2008 Volume 5 Issue 1

HOT DIP GALVANIZING TODAY

HOT DIP GALVANIZERS ASSOCIATION Southern Africa

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Featuring:

The world of hot dip galvanizing around us

Duplex coatings, coating report and galvanizing failures

Snap shot of the 2007 Eskom Awards Evening and 'Call for Nominations' for the 2008 Awards event

2008 Galvanizing Conference

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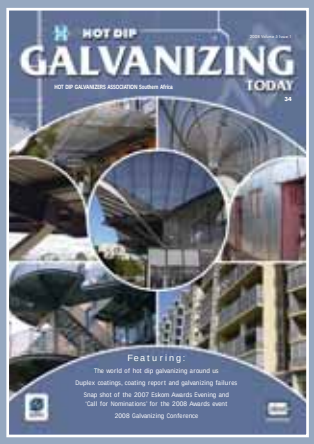

The Association is a technical information centre established for the benefit of specifiers, consultants, end users and its members

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

Office Manager
Saskia Salvatori:
Email: hdgasa@icon.co.za

Receptionist
Email: info@hdgasa.org.za

Executive Director
Bob Wilmot:
Cell: 082 325 8840
Email: bob@hdgasa.org.za

Editor and Technical Marketing Director
Terry Smith:
Tel: (021) 761 9496
Tel: (021) 797 4735 (From 1 April 2008)
Fax: 086 612 7284
Cell: 082 893 3911
Email: terry@hdgasa.org.za

Sub-Editor, Advertising and Sales:
Anne van Vliet
Tel: (011) 462-5073
Cell: 082 775 0711
Email: mwvliet@mweb.co.za

Design and Layout:
Sandra Addinall
Tel: (011) 868-3408
Fax: (011) 900-1922
Email: cbtdesign@adcot.co.za

Reproduction and Printing:
Camera Press
Tel: (011) 334-3815
Fax: (011) 334-3912
Email: cpress@iafrica.com

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Front Cover: *A kaleidoscope of photographs showing the use of hot dip galvanizing on some buildings, a pedestrian bridge and a low cost housing project.*

Hot Dip Galvanizing – Adding value to Steel

Executive Director's Comment

By the time our journal readership read these few comments we will be well into 2008. As we consider the next twelve months, we are aware of numerous challenges facing our membership as well as the broader corrosion control industry. In unison with the rest of South Africa, we have serious concerns relating to energy constraints, availability of various construction materials and the resulting decline in the growth rate. Energy, construction materials and skilled manpower are in short supply, becoming ever more expensive and as such these factors have the potential to restrict future development and growth. However, we believe that the increase in demand for hot dip galvanized steel that we have experienced over the past 18 months, will continue and generate a high degree of electric excitement and galvanize our Association's activities.

When reviewing the above scenario, it follows that we need to implement programmes to effectively use these critical resources. It is incumbent on all our industries, to better utilise and control our manufacturing processes as well as the appropriate deployment of the products that we produce.

Our industry, being part of the broader corrosion control industry, is positioned to support projects where service life, economics and sustainable development are important criteria. Association case studies, life cycle cost investigations and the application of appropriate balanced designs, hot dip galvanized steel, being a "material of construction" and not just another coating, offers our developing industrial society, long term performance and economic solutions coupled with efficient utilisation of scarce resources.

Association member galvanizers have been requested to investigate and implement thermal efficiencies of their process facilities with specific emphasis on furnace designs and related insulation.

In terms of the developing industrial market, hot dip galvanized steel offers property owners, developers and engineers a material of construction that offers longevity, speed of installation and cost effective solutions within the constraints that we will face during the course of 2008.

