HOT DIP GALVANIZING TODAY

2006 Volume 3 Issue 1

HOT DIP GALVANIZERS ASSOCIATION Southern Africa

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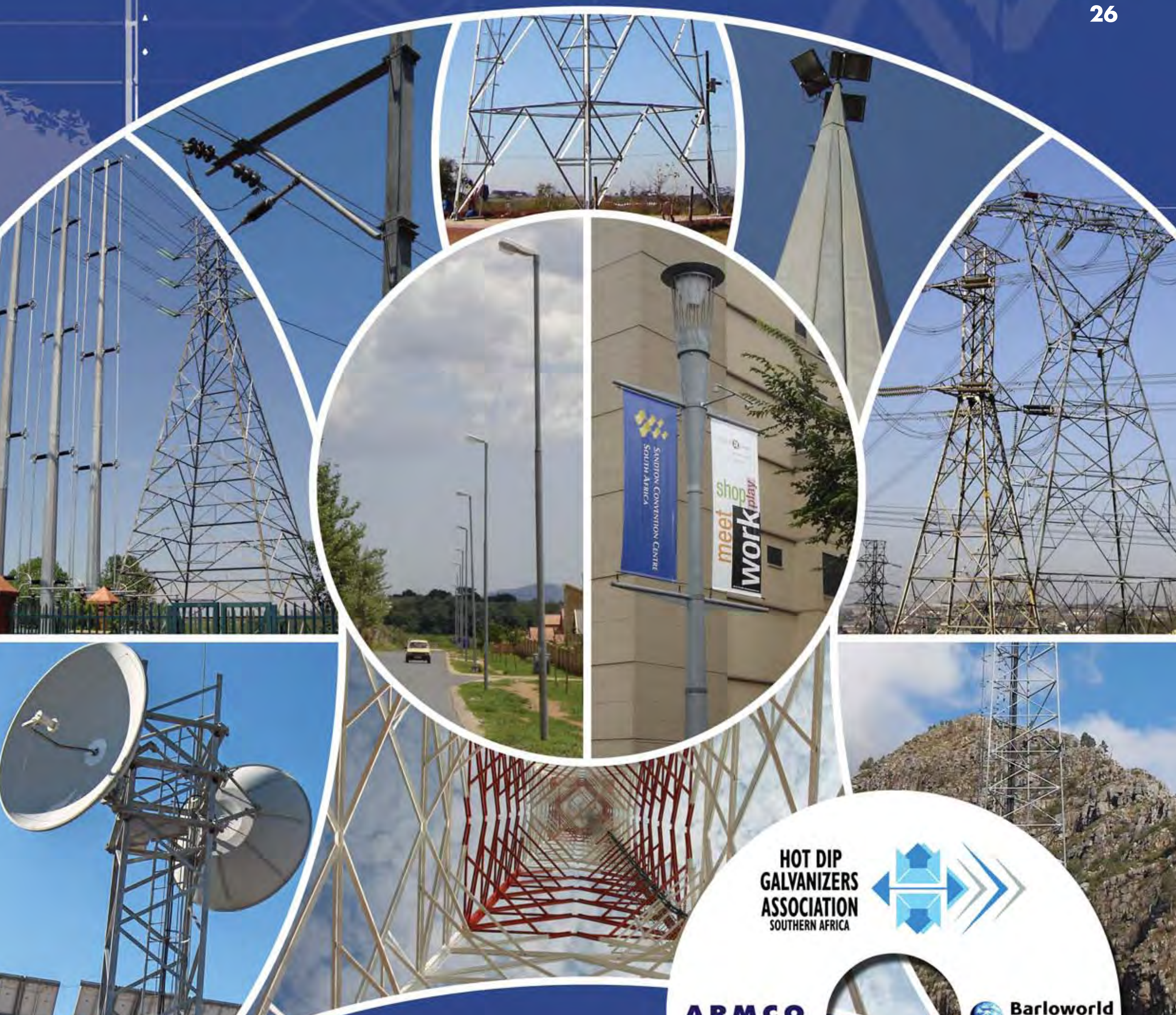


Featuring:

Masts, poles and electrical distribution pylons

Product Information Disc

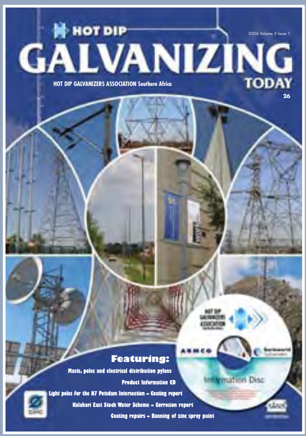
Light poles for the N7 Potsdam Intersection – Coating report

Kalahari East Stock Water Scheme – Corrosion report

Coating repairs – Banning of zinc spray paint

ZINC

SOUTHERN AFRICAN INSTITUTE OF STEEL CONSTRUCTION



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

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Official journal of the Hot Dip Galvanizers Association Southern Africa • 2006 Volume 3 Issue 1

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ISSN 1023/781X

Front Cover: *A kaleidoscope of various masts, poles and electrical distribution pylons.*

Hot Dip Galvanizing – Adding value to Steel

Executive Director's Comment

As we move into another year it is with a sense of excitement as well as concern. We are forecasting an exciting year ahead, due to marketing indicators reflecting that hot dip galvanizing, for corrosion control requirements, is in a growth phase. Market indicators are extremely positive for growth. However, with all things positive, there is a great need for caution relating to realities when pricing hot dip galvanizing.

The international zinc price, quoted on the London Metal Exchange (LME) in US dollars, has, over the past 6 months, risen to record levels. The local price of zinc, upon which our hot dip galvanizing costs are based, are subjected to the monthly variations on the LME, in US$, as well as the Rand Dollar exchange rate. The combination of the international supply and demand requirements for zinc and the strength of the Rand, the price of zinc delivered to the galvanizers has literally "gone through the roof".

While local galvanizers make every effort to avoid large fluctuations in the pricing of hot dip galvanizing, we are now facing the realities of major cost increases, which will be reflected in the selling prices quoted for zinc coatings. As zinc is a major material cost component in the makeup of hot dip galvanizing, increased prices will be unavoidable. A review of hot dip galvanizing prices over the past 3 to 4 years reflects static prices, with numerous examples of actual price reductions in a very competitive market.

Notwithstanding the concerns expressed above, the competitive standing of hot dip galvanizing within the corrosion control industry remains one of the most economical and cost effective coatings available. One needs to consider the longevity that is provided when hot dip galvanized coatings are applied. It is recommended that when project managers consider the use of hot dip galvanizing as the corrosion control system to be used for the protection of steel structures, it is advisable that "value analysis", i.e. long-term maintenance costs and not simply the initial cost of the coating, be studied.

Bob Wilmot

Note from the Editor

Gosh, it's amazing how time flies when you're having fun. The year has only just started and we're already in March!!!

I am proud to say that our database now numbers over 6 000 readers thanks to the efforts of Heather Geere. While I believe there are many people out there that would appreciate receiving the magazine. It is our firm intention not only to grow the readership, but to ensure that our magazine is as interesting as possible, for our readers.

With this in mind and because we believe in its future, we have decided to make the Duplex Feature (Duplex Coatings) a permanent one. Here Mike Book (a paint applicator) discusses the limitations of using an inorganic zinc rich paint as a primer prior to top coating and Wicus Botha of Optima Coatings tells us about the success they have had with their products as in duplex coating technology.

Added to this are two other articles which we intend making permanent features, one, the Association is often invited to comment on a Corrosion Related Issue and this story deals with one such investigation. The other article includes a Coating Report, which the Association is frequently asked to compile following our intervention when a coating is perceived by the customer, to be unacceptable.

The latter has been added for two reasons, to loudly echo our Unbiased Opinion in spite of member galvanizers and also to show our readers what the Association is capable of achieving.

We include for your use, in our opinion, an exciting Information Disc, which includes all the information you would care to use when considering, specifying, designing or finally inspecting a hot dip galvanized coating. Hopefully this assists you in so far as your dealings with our coating/s (the Disc is linked to our Web Site, when online).

Our special feature this issue is on Masts, Poles and Electrical Distribution Pylons and to this end we invited several leading organisations and fabrication companies to comment editorially.

Although the SAISC has compiled a great edition of the "Red Book", we have unfortunately found some mistakes wrt hot dip galvanizing which always seem to creep in, and we comment accordingly.

We are also proud to announce that the SANS 10094 specification that allows the use of class 10.9 hot dip galvanized fasteners, has finally been published.

Also included is some information and our first call for entries of the Annual Awards Event, which takes place on 11 August, should you consider entering this exciting event, kindly give Saskia a call.

Our Guest writer discusses "Exploiting opportunities in a flat world", whereas "Miss Conceptions" addresses what makes steel reactive to molten zinc, particularly the Silicon Equivalent. In Walter's Corner, Walter addresses "The atmospheric corrosion rate is not always what it seems to be!"

Our Personality Profile is Tom Edwards who is one of the doyens of the paint industry. Tom is now 91 years old and retired in Rustenburg.

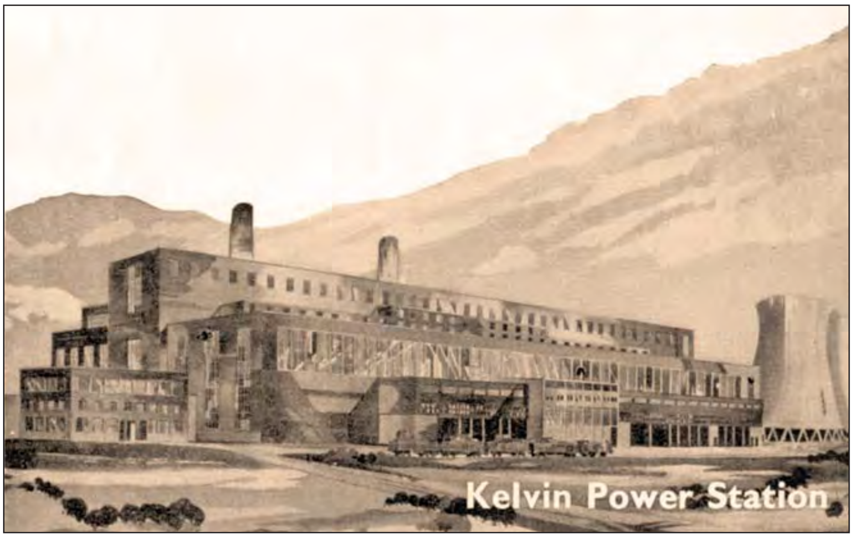
This issue's Case History, looks at the corrosion performance and sustainability of hot dip galvanizing on a number of Electrical Distribution Pylons.

Finally, we at the Association would like to wish all our supporters and readers a prosperous 2006 and to the cyclists and runners, may you achieve whatever sporting goals you have set for yourself for the year!

Terry Smith

"The Johannesburg Electricity Department operates one of the largest municipally owned undertakings in the world"

The article that was published under this headline went on to state: "As a result of the rapid expansion of townships, commerce and industry, the demand on the undertaking doubles itself approximately every seven years and planning for about ten years ahead is necessary to ensure that new power stations are built in time to meet anticipated demands. There are two power stations at present in operation and a third is in course of construction".



Kelvin Power Station when it was built about 50 years ago.

Any guesses as to when this article was written? (The answer will be found at the end of this piece). The two power stations referred to were Orlando Power Station on the north side of the Potchefstroom road and the City Generating Station by the Municipal Market in downtown Johannesburg, with the third station under construction being Kelvin Power Station out by Johannesburg International Airport (construction date - 1953).

These power stations were all coal-fired, consuming between 22 000 and 60 000 tons of coal per month (imagine the pollution!). The water requirements were immense with the City Generating Station purchasing 304 million gallons of water per year. The concrete cooling towers were a feature of all the stations. One tower alone at Orlando was capable of cooling some 86 million gallons of water per day.

The City Generating Station had an installed capacity of 120 000 kilowatts, while Orlando produced power from ten 30 megawatt turbo-alternators. Power at Kelvin was generated at 11 000 volts and stepped up to 88 000 volts for transmission.

Today's view of some of the electrical distribution pylons transporting power from Kelvin Power Station to Johannesburg, taken in Germiston – looking east. A recent coating inspection revealed some interesting facts, see overleaf.

At that time, the Johannesburg Electricity Department was operating one of the world's largest municipally owned undertakings, generating its own electricity which was purchased by 81 437 consumers covering an area of 136.71 square miles, including 42.96 square miles outside municipal boundaries. The basic distribution throughout the city was by means of a 6 600 volt cable system, connecting load centres approximately 0.4 of a kilometer apart, where transformation to 380 - 220 volts took place.

A new scheme was also being put into place which embodied the division of the city into six geographical zones, each fed by 88 kV lines emanating from Orlando, Kelvin and Prospect and with two major sub-stations in each zone. These two sub-stations were to be inter-connected by 20 000 volt cables and in addition to supplying local 20/6.6 kV, step-down transformers, would supply

One of the pylons in an industrial area, looking east.

Hot dip galvanized coating thickness was measured (176μm) where the paint, used for aviation reasons, had failed.

More paint was removed and the hot dip galvanized coating thickness was measured (169μm).

either one or two satellite sub-stations in the same zone.

There was also an agreement in place with the Electricity Supply Commission (Escom) to cover the margin between evening and day peaks under the terms of a supply interchange. The Johannesburg City Council, in terms of the agreement, established an 88 kV switching station on the City Deep Mine property called Prospect to give or receive a supply of up to 100 MVA, and installed 4-88/88 kV regulating transformers to control the power between the two systems. Escom on its part established a switching station at Rosherville with transmission lines of sufficient capacity to supply up to 100 MVA and 88 kV interconnecting power lines between Rosherville and Prospect.

Of the three power stations mentioned in this story, Orlando and City are now defunct. However, the grid of power transmission lines that was erected back then still stands to this day, as proof of the corrosion protection qualities of hot dip galvanizing. At a recent inspection of supporting towers near Barloworld Galvanizers one of the Association members, it was found that the rate of corrosion had been approximately 1 micron per year, which is to be expected under inland conditions (see photos on this page).

And the date of this article?

