the winning entry. A site visit should surely also be included before a final winner is awarded.

Kind Regards
Alan Smith

Eskom coastal sub-stations

Eskom have since the roll out of the electrical power distribution transmission lines erected throughout South Africa since the early seventies, specified hot dip galvanizing as the preferred method of corrosion protection. Many of the transmission lines are today still providing maintenance free service lives.

Sub-stations follow the same trend and the following sub-stations in the Western Cape are included as Case Histories to evaluate the durability of the hot dip galvanized coating.

Accompanied by Jannie du Toit of Eskom Brakenfell, Cape Town, Duine, Paardekloof and Rietvlei sub-stations were visited at the tail end of February 2014 and the hot dip galvanizing inspected and evaluated. *(Due to a space constraint only Duine Sub-Station is reported in this case history. The other two will follow in subsequent editions).*

Duine Sub-Station.

Radiators.

Duine Sub-Station

Application

The original steelwork for Duine Sub-Station was erected in September 1977, to date equalling about 37 years of exposure to aggressive marine conditions adjacent to Koeberg Power Station.

The sub-station is situated about one to one and a half kilometres from the sea.

The site

Marine chlorides are present *(see photos)*. Duine Sub-Station is considered to be about a C4 bordering on a C5 environment (an environment with a zinc corrosion rate of 2 to 8µm/year) in accordance with ISO 9223 or the Association's Information Sheet No 11, Corrosivity of Zinc.

Edge of the radiator (above left) and close up of the edge of the radiator showing visible marine chloride salts and an area cleaned for taking coating thickness readings (above right).

Our findings

The hot dip galvanizing is performing above expectation. Judging by the residual coating thickness on the structure as well as the holding down bolts and nuts, we predict the galvanizing will provide an excess of a further 30 years of service-free life.

Above left and right: Residual coating thickness readings of 264 & 215µm respectively on the bracing struts.

Conclusion

In spite of visible surface chlorides from the sea air, the hot dip galvanizing has performed admirably over the last 37 years reasonably close to the West Coast.

photos continued on page 14...

Zinc Metal Spraying?

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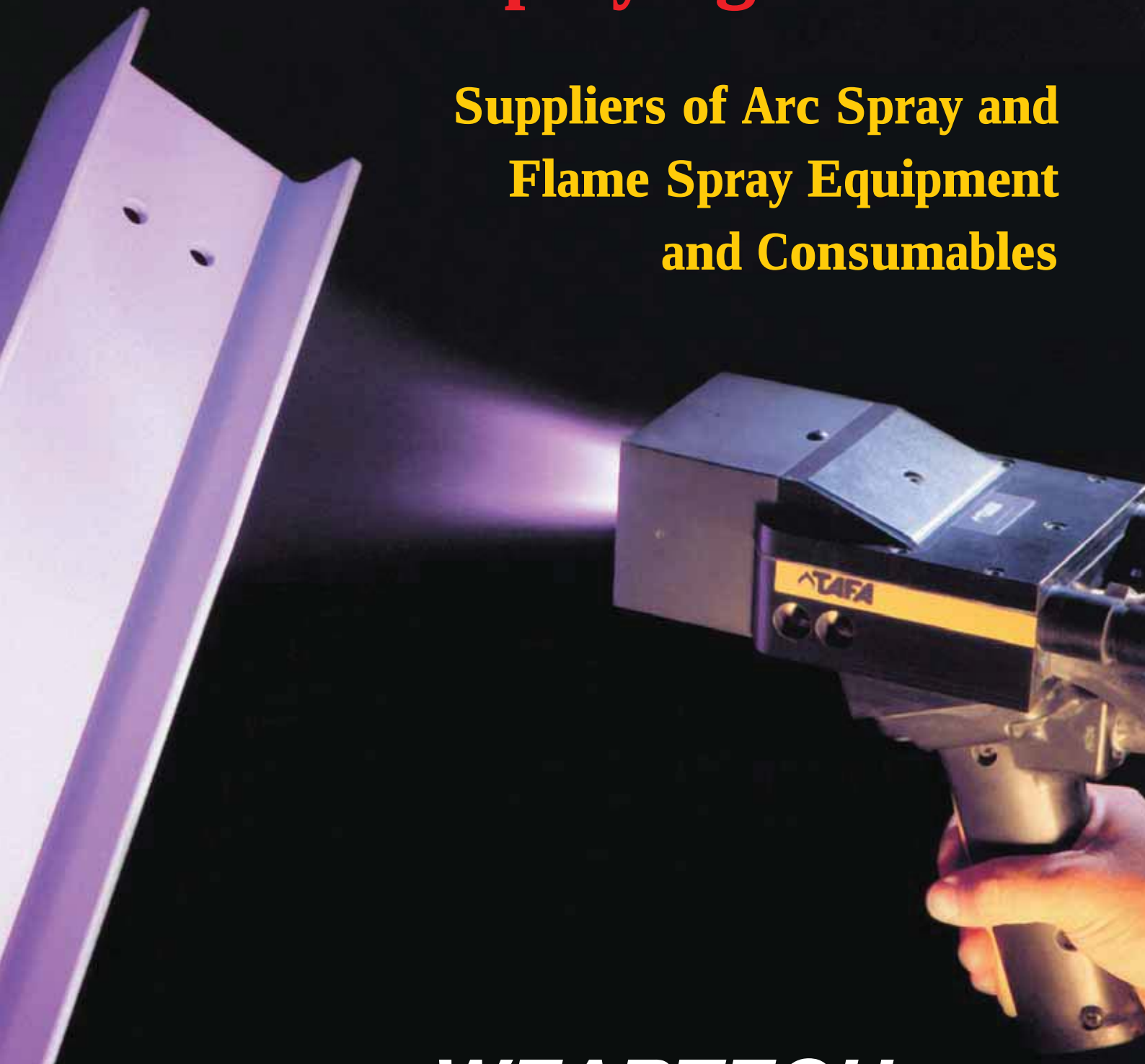

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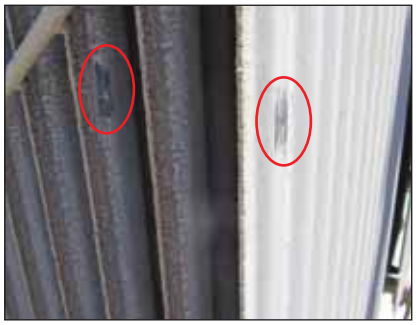

Edge of the radiator showing the two cleaned areas where residual coating thicknesses were taken.

Above left and right: Residual coating thicknesses of 71.4 and 69.0µm respectively.

Above left and right: Residual coating thicknesses of 65.4 & 75.2µm respectively.

Chloride salts cleaned off the underside of the radiator.

Above left and right: Residual coating thicknesses of 80.9 and 98.8µm respectively taken on the underside of the radiator.

Areas of coating damage (no corrosion creep).

Above left, centre and right: Residual coating thicknesses adjacent to mechanical damage of 204µm, residual iron zinc alloy coating thickness at damage of 21.0 and 35.0µm respectively.

Above left, centre and right: Appearance of the coating on support angle, with residual coating thickness taken at a cleaned area of 169 and 191µm respectively.



Above left, centre and right: Another component showing visible chloride salts, removed and residual coating thickness readings of 124 and 123µm respectively.

Above left, centre and right: Residual coating thickness readings on cleaned holding down nuts and bolts of 79.1, 85.6 and 260µm respectively.


One single base plate showed corrosion on the edge. Residual coating thickness readings of 140 and 165µm were taken adjacent to the corroded area. A possible cause is an original over cleaned edge or use of an acidic grout.

Insert showing galvanized steel duct cover plates. Above left and right: Coating thickness readings of 90.9 and 108µm respectively on the underside of the duct cover plates.

Coating thickness reading of 112µm on the steel entrance gate.

Above left and right: Coating thickness readings of 62.9 and 118µm respectively on the topside of the duct cover plates.

Coating thickness reading of of 61.2µm on the steel entrance gate.

Bellville Transport Interchange upgrade built in 2002 stands the test of time

Following a meeting early in 2002 with Henry Fagan of Henry Fagan & Partners (engineer for the structure), in association with GAPP Architects & Urban Designers, who were responsible for the concept and ideas of the interchange at the time, I became involved in the project, a rather unusually shaped transport interchange in Bellville, Cape Town.

Due to the limited expected lifespan and the continued maintenance costs of paintwork, hot dip galvanizing was selected by Henry Fagan knowing full well on its own the coating should provide at least 25 years of service free life.

My role was to advise Henry on how to hot dip galvanize the 'upside down spiders'. These were too large for a single immersion in the largest bath in Cape Town and due to a major amount of cutting of the I-Beams, double end dipping may have resulted in unacceptable distortion, so we decided to try something different.