Bob Wilmot

Note from the Editor

While continuously hot dip galvanized sheeting (CHDGS) has its place in the market and is most times superior to the complexity of painting an awkward shape such as lipped channel purlins for buildings, specifiers must be aware of the coating's limitations. A Z275 class of coating equals a nominal coating thickness of 20µm whereas a 2.5mm thick cold rolled purlin, hot dip galvanized in the general manner, will result in a coating thickness of 55 to 70µm. As life is proportional to thickness, it stands to reason that the latter will out perform the former by 3 to 4 times. Due to lack of identification of the specified class of coating of the CHDGS on site, a Z60, providing a 4µm coating thickness, could quite easily be delivered and accepted by those on site!

Generally hot dip galvanized components should therefore be used in more aggressive and exterior conditions to achieve a reasonable service free life. To this end we will soon be instituting a labelling system, identifying purlins and other components that have been hot dip galvanized by the general method, SANS 121.

Similarly, making use of zinc-electroplated fasteners instead of the equivalent hot dip galvanized in moderate to aggressive environments, in my opinion is irresponsible on behalf of the specifier/buyer.

We again extend an invitation to asset owners to allow Association staff to evaluate and report on the durability of an exposed and weathered hot dip galvanized or duplex coated component that is 10 years or older. The contribution may be entered in our annual awards event or as a case history and be published in the magazine.

Should a reader wish to participate in this programme, kindly contact the Association.

The Association has now been operating out of premises in Cape Town since the beginning of August and over and above my cellular phone and email address, we now have a contact landline telephone and fax facility. *See contents page.*

Our feature for this issue is "The world of hot dip galvanizing around us", with contributions from Australia and the United States of America.

The Awards Event is re-launched to add excitement and make it easier to enter by those who wish to participate.

Under Duplex Coatings, Mike Book of Duplex Coatings discusses methods of preparing hot dip galvanizing for painting.

Education and Training, expands on our certificated coating inspectors course, an essential requirement in any coating inspectors portfolio.

The Coating Report discusses the effects of insulating wires on hot dip galvanized purlins at Cranston College in KZN.

Galvanizing Failures addresses the failure of hot dip galvanizing on the inside of a centre pivot pipe system at Komatipoort.

Other regular articles include Misconceptions, where she suggests that all protective coatings that are thin and have discontinuities will fail in all but benign environments. Walter's Corner discusses the diversity of zinc.

Bob Andrew has qualified for his own column, called Bob's Banter and he discusses teamwork does not have to be an illusion.

Our Guest Writer, for this edition is Russell Thompson of Physmet and he presents us with an article "The pool guy".

Our Personality Profile is Mokena Makeka an entrepreneur extraordinaire.

Should a reader wish to express an opinion or provide us with an article, kindly contact me – enjoy the magazinc.

Terry Smith

2008 Hot Dip Galvanizing Awards Evening

CALL FOR NOMINATIONS

Information on Revised Process

The objective of the Hot Dip Galvanizing Awards is to recognise and promote the development, application and use of hot dip galvanizing and related technology for corrosion protection purposes.

In order to address the question of awarding excellence vs. mediocrity and to achieve the objective of the annual Awards event, the submission process has been amended and simplified. The Association is aware that time has become a precious commodity to most people and finding the time to submit an entry in the annual Hot Dip Galvanizing Awards event is something most people put off for tomorrow!

Furthermore it is felt that the hot dip galvanizing industry has not been doing itself justice with limited submissions and lack of technical information being supplied. At a recent Executive meeting, we looked at ways to improve the assessment process and how to move away from this event being a competition between industry players to recognition by industry peers, based on technical merit and contribution to purpose.