It was published in 1956 in a special edition entitled "Seventy Golden Years: 1886 - 1956", commissioned by the City Council of Johannesburg and the Johannesburg Publicity Association.

A second pylon in the industrial area, looking south west.

The second pylon in the industrial area, on opposite side, looking south east.

Corrosion products removed and coating thickness measured (200μm) on member thicker than 6mm.

Corrosion products removed and coating thickness measured (191μm) on member thicker than 6mm.

Corrosion products removed and coating thickness measured (84μm) on member about 3mm thick.

Corrosion products removed and coating thickness measured (82μm) on member about 3mm thick.

Differential aeration – a corrosion inducing mechanism that is controllable

Differential aeration or necking corrosion, as it is often referred to in this instance in Masts, Poles and Pylons, as a corrosion form which frequently occurs on partially buried steel at the interface between the buried portion and that exposed to the atmosphere. It can also occur but to a lesser degree, where steel structures are cast into concrete bases and slight shrinking of the concrete during curing results in a small gap or crevice at the interface between the steel and the concrete.

The cause of this corrosion mechanism is a depletion of oxygen where the steel surface is buried, compared with the oxygen rich atmosphere in contact with the exposed portion. The result is a corrosion cell where the steel exposed to an oxygen lean environment constitutes the anode in relation to the exposed steel which is the cathode.

This form of corrosion is frequently observed just above ground level while it should not be confused with other corrosive conditions associated with the presence of corrosion inducing substances in some soils.

Perhaps the best example of corrosion brought about by differential aeration is the street lighting pole, the base of which is normally buried in soil. **There is a misconception that the reason for the corrosion of street light poles can be attributed to man's best friend who sniffs and raises a leg at every pole that he passes. While this canine custom does contribute to the corrosion problem, it is not the root cause.**

A paint film extending some 200 - 300mm above and below the ground level will prevent differential aeration.

Less effective prevention of differential aeration.

Differential aeration may also be prevented by an additional steel sleeve situated above and below the ground level.

Prevention against differential aeration after erection may not have the desired long term benefit.

What then is the solution? Corrosion which is brought about by differential aeration is prevented entirely, simply by applying a paint coating onto the buried portion of a hot dip galvanized structure, prior to erection. The paint film should extend to about 300mm above ground level. Coal tar epoxy has proved to be singularly effective for this purpose while the surrounding compacted soil ensures that the paint coating is not disturbed after erection.

An additional benefit obtained from this duplex concept is the enhanced protection from normal corrosion attack in aggressive soils.

Municipal engineers have adopted this procedure over the years with outstanding results. Hot dip galvanizing has become the generally accepted method of corrosion control for lighting masts and poles. With the added protection of a duplex coating on the buried section, it would seem that the major cause of damage to these structures can now be attributed to errant and perhaps inebriated motorists. As an alternative to painting, some pole manufacturers have added a steel sleeve in this area, clearly providing a double layer of steel, resulting in an extended maintenance free life of the pole.

Eskom is an organization that has over the years, thoroughly researched the various causes of corrosion and how best to control them. Eskom power transmission towers which spread eagle the entire country are hot dip galvanized with an expected maintenance free life of 50 years in most environments. All base legs of these galvanized towers are coated with a familiar band of coal tar epoxy at the interface between the galvanized steel and the concrete foundations.

Exposing the hot dip galvanized grillage foundations of a 78 year old "Milleken" type powerline structure

By Dan Dukhan, Project Engineering Specialist – High Voltage Powerlines, Eskom Holdings Limited, Eastern Region

The components of the "Milleken" type powerline structure arrived from England by ship in 1928 and were transported to the District of Estcourt where they were erected. In those years the foundations were generally of a grillage type, which is made up mainly of angle iron and mass concrete. Prior to casting the concrete over the hot dip galvanized steel angle irons, they were connected to stub columns, which in turn was connected to the pylon steelwork.

Due to the relatively waterlogged environment over the years, the concrete surrounding the foundation became porous and weak and a decision was taken to unearth the foundations, for inspection purposes.

Initially the hot dip galvanized angle iron stub was exposed (the "Port of Durban" inscription is clearly visible in the photograph) and was found to be in good condition. The grillage foundation (2.5m below ground) was exposed using a jack hammer. The hot dip galvanized members are still intact and in good condition despite being encased in porous concrete.

Concrete-encased grillage pad of Milleken Powerline Structure at a depth of 2.5m.

Unearthed and exposed stub of Milleken Powerline Structure with grillage pad intact.

Editorial Comment

Thank you Dan for this contribution, although not mentioned in the article it has since been established that the mean coating thickness of one of the stubs measured to be 80µm. Based on this, it was decided to re-use the hot dip galvanized "Milleken" base for the construction of another tower without stripping and regalvanizing the components. Not bad after 77 years of service?

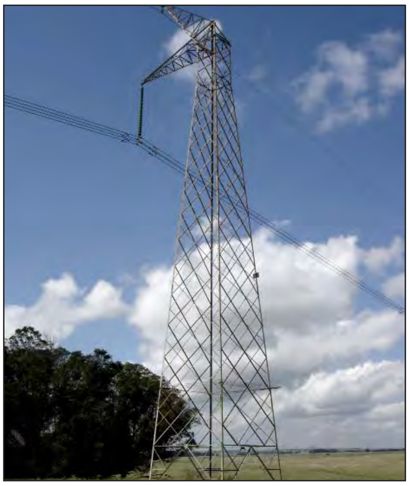
Base of the Milleken Powerlines Structure. The powerline was deviated and the structure was re-used. New foundations were installed at the relocated position.

Unearthed foundation system showing "pad and stub" arrangement. Work-in-progress to expose the grillage pad and stub using a jack-hammer.

Concrete-encased galvanized stub of Milleken Powerline Structure with the inscription of "Port of Durban". The stub connects the structure leg to the grillage foundation pad.

Hot dip galvanized H.V. Lattice transmission line towers

The base of one of the Apollo Sub-station electrical pylons, indicating the construction date.



533kV DC line from Cahora Basa to Eskom's Apollo Sub-Station South of Pretoria.

The above photos show and example of the 'V' Guyed type towers together with some component details.

A brief history

ABB POWER TECHNOLOGY SYSTEMS, previously known as Powerlines, was founded in 1954 in Pretoriusstad, Nigel on the far East Rand. Over the past 52 years ABB Nigel has been a major contributor to the development of the Southern African high tension electrical power distribution infrastructure. The company specialises in the manufacture and erection of transmission line towers and pylons. The company's activities include supply and erection of towers throughout the African continent.

During the years the company has supplied in excess of 35 000kms of power transmission lines, ranging from 66KV to 765kV. In addition, activities have included the erection of a large number of communication towers, and the electrification of several thousand kms. of railway lines throughout the region. Work undertaken for the South African Transport Services range from 3kV DC to 25kV AC supply systems.

Manufacturing plant

The Nigel manufacturing plant consists of a fully integrated steel fabricating operation including a modern hot dip galvanizing facility. The majority of steel fabricated products produced are hot dip galvanized in order to provide corrosion protection.

The Hot Dip Galvanizing plant was established in 1960 and is one of the largest operations within the Gauteng Province. The plant was specifically designed to accommodate long structural steel sections, typical of steel sections used for the manufacture of transmission pylons and communication masts.

Coating thickness measurements indicate that 60 to 75mm of zinc remain after 33 years in service. Based on the corrosion rate of zinc (1 to 2µm per year) in this environment, it is estimated that the remaining service life will be 30 to 40 years before maintenance would be required.

The hot dip galvanizing facility was originally built for Powerlines own internal production requirements, but has developed into a plant catering for "outside customer's materials" or 3rd party supplied steel, including piping, plate and a full range of structural steel sections. The plant includes state of art environmental control and waste management facilities. The company carries the SABS Diamond mark and is certified in terms of ISO 9001:2000.

Corrosion control of transmission towers

Transmission towers are located throughout the width and breadth of the sub-continent and are therefore subjected to an extensive range and variety of environmental conditions.

Following a recent field exercise, carried out in conjunction with the Hot Dip Galvanizing Association Southern Africa, the following photographs illustrate some of our findings.

Of particular interest is the 1 030km. 533 kV DC transmission line from Cahora Basa - Pafuri to the Apollo Sub-station South-East of Pretoria. Construction on project took place from 1971 through to 1973. The section of line inspected runs through the Rietvlei Game Reserve located immediately North of the Apollo Sub-station.

During our field exercise, we were able to inspect a 400kV AC transmission line that runs from Kriel Power Station, near Ermelo, into the Apollo Sub-station. Again, the construction of this transmission line dates from 1973. Close inspection of the hot dip galvanized coating revealed satisfactory results.

We also had the opportunity to inspect the more recent design of transmission tower, estimated at about 10 years in service.

In conclusion, we wish to record our thanks and appreciation to Eskom for the many years of co-operation and the professional relationships that have been developed and maintained between our two organizations. ABB stand ready to continue to be of service into the future development of the vitally necessary electrical transmission infrastructure of the total region.

Based on measurements recorded, a further service life of 60 years can be anticipated. 122µm divided by 2µm/year of zinc being sacrificed.

New hot dip galvanized products from Structa Technology (Pty) Ltd

STRUCTA TECHNOLOGY (PTY) LTD, one of the leading manufacturers of masts and towers in South Africa has developed and offers two new products to enhance their product range.

The ASTRA-base is a concreteless foundation for lattice telecommunication towers. The base is a 'galvanized structural steel bolt-together' structure, which can be assembled on-site. The structure is filled with earth ballast which resists the turn-over moment of the mast. The system allows deployment of telecoms base stations in areas which are difficult to reach and where concrete comes at a premium. The bolt together nature also has inherent logistical advantages in that each piece weighs less than 200kg and can therefore be handled without lifting equipment.

The photograph immediately right shows such a base which was recently deployed in Malawi. The tower is a standard Wildcat 54m mast, also designed and produced by STRUCTA.

STRUCTA has also launched a universal hot dip galvanized distribution pole, for use in electricity and telecom overhead distribution lines.

One of the more recent telecommunication towers in Malawi making use of the "Astra-base".

The hot dip galvanized steel – "Astra-base", is a concreteless foundation for telecommunication towers.

The newly launched universal hot dip galvanized telecom & electrical distribution pole.

The poles have a universal set of holes which are delivered plugged to the client. On-site works are therefore minimal as site crews only have to remove the required plugs. The masts are of optimum design and range in weight from 80kg - 230kg (11m pole). Users have so far indicated that the logistical advantages of the poles far outweigh the premium paid for the galvanized steel product.

A universal set of plugged pre-drilled holes, allows component attachment flexibility with no unnecessary coating repair.

In both cases, Structa engineers have optimized structures through extensive analysis and lab testing in order to gain advantages in price and logistics.

Solution to faster erection of poles and masts

Geo Stott & Co. is a 90 year old manufacturing company in the metal industry and today employs 360 people at its two factories which are located in Industria and Boksburg East.

Geo Stott operates a number of divisions which include: Metal Pressings , Heavy forgings, Mine Props , Overhead Line Hardware and a Medium to Heavy Fabrication Shop.
Geo Stott processes some 1400 tons of steel per month of which a significant quantity is hot dip galvanized.

The company for many years was owned by the Stott and Rennie families and changed hands some four years back at which time it was transformed into a Black Empowered Company with an Empowerdex "A" Rating .

The company holds an ISO 9001/2000 Quality Listing Certificate and also has it's own in-house service resources such as Design, Toolroom and Machine Re-building facilities.

The company operates in most of the industrial sectors including the Electrical, Telecoms, Mining, Transport, Construction, General Engineering sectors and also exports it's products directly and indirectly to other African countries and Europe.

Geo Stott is an innovative company and continually seeks opportunity to design and offer the market new products, which seek to improve the application for the client, and lower his process/project costs.

Two such products which were recently developed include a Pole Support Stub for pro-longing the life of transmission

Guyed mast on screwfast piles.

Screwfast pile installation.

poles and a Screw Fast Foundation Pile for anchoring and foundation applications, which dramatically cuts the installation time and costs of a project. The Pole Support Stub is a patented product and is supplied to the Electrical Industry for anchoring and clamping transmission poles.

The Screwfast foundation pile is manufactured under license to Screwfast in the UK where it was recently awarded the prestigious " Queens Award for Enterprise 2005".

Pole support stub.

Geo Stott also manufactures and supplies Telecom Masts & Towers and the screwfast foundation piles were recently used with great success on an installation project with Telecom Masts in Africa.

Both these products have been extensively tested and certified and are currently in use in various applications. (See photo illustrations of a typical Screw Fast Pile application as well as Transmission pole stub.)

The Screwfast pile can withstand both tension and compression. The uses are varied and are making significant inroads in the Telecoms Industry, on Rail and for conventional buildings requiring piled foundations.

Screwfast Piles are environmentally friendly, the piles spiral past most roots and rocks and they can be installed and removed without generating any spoil. Lifespan of piles can be designed up to 120 years.

Screwfast Piles are fully loaded as soon as they are installed. No waiting for concrete to cure. Each pile is checked as it is installed by the torque readings, which are recorded, confirming the competence of the installation.

Large rigs are not required to install the piles. A torque head attached to a JCB or equivalent machine is all that is needed.

With these new product innovations, Geo Stott & Co. offers a turnkey, low cost solution to various anchoring and foundation applications ranging from design and manufacture, through to installation.

Protekon microwave towers

Some 15 years ago, engineer Rob Forbes was part of a design team at Transnet's Structural Design office, tasked with designing about 70 microwave towers, to be used by Transnet in the transmission of electronic data to various places around South Africa. This was in the days before electronic photos and when CAD (Computer Aided Design) was in its infancy. Rob tells us about some of the difficulties encountered in this project and how they were overcome.

Structural analysis was done on a package called STRUDL which was main frame based. The towers were designed either as steel lattice structures or as steel tubular structures. The tallest tower, placed at Kimberley, was 75m high and the shortest was about 6m high, which was placed on the top of various buildings. Most of the towers were on the tops of mountains where the average height was 44m. The towers were placed 50km apart.