This entailed cutting off two of the 'upside down spider' roofing legs and masking the ends that were to be welded with "Galvstop". After galvanizing, the ends were cleaned off to achieve a zinc free surface.

The ends were then welded and the welds repaired using a layer of Zincfix neatly applied between two strips of masking tape. We knew then that although Zincfix was a recommended repair product, the weld area would be the first to show corrosion over time, especially if applied too thinly (sometimes achieved if ones finger is used to spread the product).

Accompanied by Gert Groblar of Henry Fagan and Associates we revisited the taxi

continued on page 18...

Some silver zinc rich spray paint was used, which is irritatingly highlighted against the stable hot dip galvanized zinc carbonate patina.

The "upside down spiders" on site following delivery. Notice the similarly grey tones of coating repair by "Zincfix".

Varying views of the transport interchange upgrade showing the curved tubular purlins.

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The "upside down spiders" showing atmospheric surface contamination.

The surface contamination removed and residual coating thickness of 197µm taken on the structure and 187µm on the holding down nut.

The curved hot dip galvanized tubular purlins are in excellent condition with a residual hot dip galvanized coating thickness of 134µm.

Hot dip galvanized I-Beam tubular purlin support, showing a residual coating thickness of 252µm.

Due to the application thinness of Zincfix (achieveable by thinly spreading the product with one's finger) the welded area is showing signs of premature corrosion.

Where Zincfix has been correctly applied there are no signs of premature failure.

The connection pipe from one roof to the next was for some reason only painted, see condition left, which will in a short period of time have to be re-coated or replaced.

rank last week and found the coating was performing as predicted after 12 years of exposure.

The site

Marine chlorides seem to be present *(see photos)*. Bellville is considered to be a C3 environment (an environment with a zinc corrosion rate of 2µm or less) in accordance with ISO 9223 or the Association's Information Sheet No 11, Corrosivity of Zinc.

Our findings

The hot dip galvanizing is performing to specifications. Judging by the residual coating thickness on the structure as well as the holding down bolts and nuts, we predict the galvanizing will provide a further 30 to 50 years of service-free life.

The areas where the 'upside down spiders' were welded and originally repaired using Zincfix should be cleaned and recoated with either Zincfix or Galvpatch as required.

A row of pipe bracings which were originally only painted were showing signs of some corrosion and will also require future maintenance over time, or replacement.

Conclusion

The hot dip galvanized coating lives up to its predictions of providing a long, service-free life with relatively low maintenance for a cost effective price.

Original project team:

Henry Fagan & Partners (engineer for structures)

GAPP Architects & Urban Designers (architects)

Walker Maré (quantity surveyors)

Ground Force Labour Services (main contractor)

Stocks Africa (contractor for structures)

Tenca Engineering (steelworker)

Duplex coating good after 14 years of mild to moderate marine exposure

The original task of the project team was to widen the bridge over Liesbeeck Parkway and the adjacent Liesbeeck River, sufficient to include an additional traffic lane in both directions of the inbound carriage way of the N2.

The application and key features of the final design

Key features of the final design were the following (see photos):

- *Structural steel corbel and strut attached to existing reinforced concrete piers to accommodate additional live loading and also ensure acceptable road clearance and aesthetic characteristics. (Structural steel provided the optimum solution for the transfer of the high vertical and transverse forces to the existing substructure within the existing geometric constraints).*
- *Transverse post tensioning of the pier trestle beam by means of external dywidag bars.*

The Liesbeeck Parkway intersection looking towards Table Mountain showing the duplex coated steel corbels.

- *Positive anchoring of widened pier elements to the existing by using GEWI post tensioned anchors (rock anchors used in the mining industry) to ensure adequate shear friction transfer.*
- *Jacking by means of sacrificial flat-jacks fitted into pre-made pot bearing units.*

continued on page 20...

The above photos show the duplex coated steel corbel which while slightly discolored from rain water remains successfully intact.

(Jacking pressure was achieved by a specially formulated and tested cementitious grout which hardened under vertical load after the required force was achieved).

Durability

In view of the possibility of narrow concrete cross-sections due to the existing dimensional constraints the durability received particular attention and the following main measures were undertaken to ensure adequate durability:

- *Using a blended OPC/FA mix. Not only did this provide enhanced concrete durability properties but also provided advantages related to improved concrete workability and surface finish texture.*
- *Hot dip galvanizing of all reinforcement and structural steel.*

The following are the main considerations that resulted in the decision to specify galvanized steel:

- *The location of the bridge in a moderate to severe exposure area.*
- *Extensive experience of the client with maintenance problems and costs of concrete structures with inadequate durability characteristics in similar areas.*
- *The method of construction with large contact areas between old and new concrete with critical reinforcement crossing the interface zone.*
- *The compatibility considerations of the old and new concrete properties and the effect of creep and shrinkage which could result in crack formation in the new concrete elements.*

APOLOGIES: The Association wishes to apologize to Iain Dodds, retired from Cape Galvanising for not acknowledging him as the author of *"Effective corrosion protection of structural steel"*, published in the previous magazine, No 56.

The design considerations and specification requirements were mainly based on the guidelines contained in the state of the art report, Coating Protection for Reinforcement, published in 1995 by Thomas Telford Services Limited. (This is the formal publication of the 1992 Comité Euro-International Du Beton Bulletin 112).

The following are some of the noteworthy items in this publication regarding the use of galvanized reinforcement, which was taken into consideration in the design process, as reported from case studies for mainly bridge decks:

- *Proper galvanizing techniques have no significant effect on the mechanical properties of the steel reinforcement.*
- *Zinc coating provides local cathodic protection to the steel as long as the coating has not been consumed.*
- *Corrosion of galvanized steel is less intense and less extensive for a substantial period of time than that of black steel.*
- *Galvanized steel tolerates higher chloride concentrations than black steel before the corrosion starts.*
- *Greater compatibility is achieved with lower alkali cements (in this instance the use of FA as an extender provided the added benefit of reducing the active-alkali content in the mix).*
- *Accidentally reduced cover is less dangerous than with black steel.*
- *The development of the bond between steel and concrete is dependent on both the age and the environment and usually takes longer for galvanized steel. (This was taken into consideration with the form-work stripping requirements). The final value, which may in some instances be higher than with ungalvanized bars, is dependent on the chromate content of the cement.*
- *The use of galvanized reinforcement should not be considered as an alternative to the provisions of adequate cover and/or dense impermeable concrete and must be seen as a complimentary measure.*

Aesthetic considerations

This aspect received particular attention during the design for the widening of the substructure and the client, who provided extensive input during the design process, stipulated stringent guidelines.

In view of the fact that the final widening consisted of an unusual structural steel strut it was considered especially important not to

Preparation of the existing reinforced concrete pier to accommodate the hot dip galvanized structural steel corbel and strut.

Positive anchoring of widened pier elements to the existing by using GEWI post tensioned anchors.

alter the main character of the existing reinforced concrete structure and that the widening should not have a "stuck-on" temporary appearance.

This objective was achieved by the following and it is believed that the widening has actually improved the bridge appearance:

- *Design of structural steel element geometry to be compatible with the existing concrete profile with minimal additional protrusions.*
- *The use of cover-plates to hide unavoidable structural steel like elements.*
- *The painting of the steel cover-plates with the same cementitious based protective coating, which was specified for the substructure concrete. (An extensive testing procedure was required to achieve suitable bond characteristics).*

The environmental conditions

The conditions at Liesbeeck Gardens Interchange fall into a mild to moderately corrosive environment where the corrosion rate of zinc (on its own) is likely to be at worst about 2 to 3µm per year.

Our findings

While a close up examination of the duplex coated corbel and strut was not possible due to its height, the duplex coated elements (apart from some discolouration from water runoff) are in a good condition. *(See photos).*

HDGASA would like to thank BKS (Now Aecom) – Bellville for this comprehensive article.

CNC plasma cutting machine is being commissioned at IPM.

CNC press brake being commissioned at IPM.

Leading steel pole manufacturer takes delivery of high-end CNC machines

The production plant at Industrial Poles & Masts (IPM) has recently seen some new additions to its list of manufacturing machinery, reinforcing again the company's position as the leading manufacturer and supplier of steel poles for various applications. IPM supplies poles for street lights, masts, transmission line poles, traffic signal poles, lightening conductor poles and decorative poles. The company also supplies fabricated steelwork for substations.

A state-of-the-art CNC (computer numerical control) high definition plasma cutting machine and a CNC press brake have been installed at IPM's Alberton plant in Gauteng. MD, Betsie Meyer explains, "These machines will deliver unrivalled precision and repeatability. Not only will IPM now be self sufficient when it comes to the cutting of plate materials, but the company will also be in a position to provide all our customers with the best quality products in the shortest time, at the most economical price".