THE SIMPLIFIED SUBMISSION PROCESS FOR 2008 IS AS FOLLOWS:

1. Call for Nominations (deadline date 18 April 2008):
   a. Nomination form to be completed and submitted to HDGASA by nominator by the 18th April 2008
   b. Nomination forms are available on the Awards website (www.2008hotdipgalvanizingawards.co.za)
   c. Peers, technical specialists, industry and customers are invited to nominate a project / product or process
2. Screen Possible Projects for Consideration:
   a. The projects nominated will be screened and suitable categories will be established
3. Nominated Projects are then visited by HDGASA Technical Staff Member, Assessor Panel Member and Nominator.
4. Draft Documentation prepared by HDGASA Staff Member (30 May 2008). This documentation will be reviewed by the project owner and nominator.
5. Document Prepared and made available on Website (13 June 2008).
6. Call for Review and Comments on Nominated Projects from industry peers, technical specialists and customers (deadline for comments 30 June 2008).
7. Assessment of final entries (11 July 2008)
   a. Assessment Panel will consist of invited specialists and a HDGASA Staff Member (who will have no vote and will merely provide technical advice and guidance).

Please note that the project owner is welcome to nominate themselves.

THE CONDITIONS OF ENTRY ARE AS FOLLOWS:

- At the discretion of the judges the overall winner will not necessarily be a winner of one of the individual categories.
- All nominations must be submitted to the HDGASA by the 18th April 2008 to be considered for this year's event. Nominations for 2009 will open in June 2008.
- The judge's 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 and that the information and photos may be used in the magazine, on the Association's web site and for promotional purposes.

Geelong Carousel Pavilion – Geelong, Australia

The Geelong Carousel Pavilion is located at Steampacket Quay in the city of Geelong on the foreshore of Port Phillip Bay.

The Pavilion houses the oldest and most valuable carousel in Australia, hand carved in the United States in 1892. The carousel is powered by an 1888 steam engine and is accompanied by an 1898 Gavioli band organ. In 2002, the pavilion's design was recognized with its architects winning the Victorian Architectural Award.

The structural steel is made up of a range of hollow sections and also solid angles used for support of the extensive glass work. All of the structural steel in the Pavilion is hot dip galvanized steel that has been left bare and most of it is exposed to the sea. An indication of the continuing chloride deposition from the seaspray is that one of the major structural design parameters for the building was the offshore wind loading.

The Carousel is sited directly on the shores of Port Philip Bay and the general environment can be considered a C4 to C5 category as per ISO 9223.

The design and fabrication of the structure paid due consideration to corrosion through the use of bolting to eliminate welding where possible, the minimization of "corrosion hotspots" due to proper detailing and the expanded metal roofing that reduced the wind loading and allowed the washing effects of rain on external steelwork.

Geelong Carousel Pavilion looking out onto boat harbour.

The carousel is a popular tourist attraction and during school holidays it is subject to considerable stress due to children's parties and general public traffic. This situation highlights one of the major advantages of galvanizing – its ability to withstand abrasion and impact without the need for repair or maintenance.

It has been open for 6 years and has required no maintenance in that time. This is important since it means that the Carousel does not need to be shut down for any period of time. The steelwork is in excellent condition and all the galvanized coating thicknesses taken proved to be 2 to 3 times in excess of the coating thickness required by AS/NZS 4680.

The Association wishes to thank the Australian Galvanizers Association for this contribution.

Geelong Carousel Pavilion

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A compilation of interesting projects from America and Canada

Charlotte Douglas International Airport, parking garage

Charlotte, NC

The Charlotte Douglas International Airport, with an average of 600 daily departures, is a rapidly growing airport in the southeastern United States. As the passenger traffic has increased over the past few years, so has the demand for more parking. In late 2004, the airport broke ground on a 3 000 space parking facility to increase customer-parking capacity by 13%.

The designer wanted to break away from the normal square, concrete box structure of parking facilities, and envisioned a facility that would mirror the curvature of an airplane wing.

In order to accomplish this design, the architect and engineer decided to attach stainless steel cladding to a galvanized structural steel frame. Three hundred tons of hot dip galvanized steel was used in the project including: bow-string trusses, embed plates and anchors, stair towers, stairways, hand rails, and castellated beams.