Typically they each had two 3.7m diameter dish antennae, each with its own radome. The allowable rotation of the towers under design wind load was one degree. This was to guarantee an uninterrupted data flow in all weather conditions. More than one degree, and over 50kms the microwave beam would then miss its target by about one km. However, the microwave beam spreads about 1.5 degrees either side of its target and so a strong enough signal is obtained within the one degree cone.

The tower at Amabele had to be built using an even more complex system.

Power to the towers on top of mountains was problematic as lightening causes havoc on lengthy power routes. This was solved by equipping the mountain top towers with banks of photo electric cells and lead accumulator batteries.

At that time the towers had to be built departmentally, with the equipment available from each department. This meant that the tallest crane available could only reach 35m high. The problem was solved by building the towers in two parts: a "launcher" up to 35m high and a "rocket" initially built on the ground. Then, using the crane and a system of pulleys and cables the "rocket" was launched upward through the "launcher" until the top of the "rocket" reached its required height. This idea was sparked from something Rob did as a young boy when he used to shoot arrows with a catapault.

The "launchers" of towers were fully erected in 6m high segments and then, using a special rig called the "spider" each segment was lifted complete with four riggers dangling from bosuns chairs, on to the top of the previously erected segment. As soon as each rigger had attached his four bolts, he lowered himself down to ground level. (This idea was derived from children's stacking blocks). This limited the time the crane and riggers had to work more than 6 m above ground, an important factor because high winds at the top of the mountains reduced the number of hours that the crane could work safely.

The tower erected at Amabele had to be built using an even more complex system. The launcher was too high to be constructed using the crane and, because of the height of the launcher, the rocket also could not be launched using the crane. So the erection procedure was adapted by building as much of the launcher as possible using the crane (all but the top 12m), then incrementally launching the rocket using jacks from the ground level. When the rocket was high enough it was used as a "jury pole" to help with the erection of the top 12m of the launcher.

The rocket in the meantime, was secured by a system of tension jacks from the launcher. When the launcher was completed the rocket was further incrementally launched, by sliding in new 7m lengths at the bottom until the top of the rocket reached 54m (the full height of the tower). Then the rocket was disconnected near the top of the launcher and the bottom , now redundant, parts jacked downwards and removed.

The role of the design engineer does not exclude him from getting out into the field sometimes, to sort out a problem. Rob tells in his own words of an experience he underwent to sort out a vibration problem on one of the towers.

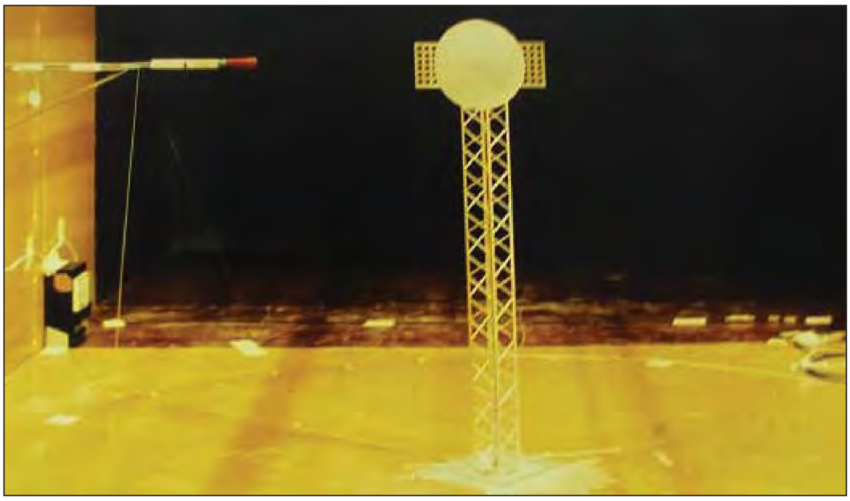
"One of the towers on top of a mountain, Lopersberg in the middle of the Karoo, was reported to be vibrating badly in the wind.

A special rig called the "spider" lifted each 6m high segment complete with four riggers dangling from bosun's chairs, onto the top of the previously erected segment.

A close-up of one of the riggers in the bosuns chair.

When this was reported to the design office, I decided to go there and investigate. It was the middle of winter and I was told that the wind only really blows during the night in the Karoo winter. So I decided to camp at the bottom of the tower until the wind came up".

Rob continues, "My wife came with me. We arrived in the late afternoon and set up the tent. It was very cold. During the night the wind did come up and I could hear something banging near the top of the tower. I put on all my clothes and gloves and scarves and started to climb up the tower. The air was crystal clear and being on top of the mountain you could see every star that God had put into the sky. It was a religious experience, climbing that tower in the middle of the night. I was reminded of the story of Jacob's ladder and the angels coming to and from heaven. When I got to the top of the tower I estimated that the amplitude of the vibration was about 10mm – very disturbing for a human who is scared about being so high off the ground, but not alarming from a structural point of view. The banging was due to a loose electronic cable. I also measured the frequency of the vibrations and it was exactly as the analysis programme had predicted."



A model of a tower was built with its two antennae and radomes and wind tunnel tested.

The hot dip galvanized microwave tower at Alicedale in the Eastern Cape.

After braving the height and the elements, Rob concludes, "After spending five minutes admiring the stars, the cold sent me back down the ladder and back into my sleeping bag. In the morning our tent was covered with ice".

However, at the insistence of the client department the CSIR was asked to investigate the vibrations. A model was built of the top of the tower with its two antennae and their radomes. It was then tested in the wind tunnel at the CSIR. It was discovered that vorteces were being induced by the windward antenna and its radome and this would cause a cross wind response on the leeward antenna and its radome. When the wind was at a certain velocity and direction, the frequencies of the vorteces would match the natural frequency of the tower and the tower's sway would be magnified with each vortex.

In order to stop the vortex formation and exitation, the CSIR recommended the insertion of two steel plates each about 3m x 3m at the top of the tower between the two antennae and the radomes. Each steel plate was to be full of holes each about 300mm in diameter, very much like a large sieve.

This was done and the vibrations at Lopersburg stopped.

Rob's concluding comment on this particular problem was, "It is interesting that there were about 10 towers of this height, also at the tops of mountains and also each with two large antennae and radomes fastened back to back at the top of the tower, but the Lopersburg tower was the only one that had vibration problems".

Rob Forbes runs his own company, Rob Forbes Consulting Engineers.

Editorial Comment

Many of the towers have recently been inspected for structural reasons and although the hot dip galvanizing is reported to be in good condition it is unfortunate that the residual coating thickness was not measured during this inspection. The Association wishes to thank Protekon and Rob Forbes for this interesting article.

The limitations of an inorganic zinc rich paint as a base coat

By Mike Book - proprietor Duplex Coatings

Question

Is it true that insufficient curing of ethyl silicate inorganic zinc rich coatings prior to top coating is responsible for many coating failures?

If so, what methods can be used to verify that proper curing has been achieved?

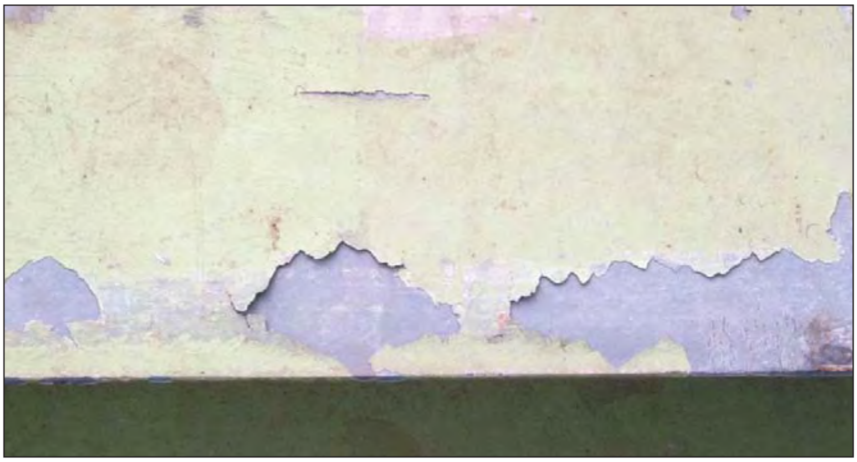
Prior to about 1994, shop painting was traditionally a blast and prime operation with the topcoats being applied on site after erection.

As a result of major fast track projects being erected at the time, it was decided by Project Managers to apply the complete system in the shop, which provided certain advantages i.e.

- Contamination:
  The primer now fully protected, could be exposed to the common environmental contaminants with little, and in most cases no clean up.
- Quality Control
  The majority of the work was carried out under a controlled environment.
- Safety
  Man hours spent working at elevated heights were reduced by 95%.

By and large, ethyl silicate inorganic zinc coatings have performed well in the field when they have been allowed to cure and then over-coated, but insufficiently cured primer leads to poor inter-coat adhesion. In addition, we have observed that there is a wide variation in curing time requirements among different formulations of ethyl silicate Inorganic Zinc Rich primers, and a dependence on ambient conditions (primarily Relative Humidity - RH).

Applying inorganic zinc rich primers in places such as Gauteng during the winter months when the RH is 20-30% results in the primer "drying" and not curing. These primers require to be sprayed continuously with a fine mist of water to accelerate the curing prior to top coating, in areas where the RH is below 50%.



A typical inorganic zinc rich primer/epoxy high build/polyurethane system failure where the inorganic zinc rich primer has not been allowed to cure sufficiently prior to topcoating of the epoxy intermediate coat and the polyurethane final coat.

For logistical reasons the applicator is always under pressure to apply the topcoats as soon as possible and where the inorganic zinc rich primer and topcoats are applied in the shop, these coatings are always susceptible to early anticipated failure.

It is imperative that prior to the application of a top coating over an inorganic zinc rich primer, a "cure test" be carried out i.e:

1) MEK *Rub Test*

   50 Double rubs with a Methyl Ethyl Ketone (MEK) saturated cheesecloth. The binder in the uncured film is soluble in MEK and can be removed in less than 50 double rubs. A completely cured film is not soluble and, at most, only a slight burnishing of the surface will occur.

2) *Coin Rub Test*

   Experienced inspectors and applicators can usually judge with the edge of a coin, but it is rather difficult to write a standard test around such techniques.

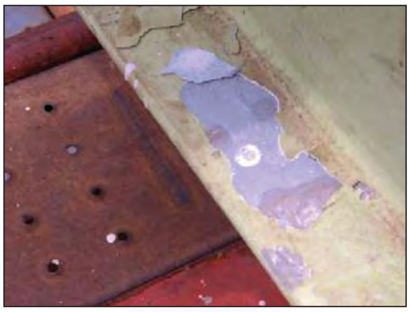
The cure process varies considerably in the various South African climatic conditions and is dependent on the thickness of the zinc coating.

The type and thickness of the topcoat also seems to affect the failure rate.

In tests carried out it has been proved that a relationship exists between the thickness of an epoxy topcoat and the adhesion of the zinc primer/epoxy system – the thicker the topcoat the worse the inter-coat adhesion.

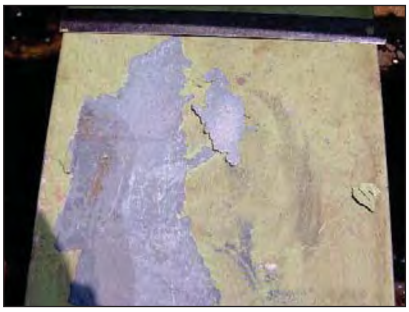
This is not surprising, since not only would a thicker topcoat serve to seal off the underlying primer from the atmospheric moisture that it needs in order to cure, but also it would develop greater stress, since thicker coatings produce more shrinkage stress than thinner ones. Indeed it is this shrinkage stress, along with possible softening of the upper layer of primer via the topcoat solvents that is believed to produce the poor adhesion in the first place.

The cure of the inorganic zinc rich primers is related to both time and humidity, as is the adhesion of the top-coated primer. The poor adhesion is believed to be the consequence of the topcoat sealing off the primer's necessary atmospheric moisture, softening the upper layer via solvent



Note the cohesive break within the inorganic zinc rich primer with primer remaining on both the steel substrate (±8 – 12μm) and on the back of the delaminated epoxy.

Undercured zinc rich primer will result in an attack of the primer by the solvents of the epoxy, followed by an additional strain as the epoxy cures and imparts shrinkage stress. Furthermore, once topcoated, the primer has greatly reduced access to atmospheric moisture needed for curing.



Once a weakened plane has been established (always just above the blast profile and within a few days of topcoat application) the zinc will cure to a hard brittle coating and will not "re-fix" itself by improving the cohesive strength, in fact, higher coating thickness will accelerate the disbondment of the coating system.

N.B The iron oxide formation where little or no zinc is left on the substrate.

attack, and introducing a weak plane subject to disbondment when stressed.

Although all coatings exhibit some moisture permeability, however small, the amount of moisture permeating the topcoat is simply not enough to effectively improve the cohesive strength of the primer.

Taking these facts into consideration, it can be seen that if a weakened plane has already been established within a few days of topcoat application and it was possible that the zinc primer were to eventually achieve a higher state of cure due to slight moisture permeation, a corresponding improvement in inter-coat adhesion would not result.

Conclusion

When specifying inorganic zinc rich coatings, careful consideration should be given to applying the full system in the shop versus prime only and topcoat on site. It is highly recommended to employ 3rd Party Inspection to inspect for curing prior to top coating.

Alternative 1

Change the primer to an organic epoxy zinc rich primer

Alternative 2

Apply a Duplex system (hot dip galvanize plus an appropriate paint).

Hot dip galvanizing and the Galvanox® Duplex System

By Wicas Botha – Optima Coatings

This article deals with the question of why and when a duplex system should be considered, some of the reasons behind duplex failures and the essential requirements for applying a good duplex system, and offers information on reliable systems to be considered.

Traditionally the application of a zinc coating for steel structures and components is undertaken using either zinc rich paint or hot dip galvanizing. Both these methods have constraints and advantages and should be used appropriately. For example, for successful applications zinc rich paint is applied to an abrasive blasted surface, which can be done 'in situ'. However, it can be brittle, only contains up to 90% zinc, and can result in a porous coating.

Hot dip galvanizing gives a solid coating and has good adhesion properties. However, there are some design constraints and the steel has to be transported to a galvanizing plant to be dipped.