The 6 000m² plant is well equipped with two 3 ton overhead cranes, as well as a 5 ton overhead crane. Other equipment includes a 250kvA generator, two swaged machines, drilling machines, band saws and profile cutters.

IPM's premises also house two workshops, each covering 3 000m². With the new machinery installed, IPM can now manufacture any plate materials required by a customer, such as base plates, flanges, gusset plates and cover plates, without having to resort to outsourcing. The CNC press brake will allow the company to bend all jackets for mid-hinge masts. IPM will also be able to provide customers with alternative options of round, tubular or octagonal masts. The options go further to include octagonal masts up to 30m, in addition to the round tubular masts which reach a height of 25m.

"In a nutshell, the CNC machines will enhance IPM's independence in the market place and it will above all create more job opportunities in the very near future", concludes Betsie Meyer.

Industrial Poles and Masts has been a Black Economic Empowered company since 2004. They are certified as a Level 2 Company with 25% black ownership. Industrial Poles and Masts is also an ISO 9001:2008 certified company, at the forefront of design and quality standards. Through their employment equity program, skills transfer and development, corporate social investment and by forming dynamic business relationships, Industrial Poles and Masts endeavours to share its wealth of knowledge, skills and opportunities with its staff, business partners and the community in which they operate.

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IPM INDUSTRIAL POLES & MASTS

General galvanizing – how does SA compare globally? PART 1 – THE MARKET?

When I was asked to write this article, I really did wonder the best way to balance what is good about the local industry versus how it compares with that overseas and what improvements or lessons can be learnt. After thought, two major areas are worthy of discussion, namely the market (its structure and how it is served) and technology (the drivers and the implications for the industry).

This article, as Part 1 will focus upon the market-place in South Africa.

Firstly, it needs to be appreciated that the local industry is quite large in terms of galvanized production (against installed capacity) in absolute terms. When compared to key countries such as Australia (the usual sports rival), the South African general galvanizing market is slightly larger in size but, and more interestingly, the local market is similar in size to that of the UK (maybe slightly smaller depending upon how the figures are interpreted). This would make it around half that of Italy and one third the size of Germany. Looking further afield, the general galvanizing market in 2011 was equivalent to the whole of Latin America combined and over double that of Brazil! So the market penetration in South Africa looks good on first inspection of the figures *(figure 1)*. I have deliberately omitted the sub-continental numbers – North America and China as we are not comparing apples with apples. For those interested in numbers and why my travels have focused upon China for the past decade and beyond, the general galvanizing production in China is estimated at around 13 million tonnes per year (2012) with perpetual double digit growth rates!

One interesting aspect of the galvanizing industry is the fact that South Africans believe that challenges exist only at home. Australia has experienced a challenging market as it has suffered from an over-valued currency which has resulted in massive importation of fabrications (estimated as greater than the total local fabrication production, galvanized and not!) and a decline in local manufacturing (note the closure of the GM operation in the country and announcements of reductions in investment of Ford, Toyota, Shell and Alcoa). Of course, this offers little succour to local players who have seen a massive decline in mining activity and some importation of galvanized fabrications (but not on the scale experienced in Australia – yet!). However, the market has been more buoyant than expected due to South Africa becoming one of the world's most attractive investment markets in renewable energy. The 2012/3 Zinc Market Report indicates that up to 15% of all the general galvanized steel consumption in South Africa is consumed by the solar market in some form. Currently South Africa rates as number 12 in the world as an FDI destination for renewable energy projects. For those with short memories (or the younger generation), during the 1970s and 1980s the investment in electricity transmission and distribution reached over 50% of the general galvanized steel market in the country! So, whilst mining has been the backbone of the industry over the past 20 years, things change. What has not changed, and it an important lesson to be learnt, is that whilst marketing can influence market share, total market size is limited by a few key drivers.

The market for general galvanizing, like that of steel consumption, is largely con-

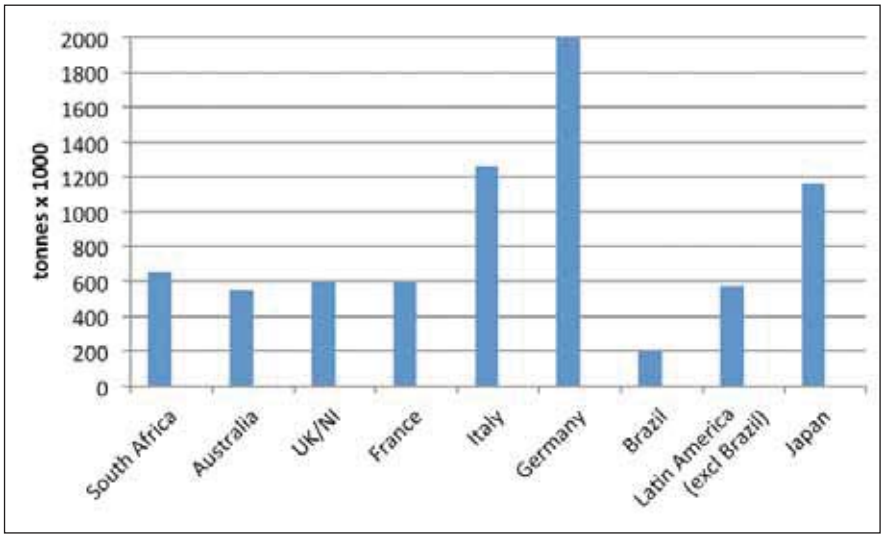

Figure 1. General galvanizing steel tonnes for various countries.

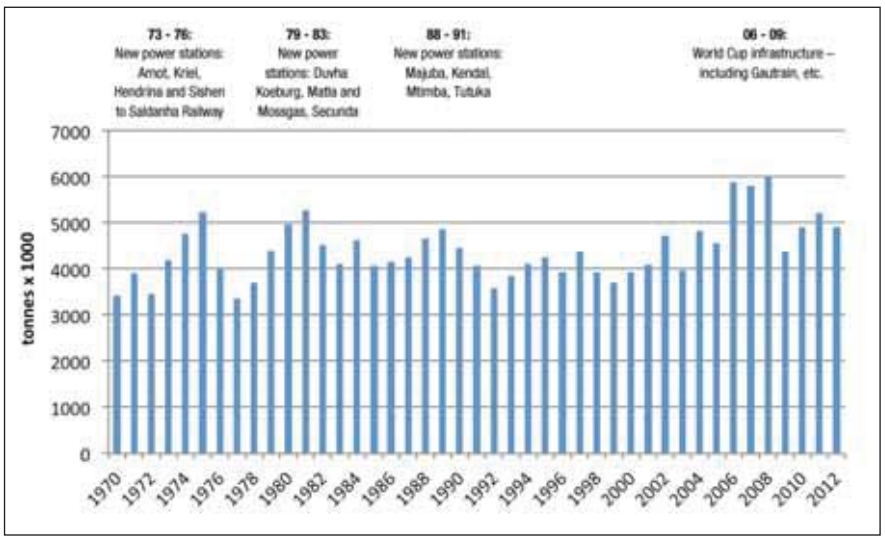

Figure 2. Apparent domestic demand of steel in South Africa since 1975.

trolled by factors beyond the industry's control, namely Industrial Production (IP) and Gross Capital Formation (GCP) previously known as Gross Domestic Fixed Investment (GDFI). Over the years IP and GCF growth rates have been low for extended periods. Flurries have resulted in kicks in steel sales but most increases of activity can be attributed to project activity within the country as clearly shown in *figure 2.*

I shall not cover the reasons behind the current economic growth situation as these are detailed in the Market Report and many are well known and beyond the scope of this article. It is important to look at the structural changes that are occurring today. *Figure 3* shows the breakdown in steel sales per sector since 2003. The pain being felt by the local mining industry is clear with the sales registered to the mining sector falling significantly below the 15% of sales trend line.

The zinc market breakdown since 1995 is shown in *figure 4.* This shows that the percentage of the zinc market allocated to galvanizing overall has increased whilst that allocated to other value adding activities has declined. The zinc market has grown but much of this is as a result of increase in continuous galvanizing capacity. The decline in other value adding activities is the direct result of a decline in local metal value adding and has resulted in, as far as the zinc market is concerned, the move to a South African market-place more akin to that of a developing country than a developed country as before.

Market sector analysis on a global scale is difficult to makes sense of due to little coherence in terms and sector definitions. *Figure 5* is a compilation of recent data gathered from various sources.