Galvanized steel was specified for its exceptional maintenance-free service life, overall aesthetic appearance, and compatibility with stainless steel. When used together, galvanized and stainless steel provide a uniform appearance and an economical alternative to specifying stainless steel for the entire structure.

By specifying a hot dip galvanized coating instead of a paint system, the garage will not require costly maintenance due to the constant vehicle and pedestrian traffic it will accommodate. Furthermore, the galvanized coating will allow the structure to remain a corrosion-free, attractive piece of the airport landscape well into the future.

7th Avenue LRT refurbishment (phase I)

Calgary, Alberta, Canada

The City of Calgary, Alberta is a leader in the use of hot dip galvanizing and duplex systems for infrastructure. Over the past decade, duplex systems have been used extensively on major overpass guardrails and pedestrian rails. Recently, the city specified hot dip galvanized reinforcing steel in all bridges. So when the city was ready to refurbish the 7th Avenue Light Rail Transit (LRT) System, hot dip galvanizing was the logical choice.

Because many commuters rely on the rail system, turnaround time was of the essence. The system had to be de-energised, erected, and re-energised in a 72-hour timeframe to minimise the impact on commuters.

Charlotte Douglas International Airport, Parking Garage.

7th Avenue Light Rail Transit refurbishment.

The hot dip galvanized lazer skeletons provide a low maintenance but stylish stairwell balistrade in the Tip Top building .

To create a uniform appearance, all hardware, hollow structural steel cords, tension members, columns, upper and lower arms, ornamental light posts, handrails, benches, and trash bins were hot dip galvanized. The durable coating will be able to withstand the extreme winter climate and constant foot and rail traffic, while remaining aesthetically appealing. Following the success of this project, there are plans for up to 14 more similar station refurbishments in the near future.

The Tip Top building renovation

Omaha, NE

The Tip Top building was first constructed in 1916 as a factory of the Ford Motor Company to manufacture Model T's. In a landmark project for the city of Omaha, the building was recently renovated into an apartment complex. The apartment homes were advertised as stylish and hip, and a change from ordinary apartment living.

The owner was looking for a low-maintenance, but stylish design for the atrium and roof railings on the building. The owner was introduced to the modern concept of using laser skeletons (the remainder of the sheet of steel after various parts are laser cut and removed) as partitions and fencing. The hot dip galvanized skeletons were a perfect fit for the modern industrial design of the building.

Actual skeleton pieces from past projects were used on the roof top railings, while the atrium railings were designed to look like skeleton pieces because they had to meet strict codes. The owner also had a short turnaround time for the railings so the building could be completed on schedule, which the galvanizer was able to meet. The use of the recycled hot dip galvanized skeletons and newly designed skeletons not only increase the aesthetic appeal of the building, but also offer the owner the convenience of maintenance-free railings in hard to maintain areas.

Metcalf Energy Center – screen

San Jose, CA

The Metcalf Energy Center is a 600-megawatt power generation facility located along Highway 101 in California's "Silicon Valley." It utilises natural gas for fuel and is one of the cleanest, most efficient facilities of its kind in the world. Since the facility is situated near a residential area, consideration was taken to help it blend in with the surrounding area and reduce the visual impact on the community. The designers decided to erect an elaborate screen to cover the plant and buffer it from existing residential areas. The screen was made of a steel frame with a tan mesh screen.

The engineer and designer wanted a long-lasting durable coating that wouldn't rust and bleed onto the outside mesh

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Metcalf Energy Center – screen.

Rapid Aerostat Initial Deployment System.

panels creating unsightly stains. So, the steel frame, which included stack triangular pipe frames, pipe columns, and braces, was hot dip galvanized for corrosion protection. The 950 tons of galvanized steel frame, supports the architectural tan screen panels and hide the industrial energy facility from view. The galvanized frames and mesh screen will allow the Metcalf Energy Center to blend into its surroundings and continue to deliver power to northern California for generations to come.