Why a duplex system?

Zinc coating on its own does not always provide adequate protection under certain conditions, so additional protection is sometimes necessary: for example in aggressive acidic and alkaline environments. A duplex system will also prevent bi-metallic corrosion; it will enhance barrier protection properties; it will ensure synergistic anti-corrosion results and it will correct imperfections in or damage to zinc coatings.

When should a duplex system be applied?

A typical duplex system comprises a hot dip galvanized zinc coating plus one or several coatings of an organic coating. Environments where this extra protection may be needed are coastal and marine installations; places where there is a high humidity and installations in chemical plants or near any type of industrial pollution.

Duplex failures and requirements for an effective duplex system

Failures occur when the surface to be coated has been inadequately prepared. Other reasons for failure include a low film build of the organic coating over the hot dip galvanized coating; poor weathering resistance; the primer reacting with the hot dip galvanized coating and a porous organic coating.

A good duplex system must first be applied to a surface that has been non-aggressively prepared. It must have good initial and long-term adhesion and good resistance to chemicals such as salts, acids, alkalis and organic solvents. It must have adequate weathering resistance to UV rays and humidity, a good mechanical and abrasion resistance and above all a proven durability.

The Galvanox® Duplex System

Galvanox® comprises a selection of systems especially formulated for different types of applications and purposes. It is ideal for all the situations described above. These include as a protective coating on hot dip galvanized surfaces to gain synergistic effect for enhanced performance. Galvanox® can also be used on its own as a purely decorative system for structural steel, roofs, side cladding and equipment.

Duplex coated railway powerline support mast – coated in 1999.

The application of the Galvanox® coating systems begins with a non-aggressive surface preparation, using a non-toxic, environmentally friendly water-based degreaser called OptiDegreaser®. Following this, the water based adhesion primer is applied to the newly hot dip galvanized surface. This in turn can be coated over by a choice of top-coats, both solvent and water-based. The top coats are either Noxyde... the RustBusta® or OptiAquaUrethane®. The former is a flexible, waterproof coating ideal for steel/concrete joints to form a seamless joint e.g. at mast bases. It has a proven long-term corrosion protection in very aggressive environments and can be applied directly to weathered hot dip galvanized steel. The latter is highly resistant to chemicals and organic solvents, and offers an attractive hard finish yet remains flexible.

Proven quality and durability.

All the components of the Galvanox® coating systems were selected from reputable suppliers in Europe and have been extensively tested and approved in material laboratories both locally and abroad. They have also been proven under South African conditions since 1997, on such installations as electrical towers, railway masts, substations and transformers.

The products are ideal as a protective coating for both new projects and for maintenance work, as they are fast drying and easy to apply by means of spraying or brushing. Small components can be dipped. All materials used in the Galvanox® Duplex Systems are non-toxic, non-flammable and eco friendly.

Editorial Comment

When used in aggressive environments the feedback from the market place suggests that this system, if correctly applied will provide a sound performance. However, the views provided in the article are not necessarily the views of the Hot Dip Galvanizers Association

Reader's response to "Zinc primers – an overview" produced in the previous edition of this magazine

Hot dip Galvanizing Today Volume 2 Issue 4 2005

We refer to the article "*Zinc Primers – an overview*" written by Dr Colin Alvey of Corrosion Advisory Technical Services (Randburg) cc and wish to respectfully comment as follows.

Cathodic Protection (CP) is somewhat complex, especially if one is to demonstrate the practicalities of inorganic zinc dust providing CP when applied to a steel surface. Important aspects such as Anode Loading (the amount of current being drawn from the zinc), the circuit resistance between the zinc, steel and moisture via the epoxy paint, the anode capacity (how much current can be delivered for a specific time duration), etc., all play a significant role. The matter is further exacerbated by the presence and/or absence of film forming products in the electrolyte (moisture), pH, temperature, etc.

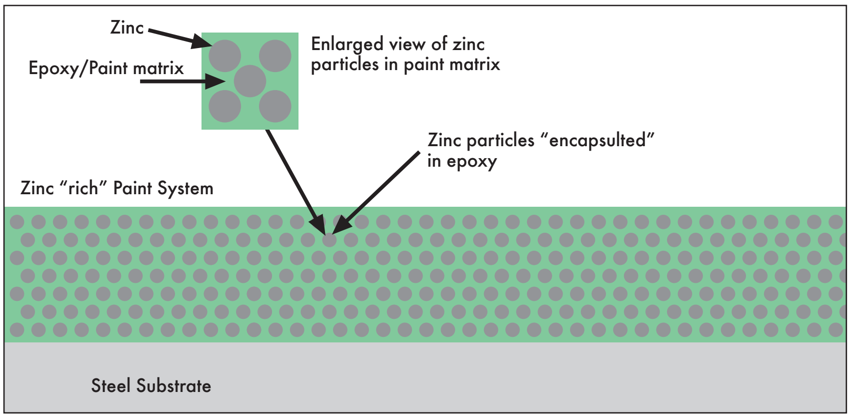
The very first paragraph of the article states that, "*It is generally accepted that particles of metallic zinc applied to a steel surface in a paint matrix in the form of a zinc primer provide protection to the steel by the process of cathodic protection*". We challenge any paint manufacturer and/or supplier that can technically justify this statement using Ohm=s Law and/or the First Law of Thermodynamics in order to prove that the zinc dust/powder would not simply oxidise long before it could offer CP.

A reputable inorganic zinc paint supplier once stated that, "*Inorganic zinc-rich primers come in two parts; a small quantity of a (silicate or equivalent) resin, and a large volume of zinc powder. The difficulty faced by the painter is to intimately mix the zinc with the resin. The goal is to have each individual zinc dust particle coated with the resin, but this is no mean feat if one considers how much zinc is added to the small volume of resin. Therefore, suitable mixing equipment is required and the painter must be properly trained and preferably have previous experience in this application.*"

Firstly, the metallic zinc powder used in the paint matrix is encapsulated in various zinc oxides. Therefore no metallic zinc is actually exposed at the powder/dust surface. This is corroborated by the simple fact that the metallic zinc is deep grey in colour, which is indicative of an oxidised zinc surface. This raises several questions such as; what is the inter-particle resistance between the powder and would it be sufficiently low in order to permit current to flow from particle to particle to the steel substrate in order to allow CP to occur? – highly unlikely; if the zinc is in direct contact with the steel, then how does this affect the overall adhesion between the steel and paint – intuitively one would expect that if the zinc powder and steel were in contact then there would be a serious loss in overall adhesion. The latter topics are never addressed by the paint suppliers/manufacturer.

Secondly, the metallic zinc (ignoring the albeit important oxide layer(s) for now), is encapsulated in a layer of epoxy. Failing which, there will be no real adhesion between adjacent zinc particles. Certain paint manufacturers refer to tack welded connection between the zinc powder, thereby permitting inter-particle connections – do they ever explain how this occurs from a metallurgical perspective? No. However, if you were to give them the benefit of the doubt, then surely this would render the coating to be porous and a poor barrier coating.

Furthermore, would this not simply permit water and other deleterious or corrosive constituents to penetrate to the steel substrate causing near instant and ongoing corrosion.



Schematic of "perfect" Zinc Rich Paint System

This is further illustrated in the diagram above. There is the notion that if more than 80% zinc "dust" is added to the paint then it will provide cathodic protection, once again, there is precious little if any technical papers to back this up. Each and every zinc particle must be encapsulated in a film of epoxy, if the organic coating is to provide a "barrier" against the corrosive environment and adhere sufficiently to the steel substrate.

The article attempts to indicate that the paint with *"sufficient quantities of metallic dust will provide cathodic protection"*. It further states that *"There must obviously be sufficient zinc particles present to ensure electrical contact with each other in order to provide a common anode."* If the powdered zinc is in "electrical contact" (ignoring any oxides) with all of the other "powdered" zinc, in order to form the so called "common anode", then what is "holding" the zinc powder together and keeping it in contact with the steel?

Furthermore, if the statement were correct, then one could simply measure the resistance between the zinc paint and the steel substrate. This could be carried out by simply scratching the paint to expose the zinc (common anode) and connecting the other end of the meter to the steel surface. In reality one cannot measure the resistance unless 2 500V or more is put across the 100µm coating and steel surface. But Zinc has a natural potential of around 1.100V (CSE) – one wonders how the current will flow during the cathodic protection process.

How is it possible to carry out a wet sponge test on a cured zinc rich paint, if there is this so called "common anode" connected to the steel?

The paint suppliers also argue *"but you can see the white rust"* where the paint is damaged – cathodic protection must be taking place. Of course a far more plausible explanation would be that the zinc powder corrodes and leaves a white residue and offers no cathodic protection whatsoever.

All in all, there is simply an abundance of technical facts that proves beyond any reasonable doubt that zinc powder and/or dust merely adds "body" to the paint and that is it.

Hot dip galvanizing (HDG) offers cathodic protection and it can be proven that this actually occurs from a number of electrochemical and metallurgical perspectives.

In Gauteng, 95% of all steel fabrication applications could be protected by HDG. HDG would be the correct product for the 95% of the applications, both technically and commercially. Paints would essentially be relegated for aesthetic purposes and where severe corrosive micro environments are present, using a duplex system.

Unfortunately, HDG offers very little in terms of on-site, pre-delivery, post-delivery and post construction inspection and ongoing annual maintenance – makes you think doesn't it!

The Association would kindly like to thank Gerald Haynes of Corrosion Technology Consultants (Affiliate Professional Member of this Association) for this valuable response.

HDGASA

Information Disc and Wall Chart 2006

Following a mammoth effort by all, including the kind sponsors who helped to make this possible, we are proud to include in this copy of "Hot Dip Galvanizing Today" the Information Disc and wall chart on "Design for Hot Dip Galvanizing", for your use.

The introduction, using visuals, music and a narrator, sets the mood for the information to follow.

The format is easy to navigate and includes detailed information on the following:

- "Steel Protection by Hot Dip Galvanizing and Duplex Coating" (latest version).
- "Practical Guidelines for Inspection and Repair of Hot Dip Galvanized Coatings" (latest version).
- Code of Practice for Surface Preparation and Application of Organic Coatings applied to New Unweathered Hot Dip Galvanized Steel (Sheet and Section) excluding In-Line Coil Coating (Duplex Coating Systems).
- Specification for the Performance Requirements of Coating Systems applied to New Unweathered Hot Dip Galvanized Steel (Sheet and Section) excluding In-Line Coil Coating (Duplex Coating Systems).

All members' details, including type of galvanizer, capacity, location, etc. are also included.

There are several opportunities for the reader to enter his or her details, which will send an automatic email to the Association requesting a response, as long as the disc is being run on an internet-enabled PC or laptop.

The Wall Chart contains extremely important information for designers and fabricators alike. This information will help to enhance the quality of the hot dip galvanized coating as well as eliminate the risk of uncoated areas, or more importantly undesirable explosions, resulting in injury and plant damage, due to inappropriately positioned vent holes.

HDGASA Information Disc printed by:
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We trust that the disc proves to be valuable to you but should you not find what you are looking for, kindly consult our web site, www.hdgasa.org.za or contact us directly.

Troubleshooting

1. This disc is designed to run automatically, if it fails to open:
   - Go to **START**
   - Click **RUN**
   - Type **D:/HDIntro.exe** (or E:/.. or F:/.. your CD Drive Letter)
   - And press **OK**

2. This disc requires Macromedia Shockwave Player and Flash Player should your computer not have these programmes they can be downloaded at no cost on **http://www.macromedia.com/downloads**

3. Adobe Acrobat Reader is also required to view certain documents, should your computer not have this programme can be downloaded at no cost on **http://www.adobe.com/products/acrobat/readstep2.html**

4. Due to the introduction of windows service pack 2, you may encounter an Active X alert when running this disc please press **"YES"** to proceed, your computer is in no way at risk.

5. This disc must be viewed in a full Internet Explorer window, should the content not be aligned with the columns, close your favourites and/or history panel.

6. If other problems persist please contact Siem de Haan at *Off The Edge Marketing* on 011 913 3658 during office hours.

FEATURES

2nd Quarter 2006

Tube and Pipe / Training and Education / Water and Grain Storage

3rd Quarter 2006

Awards Event / Agriculture / Abatoirs / Food

4th Quarter 2006

Mines and Mining – Gold, Platinum, Coal and Diamond / Bolts and Nuts

1st Quarter 2007

Continuous Sheet and Wire / Hot Dip Galvanized Re-inforcement for Concrete / Masts, Poles and Electrical Distribution Pylons

Kalahari East Stock Water Scheme

Corrosion on Internal Surfaces of Hot Dip Galvanized Fittings

Preliminary Information

The Association was approached on 12 April to comment on the corrosion of internal surfaces of pipe fittings connected to asbestos cement pipes installed several years ago for the above water scheme.

The fittings were manufactured from hot dip galvanized steel and there was evidence of perforation emanating from the inside of the pipe. On receipt of a water analysis, it was established that, according to this sample, the water could not be described as significantly aggressive to a zinc coating as applied by the hot dip galvanizing process.

At 7.9, the pH level was favourable, chloride content was low and the water had scale-forming tendencies. At 264mg/l, sulphate content was fairly high but this was not considered to be sufficient on its own to cause serious corrosion.

A sample hot dip galvanized valve was provided for examination, (*photo no. 1*) which provided convincing evidence of microbially influenced corrosion and specifically, sulphate reducing bacteria. This bacterium is anaerobic hence it requires an oxygen depleted environment typical of water in a pipeline which is not flowing to any extent or water inside a fitting that is away from the main flow.

When a colony of SRB is established, a nodule of a sludge-like substance is

Photo no. 1: Hot dip galvanized sample provided for examination.