Whilst a clear trend is difficult to ascertain from simple analysis, certain characteristics are clear. As would be expected construction in its various forms dominates the market for general galvanizing. Both public infrastructure (ranging from electricity generation, transmission and distribution to water treatment and reticulation to highways) and private construction (residential to mining) require either the establishment of national specifications or at the very least in-house specifications. For instance, the incorporation of general galvanizing

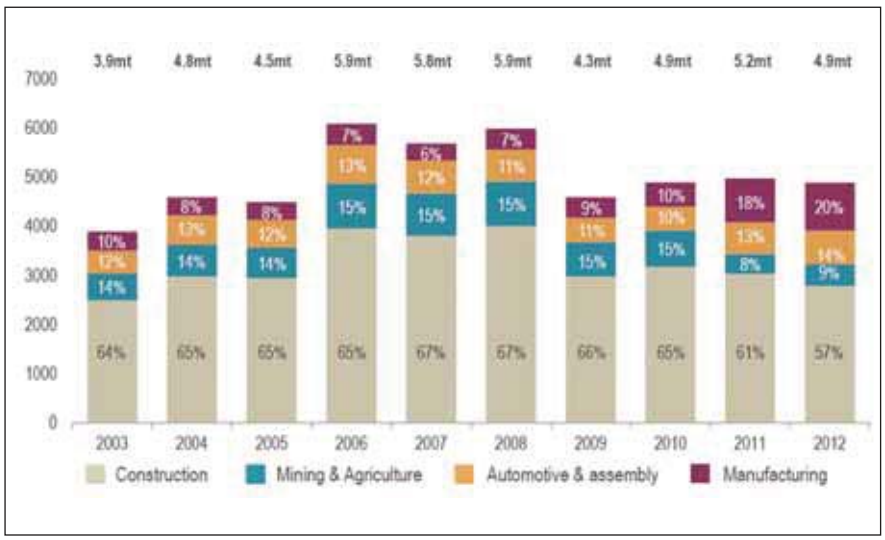

Figure 3. Domestic steel sales into market sectors since 2003, South Africa.

into solar power generation has become an international norm (it represents 6% of the total general galvanizing market in the USA and 15% currently of the South African market as previously mentioned). The need for global communications arising from this type of standardisation is clear. The use of general galvanizing in street furniture is a norm in Europe and is in fact mandatory in China! Implications for the local market are to press hard for international norms to be accepted locally. The Association has been successful in this regard but some street furniture applications remain painted.

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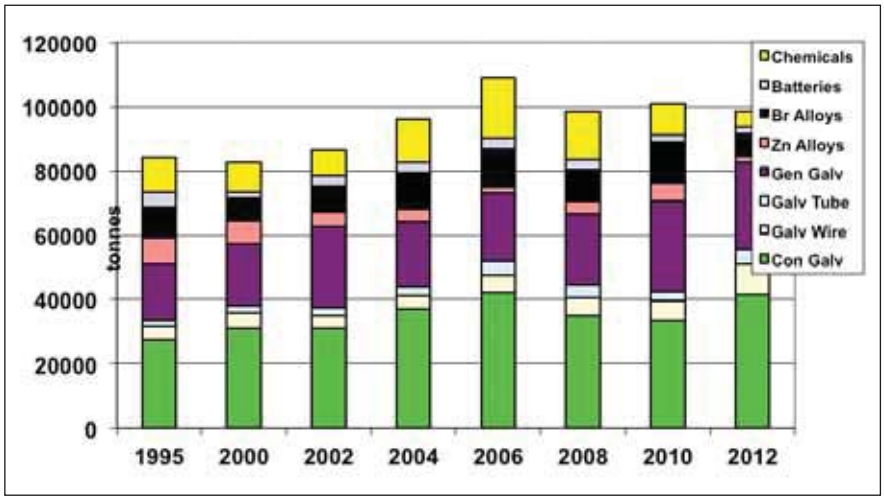


Figure 4. Estimated final market demand percentages since 1995 for South Africa.

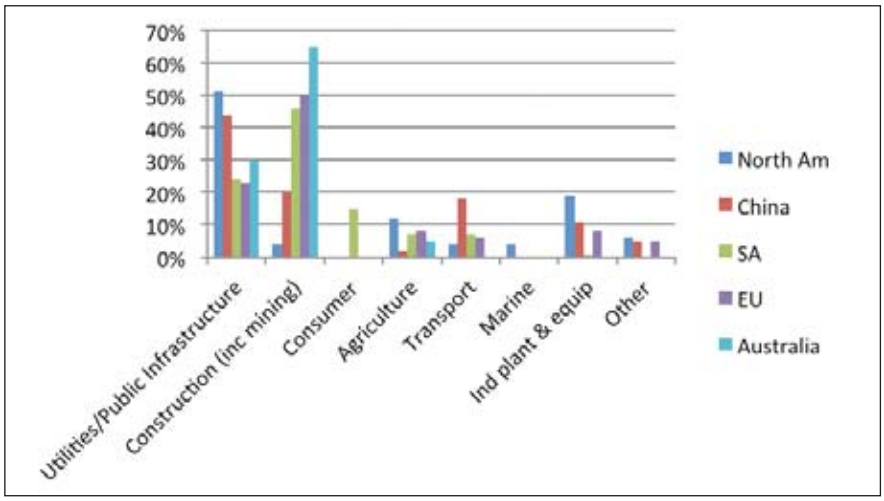


Figure 5. Attempted market-breakdown per sector for selected regions.

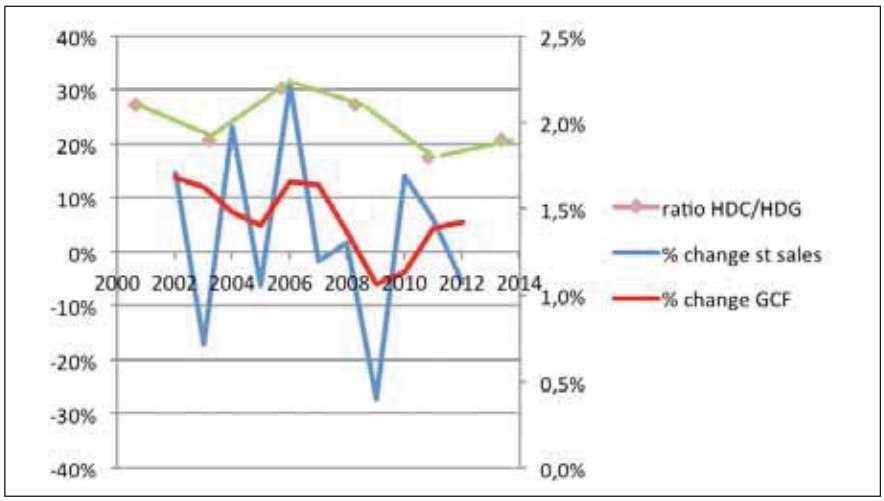


Figure 6. HDG vs HDC vs changes in GCF.

The agricultural industry is a small percentage of the overall market for galvanizing but, it is a commonly used sector description making it possible for international communication to see where applications in one regional area could be used in another. Similarly in the transport sector all new catenary systems and trackside equipment is galvanized globally. This has proved to be a significant market in China for instance where the whole High Speed Train (HST) system uses galvanized products. Much of the system employs a viaduct base. Should South Africa move towards HSTs the opportunity for the industry would be immense provided that communication is made at the specification stage. Further analysis can easily indicate where market structures are different in South Africa and those where the local industry should investigate further.

The galvanizing industry often asks about how it is doing against alternative forms of protection (mainly organic coatings). Whilst the figures are available, it is the interpretation that defines the answer. *Figure 6* shows that there has been a slight increase in the use of general galvanizing versus the use of heavy duty coatings during the past 10 years. Notwithstanding this, it is clear that, in good times (higher rates of economic growth) the heavy duty coatings industry appears to be better positioned than the general galvanizing industry to take advantage of the potential market growth.

One reason behind this poor response to rapid changes in economic conditions may be explained through the structure of the industry. The general galvanizing industry follows a well-worn path which I have described before so I shall omit what would become a large treatise. Enough is said through a simple schematic of galvanizing industry development *(figure 7).* It is clear that there is a tendency for galvanizing plants to group together. This allows for pooling of resources (such as technical and marketing) and generally provides a geographic spread. This results in flexibility, provides for well-known competitive advantages and has been stated as a key reason for industry development globally in established markets. Australia has 32 plants controlled by 16 groups, in the UK there are 67 plants with 22 controlled by just two groups. Wedge has 14 plants strategically positioned (their wording and clearly important) throughout the UK and controls plants in Europe, the USA and Italy. The larger groups have impressive figures. The Kopf Group employs over 2 000 people, has 36 plants in 9 countries in three continents. The US market is dominated by two groups – AZZ and Valmont with 35 and 18 plants respectively. The comment that this has just been corporate growth is not borne out as the Wedge Group is still largely family owned. There is a real question to be asked in terms of South Africa as to why this development has not happened. This is especially pertinent given the market size stated earlier. There are small organic coatings companies but the industry (and the galvanizers' competition!) globally is dominated by large groups.