Rapid Aerostat Initial Deployment System – *Iraq and Afghanistan*

The Rapid Aerostat Initial Deployment (RAID) systems consist of infrared sensors carried via an aerostat or stationary platform capable of detecting hostile troop and/or equipment movement at great distances. The systems were developed by Raytheon to meet the Army's developing critical needs in Operation Enduring Freedom and Operation Iraqi Freedom, enabling US forces to respond rapidly to threatening situations. Raytheon was awarded an Army contract to provide 41 RAID systems for use in Iraq and Afghanistan. The RAID system towers were specified to be galvanized because of military specification requirements.

The trailer, fender, outrigger, and tower components were all galvanized for corrosion protection. The durable galvanized coating can withstand the rigors of international transport and handling of the systems, as well as the intense environment where they are installed.

The equipment will be subjected to chemical warfare, military combat, and extreme temperature variances. The use of galvanizing ensures the RAID systems will continue to protect American and Coalition forces and save lives throughout the term of these military operations and beyond.

The Association wishes to thank the American Galvanizers Association for this contribution.

Zinc and Health:

Zinc supplements may help protect against arthritis

A team of US researchers studied nearly 30,000 women, comparing the diet patterns of those who later developed rheumatoid arthritis with those without the disease. They report that women who consumed less than 40 micrograms of beta-cryptoxanthin were at a slightly higher risk of developing rheumatoid arthritis than women who consumed more than that amount. Beta-cryptoxanthin is found in citrus fruits such as grapefruits. They also found that those who took zinc supplements had a lower risk of rheumatoid arthritis. However those with similar levels of zinc intake from food did not show a decreased risk. Greater intake of fruit and vegetables also exhibited trends toward inverse associations with risk, reported the researchers in the American Journal of Epidemiology.

Source: Am J Epidemiol 2003; 157:345-354 and http://www.nutraingredients.com/news/news.asp?id=6557

2008 GALVANIZING CONFERENCE

In order to promote the use of hot dip galvanizing and to share experience on the application and market, a 2-day conference will be hosted by the Hot Dip Galvanizers Association SA (HDGASA) and the International Zinc Association SA (IZASA) from 2 – 3 June in Johannesburg.

Who Should Attend?

The conference is aimed at those involved in the development of infrastructure (electricity, roads and rail), the building and construction industry, architects, specifiers, designers, steel fabricators and the mining industry.

Attendance:

Continuous Professional Development (CPD) points, accredited by ECSA will be available for attending this conference.

Proposed Topics:

- Capacity of the local hot dip galvanizing industry
- Current technology in hot dip galvanizing
- Positioning of hot dip galvanizing as an environmentally sound method of corrosion protection
- 95/5 General galvanizing
- Designing for fabrication to avoid distortion
- Electrical distribution
- Impact of REACH when using zinc
- Duplex systems using high-tech coatings
- Update on global general galvanizing market trends
- Metallic coatings
- Hot dip galvanizing for architectural purposes
- Galvanized water piping systems and performance predictions
- Experiences of a Project House
- Service Life Prediction and Life Cycle Costing
- Mining applications for hot dip galvanizing

CALL FOR PAPERS

Abstract submissions are now invited for the 2008 Hot Dip Galvanizing Conference. The conference language is English and submissions should either promote the use of hot dip galvanizing relating to proposed infrastructure spending; to share experience on applications and market; or to educate users in specifying hot dip galvanizing.

Abstracts must be registered with Saskia (hdgasa@icon.co.za) by 15 April 2008.