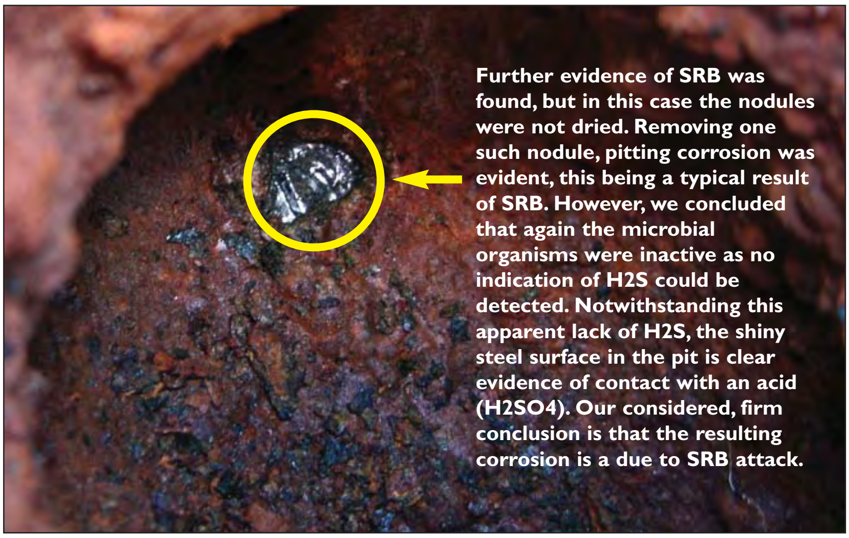


Photo no. 2: Photograph taken during the site visit on 12 May 2005.

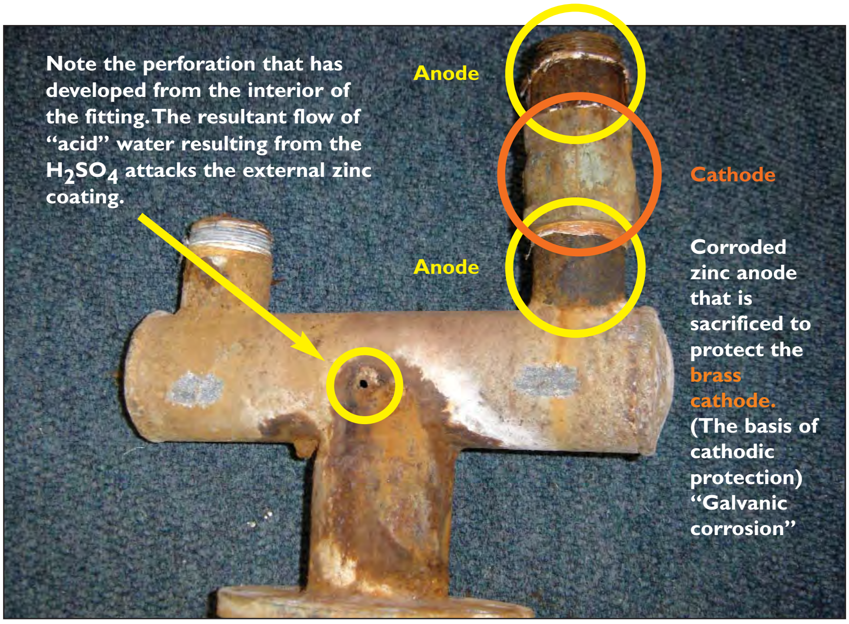


Photo No.3: A photo of the fitting sent to the Association for examination and comment.

Photo no. 4: A sample of a duplex coating system currently under investigation.

A duplex coating is defined as a hot dip galvanized base primer followed by a suitable organic coating. The situation on the said pipeline represents an opportunity to field test this type of coating system.

developed which excludes further ingress of oxygen while the colony flourishes and expands by absorbing sulphates from the water and at the same time excreting H2S which in turn is converted into sulphurous or sulphuric acid. It is this acid that causes the corrosion. Typical symptoms are voluminous quantities of sludge and local severe pitting corrosion at sites where individual colonies have been established.

As soon as these micro organisms are exposed to an oxygen rich environment and / or dry conditions, they will vanish. This makes it difficult to identify their existence under laboratory conditions when samples are removed from the site conditions.

During the visit to site on 12 May, another valve was examined and this also provided typical evidence of corrosion associated with the presence of sulphate reducing bacteria. There was also evidence of corrosion associated with the presence of sulphate reducing bacteria in the rising main leading to the valve (*photo. no.* 2).

Further inspection of the unit in our possession reveals that the hot dip galvanized pipe sections on either side of the brass valve were showing signs of severe external corrosion. (*photo no.* 3)

The horizontal or cross connecting section of pipe had significant amounts of zinc coating still providing corrosion protection.

The reason for the corrosion on the pipes attached to the bass valve is due to contact between dissimilar metals (bi-metallic couple) in the presence of an electrolyte (water). Brass is electropositive (cathode) in relation to zinc (anode) hence; we have galvanic corrosion where the anode (zinc) is attacked preferentially to the cathode (brass), which is protected.

Summary

The cause of corrosion in this instance is without doubt the presence of sulphate reducing bacteria. The fact that the borehole water augmenting the supply to this system contains a high sulphate level is the major contributing factor.

Corrosion attack is observed in fittings situated outside the main water flow i.e. favourable for the propagation of anaerobic bacteria. Meanwhile, this is exacerbated if the water flow through the system is discontinued from time to time. SRB can be the cause of severe pitting corrosion in a relatively short period of time in conditions, which are conducive while minor changes in their environment can render these bacteria to become inactive.

Photo no. 5: An indication of the hot dip galvanized coating remaining on the external surface, which was subjected to normal ground and water conditions (71.4μm). Coating thicknesses of 65 to 80μm were recorded.

Suggested Solutions

The following suggestions are submitted for consideration:

1. By chlorinating the water adequately it should be possible to control this corrosion problem. It would, however, require the installation of several chlorinating stations along the entire length of the pipeline.

   The advantage of this approach is that existing fittings could be stripped and re-galvanized for reuse while in some instances, it may be possible to seal weld where severe pitting has taken place followed by re-galvanizing. This could be achieved by acquiring a few spare fittings and recycling refurbished ones over a period of time.

2. Internal additional surface lining of fittings with an organic coating could be a possible option, which we are investigating. The problem is accessibility for adequate internal surface preparation in the case of valves of this configuration. We would suggest that we immediately select a suitable valve assembly, such as the unit examined on site, repair, re-galvanize and apply an organic coating to all surfaces. This sample unit will be returned to service in order to monitor performance over the next 6 to 12 months. (*Photo no.*4) This suggestion can be seen as part of a current investigation into new duplex coatings for severe and varied environmental conditions.

3. The more costly solution would be to replace all components with a suitable stainless steel. This would entail scrapping all existing components over a period of time.

   To avoid any microbially influenced corrosion attack, it would be necessary to use grade 316L material. Grade 304 stainless steel would be unacceptable due to its propensity for pitting corrosion while 3CR12 is even more prone to pitting.

Feedback from the consulting engineer involved in the Kalahari East Stock Water Scheme

19 May 2005

Dear Bob and Walter

Firstly, thank you very much for your kind effort. It is extremely seldom that you find people willing to travel in excess of 1 000km to provide assistance in the investigation of what some will perceive as a minor problem. Your passion for the subject of corrosion and the protection against it by means of hot dip galvanizing is infectious.

Thank you also for the report. I trust my client will now be convinced of the mechanism causing the corrosion, as I am of the opinion that they did not believe me before.

Please, if you ever pass through Upington, give me call and let's at least have some coffee.

Kind regards

Gert Meiring
ND, NHD (Civil Eng.)
BVi Consulting Engineers
P O Box 1155 Upington

Hot dip galvanized light poles for the N7 Potsdam Intersection

As part of the Association's effort to educate and improve the frequent ineffective communication between the end client and the galvanizer, often via a number of contracting parties, the specifiers finish expectations and the manufacturer and galvanizer's commitment to the quality of the final product, etc. we include for your reading, this coating report by the Association, interspersed with some extracts from the original specification and finally a summary of the situation as seen by the manufacturer.

For obvious reasons names of all parties have been withheld but the article might be invaluable to others in order to avoid similar situations in future.

Report:

On behalf of one of our member galvanizers, the Hot Dip Galvanizers Association was asked to inspect the hot dip galvanized coating on a number of street lighting poles for the N7 Potsdam Intersection in Cape Town.

The inspection and evaluation took place at a local galvanizer in late August 2005.

We report as follows:

According to the pole manufacturer, in addition to referring to the national general hot dip galvanizing specification (SANS 121), the client included reference to a Project Document and Deflection in accordance with SANS 0225:191. Copies of both documents were alleged to have been handed to all parties. Extracts of the Project Specification (highlighted) to be read in conjunction with the report (italics) have been included for the readers convenience.

Zinc spray paint used to repair weld slag.

Scuff marks as a result of insufficient dunage during transportation.

The correspondence from the specifier to the customer, requests that hot dip galvanizing conform to SANS 763.

"SABS 763, the original South African general hot dip galvanizing specification was withdrawn from circulation in May 2000 and subsequently was superseded by SABS ISO 1461. When the South African Bureau of Standards split their organisation into SABS (to control all mark schemes) and the South African National Standards – SANS, a new cover was added to the ISO 1461 and it was called SANS 121. SANS 763 does not exist. Co-incidentally for clarity and international recognition on all export orders, ISO 1461 should still be the reference specification for general hot dip galvanized coatings".

All material must be substantially free from white rust when delivered.

"Although the exclusion of white rust (wet storage stain) is possible by the galvanizer for aesthetic reasons, its presence in terms

of SANS 121, is not necessarily a reason for rejection.

Wet storage stain is formed on freshly galvanized surfaces, which are in close contact in the presence of moisture. Freshly galvanized coatings react with the environment until such time as a stable zinc carbonate film is formed on the coating surface. Wet storage stain ceases when the cause is eliminated. If the coating thickness at the affected area is equal to or greater than the minimum required by the specification, it is not a cause for rejection.

In order that the galvanizer exclude the incidence of wet storage stain at the time of delivery to site, extraneous measures may have to be implemented. These include, greater concentration of sodium di-chromate in the quench bath following the hot dip galvanizing stage. This increase in concentration may temporally result in a yellowish tinge to the coating, which in time, (2 to 3 months) will wash off.

Alternatively, the addition of a VCI (vapour corrosion inhibitor) in sachet form (when the components are packed inside containers) or the type used as a tape wrap, when packed in the open, may have to be included.

There was no white rust on the coatings inspected.

Close attention must be paid to the manner in which the material is stacked at the galvanizers works and during subsequent handling prior to delivery.

Albeit that the hot dip galvanized coating, which comprises a series of iron/zinc alloy layers (50 to 85% of the coating) is extremely abrasion resistant, special care should be exercised by the galvanizer, loader and transporter to eliminate potential mechanical / transport damage.

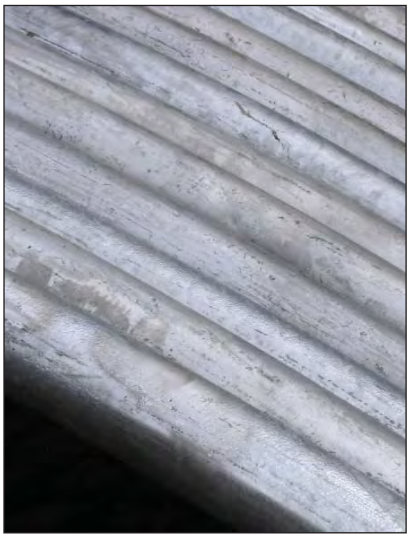
Unfortunately, all the main poles had already been stripped of zinc, before observation by the Association but the single and the Y- shaped arms were inspected. A number of these components showed mechanical damage of the coating and would have to be repaired (in conformance with SANS 121) or stripped and re-galvanized (as per agreement).

Most of the arms showed scuff marks and dirt, which in our opinion could easily be removed (see bottom photo on page 26).

The addition of adequate dunage, wrapping and correct strapping of the material prior to transportation, would have eliminated any surface discoloration and potential coating damage.

Notwithstanding the requirements of clause 5.2 of SANS 763, only poles having a bright galvanized finish will be accepted. Poles that exhibit discoloration after galvanizing will be rejected.

Clause 5.2 of SABS 763 deals with the determination of thickness of zinc coatings.



General appearance of the light arms.

Coating thickness readings taken on the lighting arms were in accordance with the specification.

As stated above, the bright hot dip galvanized finish is generally short lived due to the fact that once the coating is exposed to a normal environment; a matt grey zinc carbonate patina will naturally form. It is this matt grey patina that provides the maintenance free life that is associated with hot dip galvanized coatings. Should the supplier have had the required poles in stock they would have displayed a matt grey finish and would therefore be acceptable.

Coating discoloration on the surface caused by the presence of iron/zinc alloys in the coating are directly proportional to the chemical composition of the steel, with silicon and phosphorus playing the major roles. For this reason it is up to the manufacturer to ensure that the correct steel is used when manufacturing poles.

Apart from some mechanical damage, scuff marks and dirt, the arms that were inspected were a bright hot dip galvanized finish but this will be short lived as the coating is exposed to the natural atmosphere.

Painting as a remedial measure will not be accepted.

Does "painting" mean that no coating repairs will be acceptable or does the statement preclude zinc rich paint but allow zinc metal spraying or any other method to be used where repair is necessary?

Coating repair is allowable in terms of the specification, provided the area of repair is within the specification limits. Both zinc rich paint and zinc metal spraying is allowable.

This organisation together with a reputable paint manufacturer have developed a product primarily for coating repair based on a zinc rich epoxy. The product, called "Zincfix" is easily mixed and applied and generally matches the final zinc carbonate patina.

If all measures of coating repair are excluded, then considerable effort in terms of minimizing transport damage must be taken into account with suitable dunage and wrapping materials, particularly when goods are transported over long distances.

Several areas on both the single and the Y-arms were repaired using a zinc rich spray paint (*see top photo on page* 26).

Summary:

Hot dip galvanized coatings have over the past 50 years been successfully used in South Africa to prevent corrosion. The metallic coating acts first and foremost as a slowly corroding barrier, with a predictable service life and secondly, because zinc is electro-negative to carbon steel, it provides an effective long term sacrificial protection system when the barrier is broken. While zinc is present at damaged areas, corrosion creep (well known in paint coatings) is not possible.

Reference to the national general hot dip galvanizing specification is important but the inclusion of an accurate project specification, highlighting specific requirements is extremely useful, providing all parties have been notified of the document.