If the market in South Africa offers little respite, is it worth looking further north? The SADC region does offer immediate opportunities for export but, once transport is taken into account does South Africa really have an advantage over other exporting countries? The example of what has happened in Australia recently indicates not. It is unlikely that the present export opportunities will remain in place. Discussions with local galvanizers have shown a reluctance to look further north in terms of investment in plant either alone or through JV partners. There is little doubt that regions to the north are growing rapidly and whilst investing outside of ones' home area can be difficult the returns are attractive if done correctly. IZASA has spent some time investigating opportunities to the north (outside of the SADC region) and they certainly exist.

Current estimates are that there is some $223 billion (or R2.25 trillion!) worth of projects underway in Africa (36% in energy – 97 projects, 25% transport – 82 projects). Project values are estimated as East Africa $67.7 billion (93 projects, 29% of total), West Africa $49.8 billion (21% of total), Southern Africa Development Community (SADC) region $83.1 billion, with Central Africa still lagging due to political instability. Based on the IMF's latest forecasts, six of the ten fastest growing economies in the next five years will be in Sub-Saharan Africa. These include Ghana, Ethiopia and Tanzania.

Outside of South Africa, most of the FDI in Africa is driven by four activities:

1. The development of mining and minerals
2. The development of energy reserves
3. The use of energy reserves and natural resources for population upliftment (electrification and water provision)
4. Transportation and telecoms development.

These key markets will result in double digit growth rates in the use of galvanizeable steel for the foreseeable future. Whether South Africa or other countries will make the most of this market activity remains to be seen but the market is being eyed by most Asian countries (not just China).

IZASA in partnership with Vedanta will be hosting an Industry Meeting mid-year. This will provide an opportunity for questions and will be taken as the opportunity to further detail the information provided above.

For further information or to order the 2012/3 Market Study on the South and Sub-Saharan Africa Zinc Market please view www.izasa.org

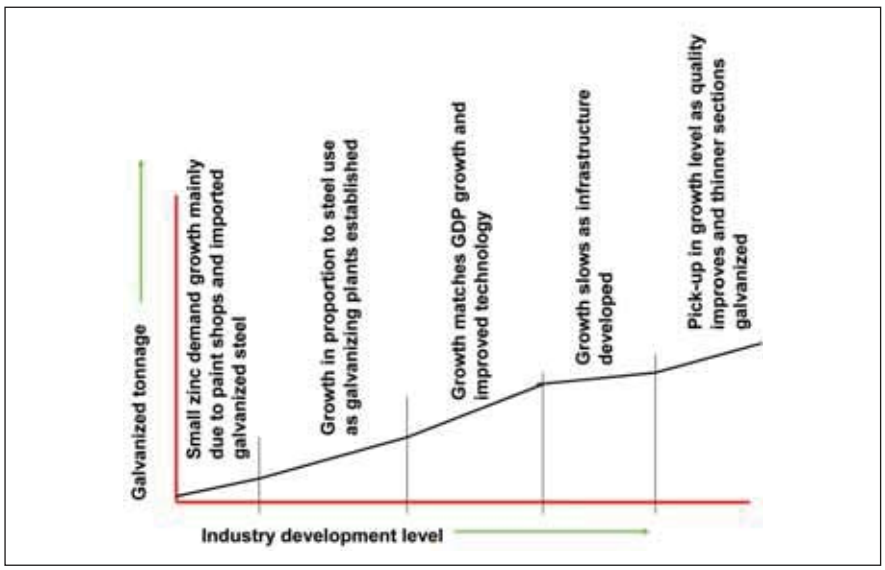


Figure 7. Changes in industry structure during market development.

Part two of this article will discuss the technical progress of the industry from bath size growth and capacity parameters to new technologies per process area and how regulatory frameworks are influencing the industry.

The Association wishes to thank Rob White of IZASA for this article.

Effectively avoiding weld spatter dramatically increases the quality of the hot dip galvanized coating

A largely unavoidable consequence of the arc welding process is the generation of weld spatter. Weld spatter is seen as sparks of molten spheroidal metal particles emanating from welding arc. These small particles of molten metal that fly off the end of a consumable electrode and land on the metal surface being welded often time fusing with the relatively cooler metal surface.

The amount of weld spatter generated is influenced by the welding process being employed, the metal surface cleanliness, the type of consumable electrode, the shielding gas, optimal machine setup, the welder's skill and whether the process is automated to some degree or other.

In *photo 1* the machine has been optimally set and the welder is skilled and experienced, however weld spatter has still been generated and has fused with the metal surface. This spatter must be removed before paintingand is desirable depending on the end use before hot dip galvanizing.

Much research has been done on the equipment and consumables to improve arc characteristics and it is only in automated or robotic application where very tight control over all the parameters results in a virtually spatter free surface adjacent to the weld.

This weld spatter as shown is *photo 1* is problematic for a number of reasons:

- It acts a crack initiation point as it is a high stress area
- It can lead to the early onset of corrosion through a number of different mechanisms. Not applicable to hot dip galvanizing *(Editor)*
- It is aesthetically displeasing once the metal surface has been painted or hot dip galvanized
- It can trap moisture which creates hazards when galvanizing as it could lead to the zinc exploding as the moisture instantly vaporises in the molten metal bath
- It is a costly removal process

Removal

Weld spatter is usually removed through one of three methods

- Manual chipping or scraping
- Grinding (electrical or compressed air)
- Needle descaling

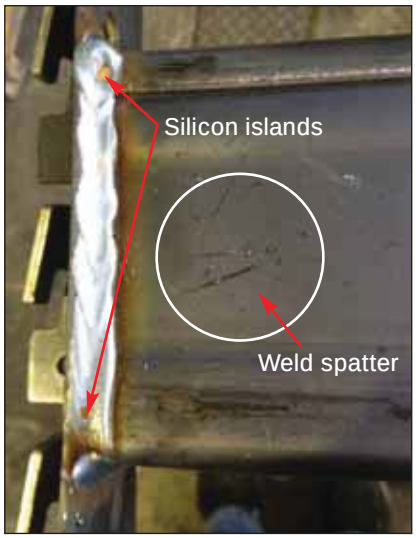


Photo 1: A quality weld with unavoidable weld spatter.

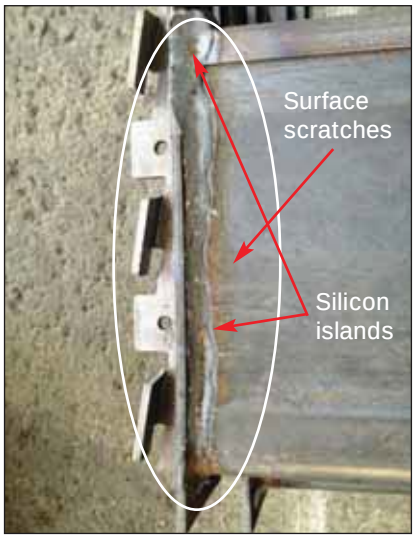


Photo 2: Showing scratched metal surface after fettling.

Photo 3: After Spatter Guard has been applied. No spatter, silicon islands or scratches.

All these processes involve labour overheads and two require the need for electrical energy to power the tooling. Direct electrical energy is used for grinding whilst compressed air can be used for both needle descaling as well as grinding. A common unintended consequence is the scratching or damaging of the metal surface *(see photo 2)*.

Compressed air is a very common energy source since the tooling is very robust. However compressed air is also a notoriously inefficient form of energy use and to add to this many leaks within the system usually exist.

Spatter Guard HT Plus

Spatter Guard is a proven product currently in use all around South Africa in many industries including structural steel, pressure vessel, cellular phone masts, trailers, transformers, fans, plasma cutting equipment and has even been used on grating that had to be galvanised and then sent to Marion Island for use as walkways over the marshy ground.

Spatter Guard HT Plus was the recent ***2013 ESKOM ETA Award winner in the Industrial Innovation*** category due to its performance and resulting contribution to reduced energy usage.

The patented product is a blend of a water soluble polymers, corrosion inhibitors and surfactants. It is simply sprayed onto the metal surface prior to welding and then can welded over while still wet or when dry some time later. In instances where there are very high temperatures such as the welding of corners then the spatter may still stick but becomes much easier to remove than without using Spatter Guard HT Plus.