Abstracts should incorporate the following:

- *Objectives of your paper*
- *Main description*
- *Conclusions*

Publishing Schedule

- *Draft Abstracts submitted by 15 April 2008*
- *Provisional acceptance of Abstracts by 30 April 2008*
- *Final presentations to be delivered electronically by 16th May 2008 for editorial review and quality check*
- *Presentations will be posted to delegates after the conference.*

IZASA
INTERNATIONAL ZINC ASSOCIATION – SOUTHERN AFRICA

HOT DIP GALVANIZERS ASSOCIATION
SOUTHERN AFRICA

For further information on the conference and registration procedure please contact the HDGASA on (011) 456-7960 or hdgasa@icon.co.za or visit the IZASA website at www.izasa.org

2007 ESKOM HOT DIP GALVANIZING AWARDS EVENING

Photos taken at the 2007 Annual Eskom Hot Dip Galvanizing Awards Evening showing a number of our esteemed guests.










Surface preparation for painting hot dip galvanized steel

Painting galvanized steel requires careful preparation and a good understanding of both painting and hot dip galvanizing. Many products have been galvanized and painted successfully, including automobiles and utility towers. Past experience provides excellent historical data for how best to achieve good adhesion. By studying past adhesion failures and successes, galvanizers, paint companies, researchers, painting contractors, and other sources have compiled the ASTM D 6386 specification, which details the process and procedures for preparing hot dip galvanized steel for painting. When the galvanized surface is prepared correctly, paint adhesion is excellent and the duplex system works synergistically, providing for enhanced corrosion protection.

Galvanized steel can be divided into three categories: *newly hot dip galvanized steel*, *partially weathered hot dip galvanized steel*, and *fully weathered hot dip galvanized steel*. Each type of galvanized steel must be prepared differently because the surface has different characteristics at each stage of weathering. It is important to know the age of the galvanized steel that will be painted as well as a knowledge of the different available paint systems.

Newly hot dip galvanized steel

Newly hot dip galvanized steel is classified as less than 48 hours old.

Newly hot dip galvanized steel should not be chromate quenched. (Contrary to this, should there be any chance of not painting in the first 48 hours and there is an abundance of moisture in the atmosphere, as is the case in most coastal cities/towns. Chromate passivation is to be encouraged. It is far easier to remove a chromate layer than it is to successfully remove wet storage stains).

This type of galvanized surface is typically very smooth. (Relative surface smoothness depends on whether the steel is silicon or aluminium killed. The hot dip galvanized surface of Silicon killed steel is far rougher in appearance than aluminium killed steel and may not necessarily require etching of the surface. However, as there may be a misunderstanding as to what is considered to be smooth or rough, all surfaces should ideally be mechanically cleaned as per the methods discussed, prior to painting) – using one of the profiling methods described below – to improve paint adhesion. A newly galvanized surface has little or no zinc oxides or zinc hydroxides, so no major etch cleaning is necessary.

Partially weathered hot dip galvanized steel

Partially weathered galvanized steel is classified as steel that has been galvanized more than 48 hours ago but has been in service for less than two years. At this stage in the life of the galvanized steel, the formation of zinc corrosion products is sometimes evident by a light white film present on the galvanized steel. This layer of oxidation must be removed to promote good adhesion between the paint and the galvanized steel. Cleaning of the surface corrosion products can be done using many methods mentioned later in this article.

Before painting partially weathered hot dip galvanized steel, it is important to know if the coating was chromate quenched. Spot testing the galvanized steel according to ASTM B 201 can determine the presence of chromate conversion coatings. If a chromate coating is detected, the chromate layer must be removed, either by brushing off by abrasive blast cleaning, abrading, sanding or allowing the steel to weather for six months. The latter is not necessarily true for coastal conditions.

Partially weathered galvanized steel also should be slightly roughened to improve paint adhesion. Any of the surface profiling methods described later in this article can be used to prepare the surface.

Fully weathered hot dip galvanized steel

Fully weathered galvanized steel has been in service for approximately two years and has completely formed the stable protective layer of surface corrosion products known as the zinc patina. The patina has a very stable and finely etched surface, which provides excellent paint adhesion. The only surface preparation needed is a warm water power wash to remove loose particles from the surface. In order to protect the surface, the power wash should not exceed 1450 psi. Allow the surface to completely dry before application of the paint system.