It is however, recommended that three items in the project document be improved for clarity. They are:

- Reference to the specification. Alter SANS 763 to SANS 121.
- *Only poles having a bright-galvanized finish will be accepted.* Erase this statement see above.
- *Poles that exhibit discoloration after galvanizing will be rejected.* Discoloration can be mis-construed as surface discoloration or discoloration as a result of excessive iron/zinc alloy growth. Should it be intended to be the latter, rather specify that a specific steel type, that is non-reactive, be used in the manufacture of all poles, or alternatively a maximum coating thickness.
- *Painting as a remedial measure will not be accepted.* Is coating damage not acceptable or is it the specific treatment of that repair that is not?

Potsdam N7 poles – hot dip galvanizing issues – final summary report by pole manufacturer.

50 Poles and outreaches for the N7 Potsdam Road were manufactured in Johannesburg and delivered to the site in Cape Town at the end of June 2005.

In August the manufacturer was officially informed by the customer that they were not satisfied with the standard of the hot dip galvanizing. A site visit was arranged and attended by various parties including the manufacturer and the galvanizer.

Some mechanical damage due to insufficient packaging.

The outcome of the visit was a total product rejection note from the specifier due to perceived hot dip galvanizing non-compliance.

In order not to delay the project any further at that stage, the galvanizer arranged to have the poles completely stripped and re-hot dip galvanized at a Cape Town galvanizer.

The whole order was subsequently hot dip galvanized and the poles straightened and the customer completed the project successfully.

The total cost of the stripping, re-hot dip galvanizing and straightening exercise was R46 360-00.

A few lessons were learnt from this exercise. The following facts are worth mentioning:

- From the SABS report it is clear that under normal circumstances only a few items would have to be stripped and re-hot dip galvanized. Under normal circumstances aesthetics do not justify outright rejection. The specification as per the specifier does however; differ from the normally accepted standard specification for these types of projects.

  In hindsight the manufacturer should have raised issues about any abnormalities in the specification at the original quotation stage.
- The Hot Dip Galvanizers Association report presents a number of valid technical guidelines for practical and good specification purposes. These guidelines should be noted and applied in future by all parties concerned. Where any further uncertainties exist these should be addressed to the Association.
- From the attached photographs of the pole arms the handling marks can be seen, which are as a result of forklift handling during loading or offloading and some rubbing during transport and stacking. The handling of the poles cannot be prevented, but special care can be taken to minimise handling marking. For these special projects the manufacturer will in future use a special packaging plastic sleeve on the poles and use additional dunage during transportation. This adds slightly to the cost but would improve the on site finish.
- Regarding the bright shinny finish, this cannot be guaranteed as this is not a long term or even medium term characteristic of the hot dip galvanized coating, as clearly explained by the Association. The project specification should take cognisance of this.
- Regarding the hot dip galvanized coating repair, if and when required within clear specification limits, we should take note of the Association's report guidelines on this.

Editorial Note:

Hot dip galvanizing has for many years provided cost effective corrosion protection and in the past applications, seldom used for its aesthetical appearance. Should the coating be required for corrosion protection and aesthetical appearance, then packaging by the galvanizer (which should only be removed after the wet trades have left the site), responsible stacking by the transporter both on the vehicle and at site (which ideally should be cleared prior to delivery of the articles) are the very minimum requirements for an acceptable coating. These requirements can be easily implemented, however, they must be communicated to all parties prior to tender, in order that all parties comply.

Why the HDGASA and SABS would like to ban the use of zinc and aluminium spray paint often used for coating repair purposes

Why the South African Bureau of Standards with the full support of the Hot Dip Galvanizers Association is considering the total banning of zinc and aluminium spray paints contained in aerosol spray cans, which are frequently used for touch up repairs to galvanized surfaces.

Coating repair by zinc or aluminium spray paint is often requested by the customer to hide small blemishes in the coating, which are generally acceptable in terms of the specification. Unfortunately, when one sprays, the fan area is most often far greater than that required to hide the blemish and furthermore, due to the colour variance between the spray paint and the oxidised hot dip galvanized coating colour, these repairs ultimately stick out like a sore thumb.

Adequate surface preparation is an essential prerequisite for the effective application and hence, ultimate performance of all protective coating systems.

The hot dip galvanizing process, as the name implies, entails total immersion in all the cleaning and pretreatment chemicals as well as in the molten zinc. The advantage of this chemical cleaning and coating method is that all steel surfaces become uniformly exposed to the pretreatment chemicals as well as to the molten zinc.

While chemical cleaning by immersion is a reliable and effective surface preparation method, there are occasions when localized tightly adhering mill scale or identification paint markings are not entirely removed by the cleaning acid. In the case of complex steel configurations, it is possible for air to become trapped in pockets where adequate venting and drainage holes have not been provided with the result that the cleaning chemicals do not wet the steel surface at these air pockets. A competent inline inspection will normally identify these localized defects and insist on additional cleaning prior to immersion in the molten zinc.

In the event that contaminated surfaces are not detected and rectified, the outcome will be uncoated areas where molten zinc has been unable to come into contact with masked steel surfaces in order to form the characteristic metallurgically bonded coating. This in itself is a favourable aspect of the hot dip galvanizing process in that, unlike a paint coating, surface contaminants which may lead to future corrosion cannot be overcoated and remain undetected. Another frequent cause of coating defects is damage due to rough and careless handling. Invariably in such cases, a portion of the Fe / Zn alloy layer of the coating remains intact but repairs are necessary in order to build up the overall coating thickness.

The original SABS 763 hot dip galvanizing specification provided clearly defined limits and procedures for rectifying coating defects. The galvanizer was restricted to using the zinc thermal spray method while either zinc thermal spraying or specifically, zinc rich epoxy paint could be used only for site repairs.

The more recent SANS 121 (ISO 1461) specification defines clearly the permissible size and number of defects that can be repaired as well as the coating thickness at repaired sites (30µm greater than that specified). This specification, however, does not restrict the use of paint to site repairs while at the same time; the paint requirement is loosely described as a "suitable zinc rich paint". Plainly this vague description is open to abuse in that no technical definition of what is meant by a suitable zinc rich paint is provided.

This has led to the promotion of easy to apply zinc containing paints which are dispensed from aerosol containing spray cans. Many of these cans display a label claiming a zinc content of 90% which, it would seem, refers to the purity of the Zinc particles and not the zinc content by mass. In fact at 90% zinc content by mass, it is probable that the dispensing nozzle on the can would soon become clogged with zinc particles.

The actual zinc content by mass of most of these products is less than

40% i.e. substantially lower than the generally accepted minimum of 80% zinc content supposedly required for effective sacrificial protection. Meanwhile, the specification does state that the paint that is used for repairs shall provide sacrificial protection.

A further problem associated with these zinc containing paints in spray cans is the difficulty experienced in achieving the specified dry film thickness. This necessitates the application of 5 or more coats, not to mention the protracted curing time between each application.

Zinc and aluminium paint products are often applied onto hot dip galvanized products merely to obscure defects and surface discolouration. Initially, these touched up areas may display the same silver luster of most freshly galvanized coatings. In time, the hot dip galvanized coating develops a dull grey appearance which is brought about by the desirable formation of the durable zinc carbonate surface film. The inevitable result is an overall dull grey coating interspersed with shiny silver patches where the level of long term corrosion protection is of a dubious nature.

"Zincfix", the well known zinc rich epoxy has been developed as a repair material which is user friendly and reliable in every respect. It is also designed to avoid the wasteful mixing of unnecessarily large quantities of expensive paint components when invariably the quantity required is small in the case of permissible repairs to a hot dip galvanized coating.

Meanwhile, at the instigation of the Association, a single pack zinc rich paint has been developed for repair purposes. Once a thorough testing and exposure programme has been satisfactorily completed, this product will be introduced to the market. The provision of a soldering stick for hot patching of small coating defects is also currently being investigated. In the past, soldering sticks were used for repair purposes but the relatively high temperature required to melt the zinc rich soldering material frequently resulted in damage to the surrounding coating at repair sites. This led to the undesirable use of low melting lead containing material which has little or no protective value.

As previously mentioned, a major cause of coating damage is rough handling. This frequently occurs during loading, off loading and inadequate provision of protective dunage during transportation. In the case of high rise masts used for electrical transmission lines, the cellular industry and for lighting purposes, coating damage is frequently encountered due to the use of lifting chains instead of soft nylon slings. This also applies during the erection of masts on site. An alternative solution could be the provision of strategically positioned lifting lugs which would facilitate the use of lifting hooks and if necessary chain slings during loading, off loading and erection.

A further significant factor which frequently contributes towards undesirable coating damage is a total disregard by some fabricators concerning the influence of undesirable levels of silicon and reactive quantities of phosphorus in some steels which are marketed at discounted prices and somewhat politely described as commercial grade material. Not only can this result in inordinately thick and brittle coatings but it is also the cause of unsightly dark grey and even black patches on the coating surface. This condition is exacerbated in the case of tubular mast sections where of necessity, steel surfaces are in contact with molten zinc for an extended period.

One has to question the wisdom of this "penny wise pound foolish" approach, which frequently results in costly site repairs and dissatisfied end users.

MISCONCEPTIONS

Miss Conception puts it "straight"

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

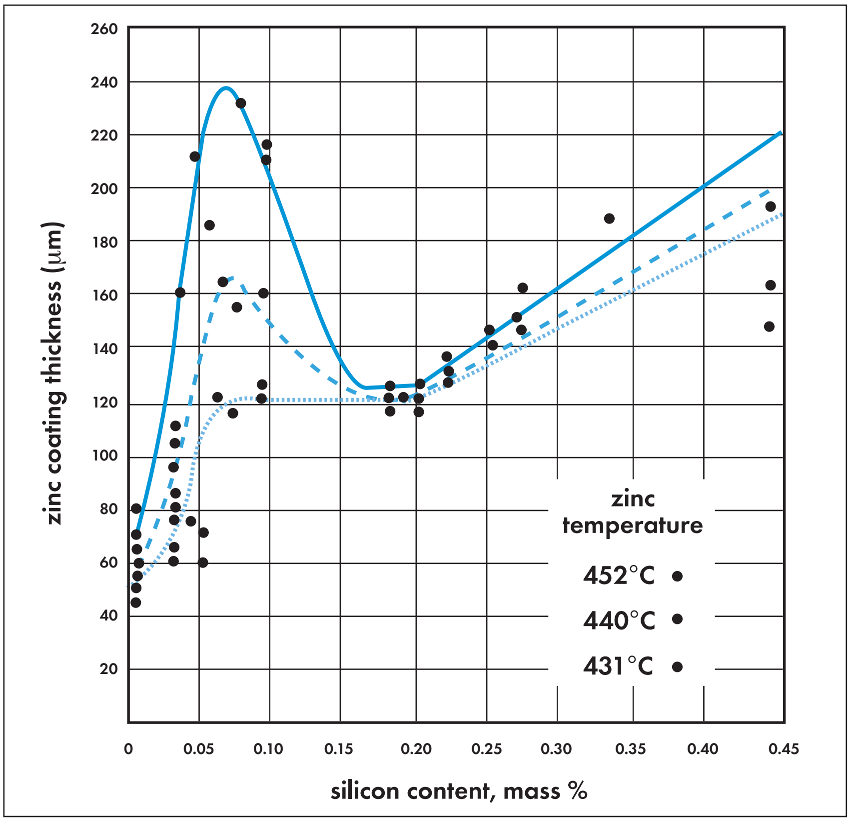
The chemical analysis of steel determines the extent to which the Fe / Zn alloy layers in a hot dip galvanized coating grow during immersion in the molten zinc.

It is the silicon content that determines the degree of alloy growth with all other elements playing an insignificant role. At levels up to about 0.04%, silicon has a negligible influence on the degree of coating growth which is parabolic with immersion time. At 0.08% Si, a level is reached where the Fe / Zn alloys grow profusely at a linear time rate. This can result in a dull grey coating with brittle tendencies and a rough surface finish.

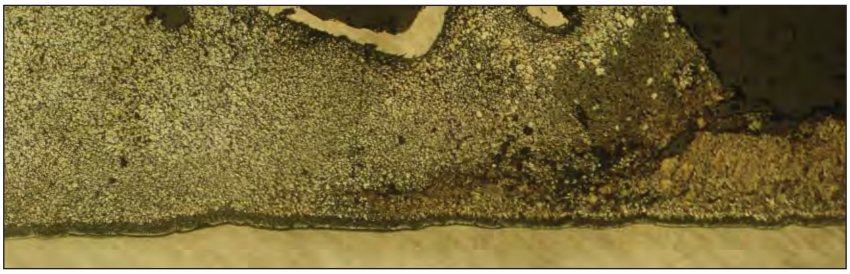
True or false?

There are four elements in steel that influence the metallurgical reaction between molten zinc and steel i.e. silicon, phosphorus and to a lesser degree carbon and manganese.

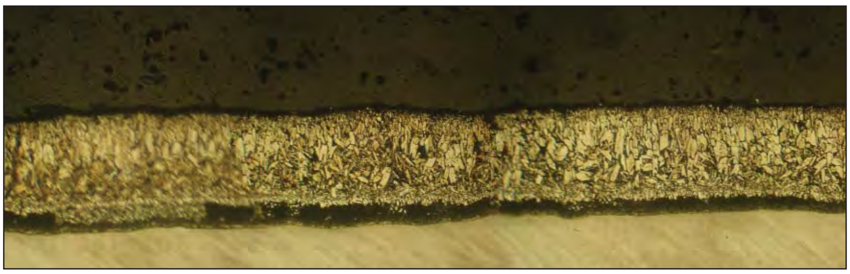
The influence of silicon is well documented and clearly depicted on the well known Sandelin Curve (see above) which indeed confirms a high degree of Fe / Zn alloy growth at a peak level of 0.08% followed by a decline from about 0.125% Si and a substantial increase once more above 0.25%. The influence of phosphorus is somewhat different. Up to 0.02% P; the influence on coating properties is negligible. At levels above 0.03%, however, the diffusion rate increases rapidly regardless of silicon content to the extent that, when a level of 0.05% is



Relationship between the silicon content of the steel and thickness of zinc coating for a similar dipping time at three different bath temperatures.