The product has a double action – fast cooling of the spatter particle as it makes contact with the thin film on the metal surface and as a physical barrier preventing fusing with the metal surface.

Due to the fact that Spatter Guard comes in liquid form it is more environmentally friendly, when compared to industry standard aerosol products. The disposal of aerosols is a major environmental issue that is also expensive to enforce. Another advantage of a liquid product is that it works out to be more cost effective per litre. This is due to the fact that aerosols are typically comprised of around 25 per cent gaseous propellants, such as propane, which is discharged into the atmosphere when utilised.

Spatter Guard HT Plus has been formulated for use in high temperature applications such as weld corners or preheated metals. Additionally it contains deoxidants which assist in removing the dissolved gases from the weld pool ensuring a cleaner weld bead.

A further benefit is that the product is safer since most other products are aerosol based containing dichloromethane as a solvent and which is a known carcinogen. Aerosol cans contain propane as a propellant which is flammable and require special disposal procedures.

The major innovation is that the product substantially reduces the need for spatter removal through manual chipping electrical or grinding and needle descaling. This benefit results in substantial energy, consumable and man hour savings.

The payback is immediate in terms of reduced compressed air consumption, man hour costs and grinding consumables. Additionally tooling life is extended.

The major advantage is that the job can be completed quicker allowing for faster invoicing and delivery thus improving the businesses cash flow position.

References

Vital Angus Macleod – Derek Brown
011 898 8500

M&P Bodies – Paul Louw
0834593007

Industrial Poles and Masts – Jaco Meyer
011 864 7665

Genrec – Renier
011 876 2300

Mast Projects – Jaques Fagan
011 306 7000

Cochrane Steel – Karl Hinteregger
0721258090

The difference between Hydrogen and Strain Age Embrittlement

Although it happens infrequently, embrittlement of steel during the hot dip galvanizing process is possible. The most known type of embrittlement is hydrogen embrittlement, but this type of embrittlement is very rare during the galvanizing process. If a steel member becomes embrittled during galvanizing, odds are it is due to strainage embrittlement, not hydrogen embrittlement. To differentiate hydrogen embrittlement from strain-age embrittlement, it is best to start at the definition of the word embrittlement.

The definition as the term is defined in *ASTM A143/A143M Standard Practice for Safeguarding against Embrittlement of Hot Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement*; embrittlement is the loss or partial loss of ductility in steel that fails by fracture without appreciable deformation. Another way to think about embrittlement is steel cracking without any bending or flexing to indicate the steel is yielding.

Strain-age embrittlement

The most common type of embrittlement encountered in the hot dip galvanizing process is strain-age embrittlement. Strain-ageing is a process where steel becomes very brittle in areas of high stress when exposed to elevated temperatures. At room temperature, strain-ageing happens very slowly, but at elevated temperatures, like those used in the galvanizing process, strain-ageing can happen very quickly. When the steel has incurred enough stress due to strain-ageing, it can become embrittled. For strain-ageing to occur, two components are necessary.

The first component is stresses must be induced into the steel prior to the galvanizing process. This normally occurs through cold working the steel. Cold working can include bending, punching, or shearing the steel. If the stresses from these cold working practices are not relieved prior to galvanizing, they become points of high residual stress during the galvanizing process and can lead to strain-age embrittlement. Strain-ageing can also be caused by impurities in the steel, such as those found in lower quality steels used for reinforcing bar. If a part cracks due to strain-age embrittlement, the cracking occurs immediately after galvanizing, but is also often seen at the job site, as in the case of reinforcing bar. Often times simple handling is enough stress to cause a strain-age embrittled member to crack.

Cracking of the steel shortly after galvanizing is a critical distinction between strain-age embrittlement and hydrogen embrittlement. There are several ways to reduce the occurrence of strain-age embrittlement, but all methods focus on one aspect – reducing the stresses induced into the steel prior to galvanizing. Instead of cold working, which induces stresses into steel, the steel can be hot worked at temperatures between 590°C and 700°C. After cold work the steel, relieving the stresses induced from cold working can be accomplished by heating the steel to 650°C to 700°C for heavy cold working and up to no more than 650°C for less severe cold working. When bending steel, it is best to allow for a bend diameter at least three times the section thickness. When punching is necessary on thicker steels (19mm or greater in thickness), the holes should be reamed at least 1.5mm around the edge of the hole. When flame cutting, such as on structural beams, the minimum radius of the copes or snipes should be 25mm or greater. Grinding the areas around the cope is recommended to remove small micro-cracks in the steel from the flame cutting process.

What is a cope?

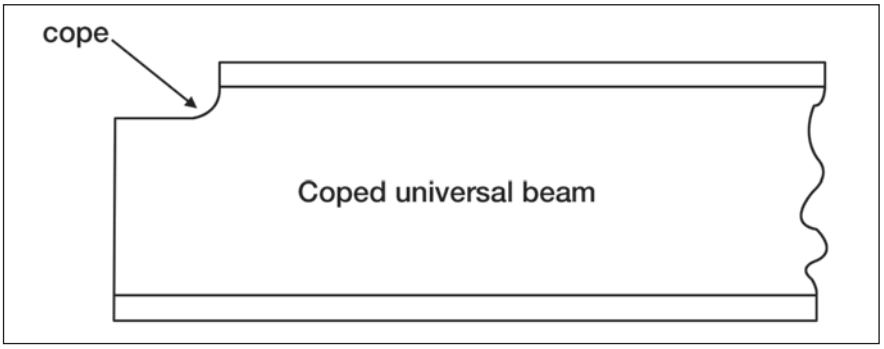
Diagram 1 shows a cope detail on a universal beam. Copes are oxy cut, usually in two operations. The first cut removed the top flange and a section of the web. The second operation cuts the cope radius and removes the remaining section of the web.

Hydrogen embrittlement

Hydrogen embrittlement occurs when steel cracks due to hydrogen trapped between the grains of the steel. Although steel commonly absorbs hydrogen during the hot dip galvanizing process, it is usually expelled due to the temperature of the zinc in the galvanizing kettle. In some cases, however, the grain size of the steel is too small to allow release of atomic hydrogen. This can later cause cracking due to increased stress at the location of the hydrogen between the grains. Grains of steels with a tensile strength below 1 000MPa (150 000 psi) are usually big enough to allow escape of hydrogen, but for steels having a tensile strength greater than 1 000MPa, there is a potential for hydrogen to remain trapped between grains leading to hydrogen embrittlement. Hydrogen embrittlement is not observed until the part is under load, unlike strain-age embrittlement which is observed shortly after galvanizing. In other words, whereas strain-age embrittlement can be observed shortly after galvanizing, hydrogen embrittlement is not seen until the steel has been under load for some extended period of time. Hydrogen embrittlement can be avoided in several ways.

The most obvious way is to ensure the designer has chosen steel with a tensile strength less than 1 000MPa. As stated earlier, these types of steels have grains large enough to allow escape of any trapped hydrogen. When it is necessary to galvanize high strength steel, a modified galvanizing process can be used to minimize the chances of hydrogen embrittlement. Rather than pickling the steel for the normal length of time, this modified process includes mechanically clean-

continued on page 32...



A cope detail on a universal beam.

Cape Galvanising Consolidated was established in 1968 and has been involved in every major project involving galvanising for 45 years. It also has the largest zinc kettle in the Western Cape measuring 14 x 1.5 x 2.6.

Our most recent project is a joint venture with Spanish company Solar Technology Systems who have secured a long term solar manufacturing contract as part of the Eskom renewable energy program.

Other projects that we have been a large part of in past years include major infrastructure projects for Koeberg Nuclear Power Station and transmission lines to the grid all carrying the SABS mark. Other more recent projects are the Cape Town Docks Refrigeration Container Terminal and the City of Cape Town BRT bus program and stadiums.

CGC also has an extensive transport fleet ready to service its customers' requirements from near and far and is currently expanding its operations.

Our team of experienced professionals is looking forward to South Africa's new challenges.

CGC
Cape Galvanising Consolidated (Pty) Ltd.

www.hotdip.co.za Tel: +27 (21) 931-7224 Fax: +27 (21) 931-9490 info@capegalvanising.co.za




ing the steel, such as by blast cleaning, and then flash pickling for less than 30 seconds. Flash pickling is necessary to remove any residues from the blasting operation. This reduces the amount of hydrogen the steel is exposed to and thus reduces the chances of hydrogen becoming trapped in the small grains of high strength steel.