Heavy uneven hot dip galvanized layer on the pipe section.



Uniform hot dip galvanized layer on the clamp section. Note the defined crystal structures of the intermediate iron/zinc alloy layers.

Smooth appearance of the hot dip galvanized layer on the clamp section.

A close up showing the difference in surface appearance between the reactive and non-reactive steel after hot dip galvanizing.

Pimpled and rough appearance of the hot dip galvanized pipe section.

reached, the overall coating thickness can be as much as 500µm while adhesion to the steel substrate is virtually non-existent.

Fortunately, undesirably high levels of phosphorus are not encountered in structural steels which conform strictly to the relevant specifications but this problem is encountered with some cheaper so-called commercial grade steels which may be structurally acceptable but not necessarily suitable for hot dip galvanizing.

An interesting phenomena which is not always understood is the influence of a combination of relatively low silicon and phosphorus levels at which individually these elements would have little impact. This phenomena is referred to as the silicon equivalent where 2.5P + Si = Si equivalent, e.g. (0.02P x 2.5) + 0.03Si = 0.08 silicon equivalent.

In this example, the two elements individually have only a modest influence on alloy growth whereas when both are present in steel at these levels, the effect is the same as for silicon alone at 0.08% which is the first peak in the Sandelin curve.

It must be said that thick hot dip galvanized coatings provide a greater degree of protection from corrosion provided that the adhesion properties are satisfactory which is usually the case. The downside is the dull grey and frequently rough surface finish which aesthetically is undesirable in applications such as architectural features.

The hot dip galvanized clamping pipe.

Personality Profile

Tom Edwards – retired

On the day we spoke to Tom Edwards at his home at Alt Kroendal outside Rustenberg, the first soaking rains of summer were falling gently on the gardens and the fields surrounding this peaceful Lutheran old age home. Tom lives in his own self-contained cottage on the estate, on his own now since his wife Pat passed away two years ago. However, he's still an active member of the community, plays chess with his neighbour, and attends meetings of the Corrosion Institute and the Oil and Colour Chemists Association both of which he is a member.

Tom Edwards was born on August 8th, 1914, in Australia. He obtained a degree in science at Sydney University in 1935 and then joined the Australian Air Force as a technical officer for a short time. However, wanting to make use of his science degree, he took up a job as chief chemist with the company British Australian Lead Manufacturers (BALM) and moved to Adelaide. His task was to prepare formulations, keep an eye on quality control and run tests.

Prepared paints were a novelty back then, and Tom was starting in his career at a time when they were just beginning to gain in popularity. Up until then, customers would buy coloured paint powders and have them mixed with boiled linseed in a drum. The base of the powder was made from white lead, which was obtained by stacking pots containing lead blocks between layers of bark or manure and allowing the fermenting process to corrode the lead and turn it into a powder.

BALM Paints, as the company became known, obtained a licence from Dupont to produce Dulux as a ready-mixed paint. Back in the late 1920's Dupont had bought the patent from Carruthers for the development of alkyd resins. But with the advent of factory produced motor cars, a paint was needed that would be quick-drying and weather resistant. The varnish makers with their oils and gums were now being replaced by young chemists such as Tom Edwards.

It was discovered that gun cotton (in essence, nitro cellulose), when dissolved in solvents could be turned into a lacquer base suitable for paints for the motor industry. There were large stocks of this gun cotton which had been left over from World War 1 and so production was cheap and plentiful. However, only grey and black were truly colour-fast, which gave rise to the famous quote attributed to Henry Ford, "You can have any colour you like as long as it's black"!

Tom stayed with BALM until the outbreak of World War 2. He was not obliged to join up, as he was considered to be working in a reserved profession, but after the fall of France in 1941, Tom volunteered for the AAF again. He trained as a

navigator and was due to be sent to England when the Japanese threat to Australia become serious. In February 1942 the Japanese bombed Darwin and Tom was posted up there with a flight of Lockheed Hudson bombers to fly patrols and drop supplies on Australian-protected Timor.

At the end of his first tour, he was finally sent to England to do a specialist navigation course. It was here that he met his wife Pat, a young Irish WAAF working as a cipher officer. Tom travelled all over Britain visiting RAF establishments, radar posts and coastal and bomber commands. After 11 months he returned to Australia via the USA where he also visited naval and radar research stations. Back in Brisbane, Tom joined the operational headquarters under the command of General Macarthur where he stayed until the end of the war.

In 1945 Tom Edwards accepted a job with the British Colonial Office for a capital expansion programme in Nigeria, involving corrosion control. He stayed for two terms of 18 months, in order to get the work done. Getting products specified, accepted, ordered and sent out from the UK was very time-consuming, but Tom used his time and contacts well. He saw most of the representatives of paint manufacturers that came to Lagos, and he pushed for ready-mixed paints to be specified on all jobs. One episode he remembers as illustrating the need for ready-mix as opposed to the old linseed-based paints, took place in the Niger Delta. He was receiving complaints from this region that the paints were not drying properly and that fungus was even growing in the tins of paint. Upon investigation when he visited the region, he discovered that the local people were pouring the linseed off the top of the tins and using it as an alternative source of oil to lend a bit of variety to their bland diet! Tom also recalls being invited out to dinner by the representative of the Atlas Paint Company, a Mr. Dennis Thatcher, who insisted that Tom should come and dine with him and his wife Maggie whenever he found himself in London.

At the end of his term in Nigeria, Tom flew to Durban for an interview with Louis Berger Paints. This was in 1948 and Tom has been living and working in South Africa ever since. Louis Berger Paints had a manufacturing agreement with AECI at the time, but eventually the two companies merged to form AECI Paints, which later became Dulux and finally Prolux, when they became part of Protea Holdings. Tom came to have a special interest in corrosion protection after his time in Lagos and he established the Heavy Duty Corrosion Division of Dulux and became a founding member of the SA Corrosion Council, later the Corrosion Institute of South Africa.

When asked his opinion of inorganic zinc-based paints versus hot dip galvanizing, Tom said, “Both have their appropriate uses. There are cases where one is indicated and not the other, depending on the conditions and circumstances”.

He added, “Painting over galvanizing is simple now, with the development in paint formulations”.

Tom finally retired in 1981. Apart from his activities in Rustenberg and with the associations, he also travels to visit one of his sons in London, a daughter in San Antonio, America and a sister in Australia. He is proof that an active interest in technology and family can keep one going well beyond retirement age.

Walter's Corner

The atmospheric corrosion rate is not always what it seems to be!

I recently received a request from Europe for information regarding the durability of a hot dip galvanized coating in a Middle East desert environment. There is of course no single answer to this question since the atmospheric corrosion levels can vary substantially in arid areas as in other regions.

The generally accepted depletion rate of 0.03µm / year for a hot dip galvanized coating in desert conditions is no doubt reliable but to generalise can be highly misleading since the atmospheric corrosion rate can vary substantially from one site to another even over short distances and this also applies to desert regions.

Factors, which determine corrosivity levels, include humidity, wind direction, land contours, proximity to the sea and industrial pollution in the form of emissions of S02 into the atmosphere. A combination of chlorides and sulphur dioxide will of course increase the propensity for corrosion.

At higher atmospheric temperatures corrosion rates increase while extreme temperature fluctuations over a 24-hour period can result in condensation. This is demonstrated by the presence of ground frost on cold highveld winter mornings even when relative humidity levels are below twenty but the dew point is reached at ground level. If corrosive substances are present in the atmosphere, condensate deposited on steel will accumulate and cause corrosion.

Extended exposure to moist or wet conditions increases the degree of corrosion but a cause of aggressive corrosion in some arid regions is the absence of the washing effect provided by good rainfall.

In southern Africa, we have a vast variety of conditions both natural and some linked to industrial activity which provide a fascinating environmental study of corrosion.

The coast of Namibia, which borders on the Atlantic Ocean is mainly desert with no vegetation, only shifting sand dunes. The cold Benguela current, which flows along this coastline, results in mists, which contain chlorides, stretching up to 30km inland, hence the corrosion rate in this mist belt is significant. In the vicinity of Walvis Bay a natural emission of hydrogen sulphide from the seabed has an exacerbating influence in that dilute sulphurous acid is deposited onto steel structures. The annual rainfall is about 20mm (virtually no washing effect).

We have contrasting corrosion rates from one side of the Cape Peninsular to the other. At Cape Town Harbour the on-shore north-westerly winds are associated with rain

whereas in False Bay, the on-shore south-easterly winds are dry (no washing effect) with the result that corrosion rates in the vicinity of False Bay are substantially higher than on the other side of the Peninsular in Cape Town, where in the vicinity of Cape Town Harbour a hot dip galvanized coating is attacked at less than 4µm / year, compared to about 20µm / year in the spray zone from Muizenburg to Glencairn Beach. Further down the False Bay coastline at Simons Town, a hot dip galvanized coating is attacked to a far lesser degree (probably less than 4µm/annum) this is due to the land contours, which reduce the intensity of the chloride containing south-easterly winds.

The CSIR have categorized the Cape Town peninsula with a C4 / C5 corrosivity classification, which is accorded an overall zinc coating loss rate of 2 - 30µm/annum. "Normal" unprotected steel corrodes at a rate of 20 - 300µm/annum. The rate range reflects peculiarities of specific exposure sites. (Refer also to corrosivity categories in ISO 9223).

An interesting exception to the general atmospheric corrosion pattern along the peninsula coastline can be found in the vicinity of Chapman's Peak. This local coastline is west facing and as such is exposed to the north-westerly rain bearing winds, which in theory should provide a desirable washing effect. Across the bay from Chapman's Peak, the Sentinal Peak and its associated range do not shelter the coastline in the vicinity of Chapman's Peak but rather the north-westerly winds are deflected onto the cliff face. This results in severe wave action at the base of the cliff. Salt-laden spray is swept up the face of the cliff, thus the rain-washing effect associated with the north-westerly winds is considerably negated. Under these conditions, the C5 corrosivity classification, which entails a zinc coating loss of 15 - 30µm/annum, is probably applicable.

This micro environmental pattern is also reflected in the somewhat different vegetation when compared with surrounding areas, for a distance of about 1km along the main road in the vicinity of Chapman's Peak.

Another interesting situation is observed on the Durban Bluff where a corrosion rate for zinc is said to be 8 microns per year due to high chloride levels in the humid air driven inland by the onshore winds. On the landward side of the Bluff and close by, there are two oil refineries where large quantities of hot dip galvanized steel are in service. Our estimates suggest that the corrosion rate of a hot dip galvanized coating at these refineries is no more than 2.5µm / year despite some industrial atmospheric pollution. Here the annual rainfall is high.

Where the atmospheric corrosion rate of zinc in the form of a hot dip galvanized coating will exceed about 10µm / year, and a maintenance free life of twenty years or more is required for structural steel, additional barrier protection by means of an appropriate paint coating has proved to be singularly successful, even in contrasting aggressive environments such as those encountered in the vicinity of Walvis Bay and False Bay. Similar favourable duplex protection results are achieved in areas where industrial atmospheric pollution is high.

The mechanism whereby a hot dip galvanized coating combined with an appropriate paint system provide outstanding corrosion control is very often ignored. This can lead to suspect decisions by specifiers, whereas the concept of duplex protection is based on technical facts and substantiated by proven track records.

The Association would like to acknowledge the advertisers and thank them for their support

Guest Writer

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

Exploiting opportunities in a flat world

Thomas Friedman, the multi-award winning columnist of the New York Times, believes the world is flat. No, he doesn't promote the Flat Earth Society but in his new book, The World is Flat, uses this metaphor to show how globalization has leveled the playing fields in terms of international trade and cultural exchanges. Rapidly accelerating advances in information and communication technology, highly efficient transport systems, and the new interdependence of countries, has transformed our world into a global village. At the dawn of the twenty-first century, we seriously need to understand what our role, and that of our government, business and society, will be to adapt to the flattened world.

Whatever we believe about globalization, and there are some who think it just about big business getter bigger, globalization encourages the human values of creativity and freedom. In the age of the Internet, individuals have increasing opportunities to compete on the global stage. Just as the advent of the printing press enabled large numbers of people to more actively participate in the affairs of the day, so to will evolving communications technologies and the Internet allow people to become more active decision makers about their own lives, as well as having greater influence on their work environments.

In the 1990's, when globalization was first beginning to impact on the world, the call was: "think globally and act locally". Now, when globalization is not just a possibility but a reality, the call should perhaps be: "act globally and act locally" – there's no time left for thinking, we need to act or we'll be flattened by the flat world.

Globalization and communication technology allow us as individuals, as a business or as a country, to work and compete anywhere we want to – there are no restrictions: only what we can do and when we can do it are important. If the thing we can do is better or cheaper than anything else, there should be no reason why we can't do or sell this thing anywhere where someone wants it. But, if we want to compete, we will have to market or do it by means of modern technology. You need a Formula 1 car to take part in a Formula 1 race. We very quickly need to become proficient in all existing technology and to keep up to date with advancements, which don't come about anymore after a couple of years or so, but are more like monthly or even weekly.

But, you must be careful what you want to do or sell. People who just make physical goods will not do as well as people who develop or sell new ideas. If you sell a slab of steel, or a bar of gold or platinum, you will not do as well as the person who has sold an idea for converting steel into something novel or the gold and platinum into unique pieces of jewelry. There is a big difference between idea-based goods and physical goods. Physical goods can have decreasing markets whereas markets for idea-based goods can be exponential. If you come up with the next Windows or Viagra, you can potentially sell one to everyone in the world. Through technology, idea-based products can be sold to everyone in the global market at once and kept on selling until a new idea comes up.

Ideas come from knowledge and this is what the flat world is all about – finding, creating, sharing and using knowledge. We need to become, produce and develop knowledge workers. In our current environment there are only so many factory jobs available that contributes to unemployment. There should, however, be no limit on the number of idea-generated jobs and a potential for employment for all.

If we believe that creativity has no limits and we have motivation and freedom to create, we will have no problems in adapting to the flat world. If we believe that human wants and needs are infinite, there are infinite ideas to be exploited, infinite jobs to be done. The only limiting factor is our imagination.