Responsibility for avoiding embrittlement

ASTM A143/A143M spells out who is responsible for avoiding embrittlement. The responsibility lies on the designer, fabricator, and the galvanizer, but each party has different responsibilities. Choosing steel appropriate for the practices normally encountered in the galvanizing process and designing the product to avoid embrittlement are the responsibilities of the designer. The fabricator is responsible for using suitable fabrication procedures to avoid embrittlement, such as following minimum bend recommendations and reaming holes on thicker steel (as discussed above). And finally, the galvanizer is responsible for employing proper pickling and galvanizing procedures during the galvanizing operation. Communication between the designer, fabricator, and galvanizer is the key.

Communication throughout the design, fabrication, and galvanizing processes ensures best practices are used throughout and thus minimizes the possibility of strain-age or hydrogen embrittlement.

Acknowledgement

American Galvanizers Association, Technical department. Authored by Bernardo A. Duran III.

Galvpatch successfully exposed to fridge conditions at minus 25°C for 8 months

Some time ago I was asked whether Galvpatch could be exposed to sub-zero temperatures without any detrimental effects?

I prepared a hot dip galvanized sample and through the centre removed to galvanizing by grinding away the coating *(photos 1 and 2)*.

The area was then treated with Galvpatch using the spatula which is included in the package. Coating DFT was well in excess of the SANS 121 coating thickness requirements of 100um *(photos 3 - 5)*.

Galvpatch has been made purposefully to resemble the zinc carbonate patina, presented by a hot dip galvanized coating after months of weathering.

For immediate aesthetical appearance one half of the repair was LIGHTLY mist coated using a zinc rich spray paint *(photos 6 and 7)*.

There were no detrimental effects to the coating after 8 months of exposure in a fridge maintained at minus 25°C. *See photo 8* after 8 months.

Photo 1.

Photo 2.

Photo 3.

Photo 4.

Photo 5.

Photo 6.

Photo 7.

Photo 8: After exposure there was no physical deterioration of the Galvpatch repair material.

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TEL: 011 420 0912/14

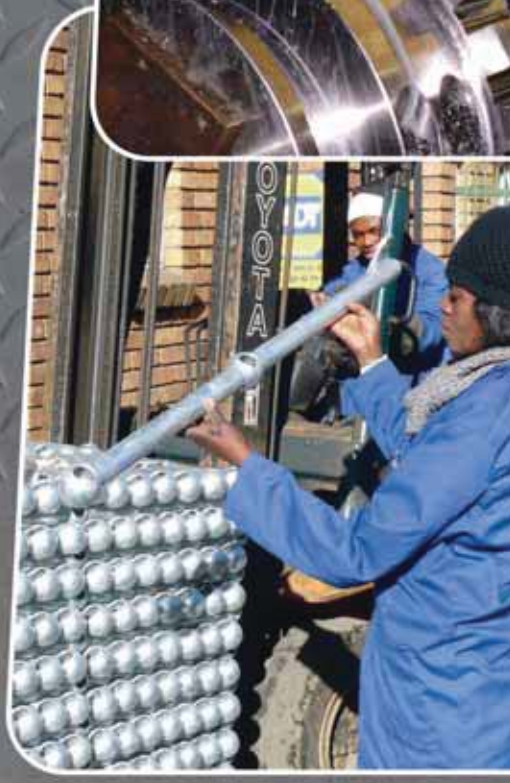
SMT GALVANIZERS

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;
- **Supply** of electrical spares at the best prices.



SABS ISO 1461 SANS 121 | SATAS | SEESA BEE COMPLIANT

SMT GALVANIZERS
SPINNING & DIPPING

SMT Galvanizers (Spinning & Dipping) | **jan@smtgroup.co.za**
SMT Electroplaters | **kevin@smtgroup.co.za**
SMT Steel (Engineering) | **bernadette@smtgroup.co.za**

3 CPD POINTS

3-day Galvanizers Inspectors Course

Hot dip galvanizing is one of the most widely used methods of protecting steel from corrosion. During and after fabrication and after hot dip galvanizing the coating is inspected for compliance with the relevant specifications.

The course commences at a selected venue where course material is presented and reviewed, the lecturer encourages discussions between delegates and himself. Each lecture is preceded by a number of pertinent questions on the previous lecture.

Once the delegates have a reasonable knowledge of the coating, including its inspection criteria, the venue moves to a selected galvanizer where a batch of incoming components are discussed en-group and then in teams, preselected hot dip galvanized components are inspected and reports are required to be completed.

If available at the galvanizer or other venue, preparation by sweep blasting and/or chemical treatment is demonstrated and duplex coatings are discussed.

The course will provide delegates with sufficient knowledge to advise on fabrication for successful hot dip galvanizing and also test, inspect and interpret test results after hot dip galvanizing.

COURSE DURATION AND CONTENTS

Day 1	(08h00 to 16h00)
Lecture 1	Introduction to the Environment, Steel & Corrosion
Lecture 2	Understanding Zinc Coatings (How does Zn protect) ISO 9223 & 12944
Lecture 3	Designs, Fabrication and Inspection before hot dip galvanizing SANS (ISO) 14713:1999
Lecture 4	General Hot Dip Galvanizing Processes SANS 121 (ISO 1461:2009) Batch type galvanizing SANS 32 (EN 10240: 1997) Automatic T & P SANS 10094:2007 HDG of Friction Grip Fasteners
Day 2	(07h00 to 16h00) Hot Dip Galvanizing Plant Visit and Inspection
Lecture 5	Duplex Coatings and HDG Reinforcement in Concrete
Day 3	(08h00 to Completion of Exam)
Lecture 6	Inspections after Hot Dip Galvanizing
Lecture 7	Quality Assurances in Coating Applications Application of specifications Control documentation for a QA System Examination on Course Effectiveness

Course schedule may be altered and interesting activities added for the benefit of delegates.

Following the course and successful result in a three part exam, the delegate will be issued with a certificate and if required, registered as an approved HDGSA Galvanizing Inspector. Registration will be confirmed on an annual basis. Successful galvanizing inspectors will become Affiliate Galvanizing Inspector Members of the HDGASA for the year.

VENUE AND NUMBER OF DELEGATES

The courses are usually run in Johannesburg from the Hot Dip Galvanizers Association in St Andrews, Bedfordview and also from a suitable venue in Cape Town. Bookings are limited to 10 people per course on a first come first serve basis. Courses in other areas are possible, contact HDGASA.

DATE AND TIME

Courses commence at 08h00 sharp and end at 16h30 (or as otherwise instructed). Lunch and refreshments will be provided. Comprehensive course notes can be collected from our offices two weeks before the course (this is highly recommended).

Johannesburg:
25 to 27 February; 18 to 20 March; 13 to 15 May; 24 to 26 June; 12 to 14 August; 7 to 9 October; 25 to 27 November.

Cape Town:
4 to 6 March; 3 to 5 June; 16 to 18 September.

Special courses can be arranged for a minimum of 6 delegates at appropriate venues in South Africa.

COURSE COST AND PAYMENT TERMS

R4 200.00 per person exclusive of VAT. Should you have two or more delegates from the same company, course costs will be R4 000.00 per person exclusive of VAT. Please note that payment is due on the first day of training. Cheques are to be made out to "Hot Dip Galvanizers Association SA". Members qualify for a discount.

CONTINUOUS PROFESSIONAL DEVELOPMENT (CPD)

By attending the Association's 3 day course Galvanizing Inspectors Course, you will obtain 3 points (accredited by ECSA).

SHOULD YOU BE INTERESTED, KINDLY CONTACT SASKIA SALVATORI AT THE ASSOCIATION

Make a lasting investment – HOT DIP Galvanize it!

Specify hot dip galvanizing and get at least 30 years of maintenance free protection

In the vast majority of applications the corrosion rate of a hot dip galvanized coating is less than 2µm per year. Coating thickness achieved on structural steel averages about 100µm.

In some aggressive marine and polluted industrial applications, the additional barrier protection provided by a duplex coating (hot dip galvanized plus paint), together with the sustained sacrificial protection performance provided by the hot dip galvanized coating will invariably solve most steel protection problems.

For further information on our members and general corrosion advice, contact:

Quality House, Unit U4, St. Christopher Road, St. Andrews, Bedfordview
P.O. Box 2212 Edenvale 1610 Tel: (011) 456-7960 Fax: (011) 454-6304
hdgasa@icon.co.za Website: www.hdgasa.org.za

Cape Town: Tel: (021) 797-4735 Fax: 086 612 7284 terry@hdgasa.org.za

HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA

CBT (011) 868-3408 HDGASA 1443/08/11

Positive deviance

Positive Deviance is a social behavioural phenomenon, where certain members of a community (the so-called 'positive deviants') are able to solve problems that other members of the community cannot. They do this on their own and without special resources or knowledge, and without the burden of authority, although they face the same challenges and obstacles as their peers.