The Hot Dip Galvanizing Conference – review

The conference was attended by 90 delegates. The motivation behind the conference was to share global industry developments and address these developments for the local market. Great emphasis was placed on hot dip galvanizing alloys now commonly used overseas. Increased local usage of these alloys can help the galvanizer to cope with variable steel quality, improve coating consistency and more importantly, appearance. Several international and local speakers on day 1 addressed the use of alloys, good pre-treatment control, kettle heating and a range of environmental issues.

Day 2 covered perceptions of the fabricators and end users of the galvanizers. These presentations generated much heated debate but the need to engage all the stakeholders more frequently is apparent.

The need for the galvanizer to become part of the overall team through the development of partnerships in any undertaking was highlighted.

The initial objectives of enhancing the long-term sustainability of the industry through technology and the need of the user industry to engage the galvanizing industry appear to have been met.

For more information contact HDGASA.

Hot dip galvanizing errors in the "Red Book"

Whilst mindful of the enormous task our sister organisation the SAISC had in updating the "Red Book", while still successfully running the organisation to the inordinately high expectations of members, the appearance of a few errors and omissions after publication, is then reasonably acceptable. However, these errors and omissions are on the subject of hot dip galvanizing and we discuss these in this article.

Following some major altercations in the market several years ago, with a zinc rich paint product, impersonating our coating with major hassles in the market, we were advised to use the term, "Hot dip galvanizing" in all of our publications. This naming sets us aside from the "cold galvs, pre-galvs, electro-galvs", etc.

Also the word hot-dip galvanize, with a hyphen is unnecessary and in all the new national and international specifications where hot dip galvanizing is referred, the hyphen has been eliminated.

Furthermore, the terminology, "Hot dipped galvanized steel" is also unnecessary and should be only hot dip galvanized steel.

On page 2.12 "Steel can be .....etc., should be applied to achieve good quality coatings, **eliminate potential explosions in the process** (#1) and also to reduce costs.

To obtain an aesthetically pleasing..... (rather use): **"To obtain an aesthetically pleasing hot dip galvanized finish is a function of appropriate steel design, good fabrication and correct steel chemical composition. The latter emcompasses the amount of Silicon (Si) and/or Phosphorus (P). For industrial/mining purposes, the Si should be 0.125 to 0.30% with P equal or less than 0.02%.**

For architectural purposes, the Si should be 0.03% with P a max of 0.01% or alternatively, Si should be 0.15 to 0.25% with P equal or less than 0.02%". (#2)

The reason for the alternative in terms of architectural hot dip galvanizing is the **Silicon Equivalent**, *see "Misconceptions"*.

Chapter 6. pg 6.18. De-embrittlement. Following electroplating **(erase "or hot dip galvanizing").**

For hot dip galvanized Class 10.9 fasteners... Annex B of SANS 10094. Add – **Hot dip galvanized Class 10.9 fasteners do not have to be de-embrittled.**

Also in Figure 2.1 the table refers to **"Galvanising" and also the position is set at about 460 to 470 degrees C, whereas hot dip galvanizing in SA seldomly exceeds 450 degrees C.**

***Editors note*:**

#1 *Following an explosion at a galvanizer last year where appropriate vent holes were overlooked, resulting in the deaths of two galvanizers, extensive damage to the plant, closing of the plant for a number of months leading to huge financial losses to the owners – the suggested statement in our opinion would seem appropriate.*

#2 *Whilst mindful of the two steel producer's constraints in conforming to this requirement from a production perspective, the pre-ordering of a specific steel with the correct chemical analysis can be achieved, providing it is specified.*

Electrical transmission towers

The application

Over the past 50 years, Eskom transmission towers have been hot dip galvanized for corrosion control purposes. These tower pylons are situated throughout the country and are therefore subjected to the full spectrum of environmental and climatic conditions. The application and use, by Eskom, of hot dip galvanizing to provide corrosion control of this National asset, is testimony to the corrosion protective properties of this type of coating.

Environmental conditions

South Africa is known for its many severe corrosive atmospheric conditions. These environmental conditions are not only restricted to the coastal regions, but include many inland industrial areas as well. Environmental conditions range from benign rural areas to severe marine and industrial sites. Atmospheric corrosive environments are broadly classified in terms of ISO 9223, which are similar to ISO 12944 and ISO 14713.

The site

As indicated the sites range across the full spectrum of climatic conditions. We shall therefore restrict this case study to three sites, ranging from a benign condition, an inland industrial and a severe marine coastal environment.

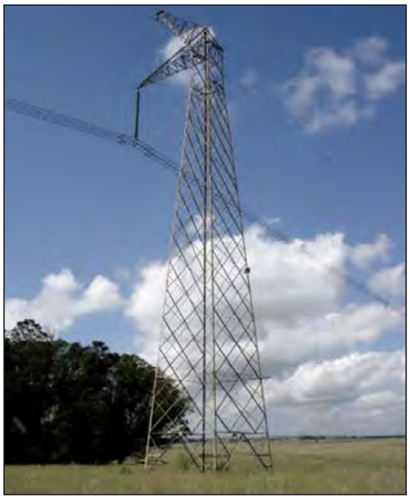
Site No. 1

- Relatively Benign Conditions.
- 53kV DC line from Cabora Basa to Eskom's Apollo Sub-Station South of Pretoria installed 1973.

Site No. 2

- Inland Industrial site selected for its relatively severe corrosive conditions. This site is located within Germiston Industrial area.
- The specific tower is believed to have been in service for the past 40 years.

53kV DC line from Cahora Basa to Eskom's Apollo sub-station south of Pretoria.



Relatively benign conditions.

Severe marine coastal conditions. Buffalo-Port Rex Transmission line situated in East London. At the time of the coating inspection, the towers had been in service for about 25 years.

Inland industrial site selected for its relatively severe corrosive conditions. This site is located within Germiston Industrial area. The specific tower is believed to have been in service for the past 50 years.

Site No. 3

- Severe Marine Coastal Conditions
- Buffalo-Port Rex Transmission Line situated in East London. At the time of the inspection, the towers had been in service for 25 years.

The site selected for the severe marine conditions consists of transmission towers on the Buffalo-Port Rex Transmission Lines situated in East London. We acknowledge and thank Eskom for allowing us the use of their inspection report relating to this particular installation.

Our findings

Site No. 1

After removing the "apparent" rust discolouration, the underlying zinc hot dip galvanized coating measured

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65.4mm. Accuracy of the instrument is approximately 5%.

Site No.2

After the removal of the discolouration, i.e. corrosion products, a measurement of the remaining hot dip galvanized coating revealed 119mm.

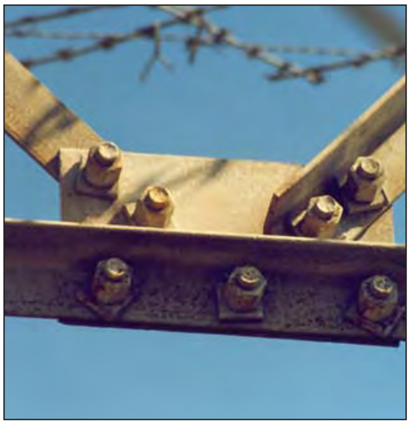
Site No.3

General condition of the tower after 25 years of service, was found to be such that an over coating of a paint system was recommended in order to extend the service life of the structure.

The tower that was inspected is situated approximately 3km from the ocean next to the Buffalo River salt-water estuary, as well as alongside a city dump. At the time of the inspection the tower had been in service for 25 years. The initial corrosion protection comprised hot dip galvanizing and had never been over coated with an organic coating system. Severe corrosion with subsequent metal loss was observed on some of the structural members. In one isolated instance the degree of metal loss was so severe that it had resulted in the perforation of the member. The nuts and bolts of these corroded members were also severely rusted. The most severe corrosion was mainly located on the inner surfaces of the members. The members that showed severe signs of corrosion were either perforated or the degree of metal loss was in the 1 to 2mm range. The outer surfaces of these members were only superficially corroded and the hot dip galvanized thickness readings ranged from 87 and 104μm.

Site No 1. – After removing the "apparent" rust discoloration, the underlying hot dip galvanized coating measured 65,4μm. Accuracy of the instrument is approximately 5%.

Site No 2. After the removal of the discoloration, i.e. corrosion products, the hot dip galvanized coating thickness measured to be 119μm.



Site No 3. General condition of the tower after 25 years of service. A subsequent paint coating (providing a duplex coating system), has been recommended in order to extend the life of the structure.

Conclusion

The information gained from inspections of transmission towers is very useful in that it allows us to study the effects of corrosion and the protective qualities of hot dip galvanized steel, across the full spectrum of environmental conditions knowing the years of service. Service life of a steel structure depends on two fundamentals, viz, type and quality of the protective coating and environmental conditions in which the structure is located.

Hot dip galvanized structures have been shown to exhibit outstanding performance over the full spectrum of environmental conditions. Where severe environmental conditions are encountered, Duplex coatings (hot dip galvanizing plus a top paint coating) should be considered.

HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA

"Make a lasting investment, hot dip galvanize it"

2006 CALL FOR ENTRIES
HOT DIP GALVANIZING AWARDS

HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA — Eskom

OBJECTIVE

To recognise and promote the development, application and use of hot dip galvanizing and related technology for corrosion protection purposes.

CATEGORIES

- Vintage
- Duplex Coating Systems
- Mining and Industrial
- Architectural
- Research & Development and Innovation
- Export

Vintage:

Long-term, maintenance free corrosion protection of hot dip galvanized and/or duplex coating applications that are 10 years or older.

Duplex Coating Systems:

Hot dip galvanizing plus an appropriate paint system, suited to the environment, aimed at longevity and/or aesthetics.

Research and Development and Innovation:

This category recognises research & development and innovative work carried out by galvanizers, universities, technikons, professional institutions and end users. For example

- Where a significant contribution has been made to expand the knowledge of the hot dip galvanizing process.
- Where the characteristics of the zinc coating or the application of the coating has been considerably improved.
- Where innovative design or novel process or procedure has been facilitated to improve the coating.
- Where in a specific application, the concept of hot dip galvanizing or a duplex system has made a newly developed product or project unique

MATERIAL TO BE SUBMITTED

NB: Technical information is extremely important. Motivation, numbers and facts will assist with the adjudication.

Submissions shall include a minimum of 5 full colour photographs. If digital photographs are to be supplied, please ensure that they are taken at 300 dpi for reproduction purposes.

Kindly ensure that electronic copies of the digital photographs are supplied on CD with entry.

The motivation shall include:

- Name of product / project
- Description of product / project
- Application
- Location
- All project partners (spelling accuracy is important)
- Quantity of steel hot dip galvanized or duplex coated
- Inception / commissioning date
- Value
- Future potential, etc.

Kindly contact the Association for further details at (011) 456-7960 or hdgasa@icon.co.za

CLOSING DATE FOR SUBMISSIONS IS 31 MAY 2006

CONDITIONS OF ENTRY

Submission to be completed according to template (available on website or on request)
Submissions that have not covered the prompts in this template, may not be considered by the Judging panel.

The judging panel will, at its discretion, change the category of the entry where it deems such a change would benefit the applicant and where it maximises the value of the award to the industry in general.

Only new submissions will be accepted, other than previous projects now qualifying for the Vintage category.

At the discretion of the judges the overall winner will not necessarily be a winner of one of the individual categories.

The product or project must be complete before being submitted.

All entries must be submitted to the Hot Dip Galvanizers Association, Unit U4 (Upper level), Quality House, St Christopher Rd, St Andrews, Bedfordview, Johannesburg, on or before 31 May 2006.

The Judges decision is final and no correspondence will be entered into.

By submission of an entry, the nominator assumes responsibility for the accuracy of all information, and provides the HDGASA with assurance that permission has been obtained from the developer / owner.

The professional standard of the submissions form an integral part of the judging criteria.

HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA

"Make a lasting investment, hot dip galvanize it"

2006 CALL FOR ENTRIES
HOT DIP GALVANIZING AWARDS

ENTRY FORM 2006

I hereby submit the following project thereby accepting the conditions of entry as detailed in this document.

Project Name:

Your Name:

Company:

Postal Address:

Tel Number:

Fax Number:

Email:

Signature:

Date:

THE JOINT WINNERS OF THE WGS BARNETT TROPHY WERE MTN HEADQUARTERS AND THE KFP TREAD STEER BOGIE

PROJECT TEAM

Developer / Owner

Contact Name:

Tel Number:

Architect

Contact Name:

Tel Number:

Specifier

Contact Name:

Tel Number:

Project Manager

Contact Name:

Tel Number:

Main Contractor

Contact Name:

Tel Number:

Other

Contact Name:

Tel Number:

Hot Dip Galvanizer

Contact Name:

Tel Number:

HOT DIP GALVANIZERS ASSOCIATION SOUTHERN AFRICA

"Make a lasting investment, hot dip galvanize it"

ERRATUM –

HISTORY OF HOT DIP GALVANIZING IN SOUTH AFRICA:

THE FIRST GENERAL HOT DIP GALVANIZING OPERATION IN SOUTH AFRICA

In Hot Dip Galvanizing Today No. 24, we published an article regarding the History of Hot Dip Galvanizing and more specifically "The first general hot dip galvanizing operation in South Africa".

Subsequent to the printing of that article, it has come to our notice via an article in a book published in 1965 by the Port Elizabeth Regional Chamber of Commerce & Industry (PERCCI), on the occasion of their centenary year, that the Crittall-Hope Group of companies established a general hot dip galvanizing operation in Port Elizabeth in 1948.

This is clearly two years prior to the said oldest plant, which was started in Industries West, Johannesburg.

WE APOLOGISE FOR OUR OVERSIGHT.

HOT DIP GALVANIZERS ASSOCIATION

ANNUAL GOLF TOURNAMENT

The Association has arranged a Golf Day for members of the Association, their customers, suppliers to our industry, specifiers, consultants and architects to be held on Thursday 23rd March 2006 at the Royal Johannesburg & Kensington Golf Club, East Course.

For further information please contact Saskia on (011) 456-7960

The Association would like to acknowledge the following sponsors of the Information Disc and thank them for their support

Further sponsors of the Information Disc

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