First used to reduce malnutrition in Vietnam in the 1990s, the application of positive deviance to bring about social change, relies on the knowledge and wisdom of so-called 'outliers' in the community who are managing to do better than the rest of the community. Instead of imposing solutions from without, social workers, who recognise the importance of positive deviance, facilitate the acceptance by the whole community of the behaviours and strategies of the positive deviants. Instead of throwing money at a community problem or devising grand solutions, positive deviance urges the whole community to look more closely at what some of their members are already doing and to encourage them to accept the practices of the deviants. In this way, the social workers acknowledge that the communities already have the knowledge and all they need to do is to transform the positive deviants' knowledge into collective knowledge.

In their pioneering book on positive deviance (The Power of Positive Deviance: How Unlikely Innovators Solve the World's Toughest Problems), authors Richard Pascal and Jerry and Monique Sternin demonstrate that positive deviance requires the letting-go of traditional ideas about authority, power and people management, instead, allowing people to discover answers for themselves through their actions. It also needs a viewpoint that everyone in a community has something to offer; not just those who happen to be rich, educated, powerful, entitled or just talk the most. A serious obstacle of achievement by positive deviance is the 'not invented here' syndrome.

The concept of positive deviance in managing change can be extremely valuable in project management. Project leadership will be encouraged to be inquiry-based, problem solving will flow from solution identification, successful processes and procedures will be open to self-replication and the project management team will be knowledge asset-based and learning driven. Rather than starting with prescribed definitions and practices, attention can shift to fertile new grounds and minds that are opened to reveal new possibilities. The old adage 'seeing is believing' has special potency and examples of solutions that have worked in similar circumstances must be discovered and communicated.

Positive deviance will work best for projects where there are no off-the-shelf solutions, with isolated and concealed strategies having to be discovered. Positive exceptions to the rules, being practiced by a few isolated and unrecognised groups operating with the same constraints and resources as everybody else, need to be acknowledged. The people affected need to identify the problem as well as the benefits they will gain if they solve the problem. These people need to be allowed to develop and use their own data to make the problem concrete and quantify solutions. In this way, successful solutions are spread from the inside outwards through finding and amplifying existing solutions. Positive deviants thrive on 'organically' derived community solutions rather than on imposed solutions by higher authorities or experts.

The Association wishes to thank Bob Andrew who is a consulting value engineer and honourary member of the Association for his article. He can be contacted on anneve@iafrica.com or boband@mweb.co.za.

HOT DIP GALVANIZING MEMBERS

GALVANIZER	LOCATION	TEL. NO	SPIN	NO. OF LINES	BATH SIZES (L x W x D) (m)
GAUTENG					
ArcelorMittal South Africa	Vanderbijlpark	016 889 9111		3	Sheet galvanizer
Armco Galvanizers	Isando	011 974 8511		1	13.2 x 1.5 x 2.2
Armco Galvanizers - Dunswart	Dunswart	011 914 3512		3	5.2 x 1.20 x 2.0
					3.0 x 1.0 x 1.5
					2.0 x 1.0 x 1.5
Armco Galvanizers - Randfontein	Randfontein	011 693 5825		1	6.5 x 1.3 x 2.0
Babcock Ntuthuko Powerlines (Pty) Ltd	Nigel	011 739 8200		1	12.0 x 1.4 x 1.8
Galferro Galvanisers	Springs	011 817 3667		4	13.5 x 1.65 x 2.5
					6.8 x 0.9 x 1.4
					6.5 x 0.9 x 1.5
					6.45 x 0.755 x 0.9
Galvadip (Pty) Ltd	Silverton	012 843 8000		1	7.0 x 1.7 x 2.0
Galvaglow	Factoria	011 955 5200		1	4.0 x 1.5 x 2.5
Galvspin Galvanizers cc	Boksburg North	011 918 6177	• robotic	1	3.0 x 0.9 x 1.5
GEA Air Cooled Systems	Germiston	011 861 1571		In-Line	11.5 x 1.0 x 1.0
Lianru Galvanisers cc	Nigel	011 814 8658		2	7.2 x 1.3 x 1.6
					4.5 x 1.3 x 1.6
Macsteel Tube and Pipe	Boksburg	011 897 2194		In-Line	13.5 x 1.6 x 2.4
Pro-Tech Galvanizers (Pty) Ltd	Nigel	011 814 4292	•	2	3.2 x 1.1 x 1.5
					3.0 x 1.1 x 1.2
Robor Galvanizers (Pty) Ltd	Germiston	011 876 2900		3	14.0 x 1.35 x 2.5
					10.0 x 2.0 x 4.0
			Tube		Dia 42mm to 114mm max tube length 6.7m
Robor Tube	Elandsfontein	011 971 1600		1	Tube & Pipe Galvanizer
SMT Galvanizers	Benoni South	011 421 1495	•	2	2.6 x 1.0 x 1.5
					2.0 x 1.0 x 1.5
Supergalv	Alrode	011 908 3411		1	6.0 x 1.2 x 1.8
Transvaal Galvanisers	Nigel	011 814 1113		3	9.0 x 1.0 x 1.0
				In-line &	8.0 x 1.2 x 1.5
				general	6.0 x 1.3 x 1.3
FREE STATE					
Harrismith Galvanizing & Steel Profile	Harrismith	058 623 2765		2	4.5 x 1.3 x 2.5
(NB: big line is not in operation)					(12.0 x 1.2 x 2.5)
NORTH WEST					
Andrag Agrico	Lichtenburg	018 632 7260		#	In-line galvanizer
WESTERN CAPE					
Advanced Galvanising (Pty) Ltd	Bellville	021 951 6242		1	14.0 x 1.4 x 3.0
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
Pro-Galv cc	Stikland	021 945 1803		1	7.2 x 1.3 x 2.6
South Cape Galvanizing (Pty) Ltd	George Industria	044 884 0882		2	3.7 x 0.94 x 2.3
(NB: big line is not in operation)					(5.5 x 1.0 x 2.6)
EASTERN CAPE					
Galvanising Techniques cc	Port Elizabeth	041 486 1432		1	12.0 x 1.3 x 2.3
Galvaspin (Pty) Ltd	Port Elizabeth	041 451 1947	•	1	3.0 x 1.2 x 1.8
Morhot (Pty) Ltd	East London	043 763 1143		1	7.0 x 2.5 x 1.5
KWAZULU/NATAL					
A&A Galvanisers	Pietermaritzburg	033 387 5783	•	1	3.3 x 0.9 x 1.9
Bay Galvanisers	Richards Bay	035 751 1942		1	5.0 x 1.2 x 2.5
Phoenix Galvanizing (Pty) Ltd	Phoenix	031 500 1607	•	2	14.0 x 1.4 x 2.5
					3.0 x 1.2 x 1.2
Pinetown Galvanizing	Pinetown	031 700 5599		1	9.0 x 1.2 x 3.0
Voigt & Willecke (Pty) Ltd	Durban	031 902 2248		1	14.0 x 1.3 x 2.5
MOZAMBIQUE					
F&F Services	Beleuane	+258 823021260		1	4.0 x 0.8 x 1.5
MAURITIUS					
Galvanising Co Ltd	Port Louis	+230 234 5118		1	7.0 x 0.75 x 1.68
ZIMBABWE					
Essar Tubes	Graniteside	+263772833477		1	10.0 x 1.1 x 1.0

 # 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 (e.g. sales or production personnel) and mobile telephone numbers, contact company receptionist.*
- *The bath sizes are inside dimensions and not maximum component size (length, width and depth). Kindly take note of the expansion of the component when dipped into molten zinc, or discuss with relevant galvanizer.*

Consistently delivering superior quality galvanized products to all our customers

Armco Galvanizers Isando has been operating since 1989. Geared up to accommodate heavy structural steel up and till 13m in length. Isando has an average output of plus minus 2000 tons per month. With an improved lay down area and increased loading capacity by addition of a tower crane we strive to give "A" class service to all our customers big or small.

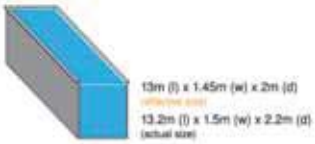
Armco Galvanizers Dunswart is a second facility based in the Boksburg area. Dunswart has an average output of plus minus 900 tons per month. This branch specializes in small structural components and is geared up to accommodate items up and till 5m length.

Armco Galvanizers Randfontein is a third 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 6.2 m in length.

The company has it's own SANS 121 2000 ISO 1461 accredited Hot Dip Galvanizing plants. And is listed under the SABS ISO 9001 scheme.

GALVANIZING BATH SIZE

ISANDO



DUNSWART

RANDFONTEIN

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Randfontein +27 11 693 5825

Web. www.armco.co.za

ARMCO SUPERLITE

OBO Bettermann Group