Should the hot dip galvanizing have been subjected to marine conditions and a layer of zinc chloride exists, mechanical cleaning, such as sweep blasting, may be required to remove this tenacious layer prior to painting.

Surface preparation

There are many different methods used to clean or profile the hot dip galvanized surface for painting.

Sweep blasting at a blast pressure of less than 200kpa and correct angle removes the zinc corrosion products and roughens the surface to make a good profile for paint adhesion.

Below are descriptions of the various methods used to effectively clean hot dip galvanized steel.

Alkaline cleaning

Oil, grease and dirt can be removed by using an alkaline solution in the pH range of 11 - 12, but not greater than 13. An alkaline solution is nominally 5 to 10 percent sodium hydroxide compounds with small additions of emulsifying or chelating agents. The solution can be applied through dipping, spraying or brushing. If brushing, use a soft bristle brush of nylon, not copper or steel. If dipping or spraying the alkaline solution, the temperature should range between 60 to 85ºC. For newly galvanized surfaces, a water-based emulsifier can be used to remove contaminants. After cleaning, thoroughly rinse the surface with hot water, followed by cold running water and then allow to dry completely.

Solvent cleaning

Mineral spirits, turpentine, high-flash naphtha, and other typical cleaning solvents can be used to clean galvanized surfaces, provided they are applied with lint-free rags or soft bristled nylon brushes that are frequently changed in order to avoid redistribution of the contaminants. After cleaning, thoroughly rinse the surface with hot water, followed by cold running water and then allow surface to dry completely.

Profiling

In order to provide a good adhesion profile for the paint, the galvanized surface must be slightly roughened to provide an anchor profile for the paint system. Sweep blasting, phosphating, and using wash primers or acrylic passivations are the most common methods of increasing the profile of a galvanized surface. Again, care must be taken not to damage the galvanized coating.

High spots

Any high spots or rough edges should be removed and smoothed out in order to provide a level surface for paint. Use hand, power tools or flexible grinding pads to grind down

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the high spots. Care should be taken particularly on edges to remove as little zinc as possible.

Sweep blasting

In order to remove excess zinc ash, lumps, protuberances and to roughen the typically smooth galvanized surface after cleaning, an abrasive sweep or brush blast may be used. Care should be taken to prevent removing too much of the zinc coating. Particle size for a sweep blast of galvanized steel should range between 200 – 500 microns. Aluminum / magnesium silicate as well as Garnet has been used successfully in the sweep blasting of galvanized steel. Organic media such as corn cobs, walnut shells, corundum, limestone, and mineral sands with a Mohs hardness of five or less may also be used. Sweep blasting while the galvanized part is still warm, however impractical, between 80 - 200º C, provides an excellent profile. Ambient conditions for sweep blasting are recommended to be less that 50% relative humidity and a minimum air temperature of 21ºC.

Penetrating sealers

These products are known as a two-part epoxy penetrating sealer. They have been used as a surface treatment method on difficult to clean surfaces such as partially weathered galvanized steel. Always follow the manufacturer's directions for application and always use a topcoat over the sealer.

Zinc phosphate treatment

As discussed earlier, phosphating is a conversion coating, which can increase the adherence and durability of the paint film. The phosphate treatment can be applied by immersion, spray, or soft bristle nylon brush. The phosphate should only be left on the galvanized steel between three and six minutes. The piece should then be washed with running clean water and allowed to completely dry. Begin painting when the surface is dry. Do not use phosphate treatments in conjunction with zinc-rich paints.

Wash primers

This treatment uses a metal conditioner to neutralize surface oxides and hydroxides, as well as to etch the galvanized surface. Adhesion problems will be experienced if the coating is applied above the recommended DFT's. Because of this, this profiling method is best applied in shop conditions and not in the field. When using wash primers, follow the manufacturer's directions for maximum performance.

Acrylic passivations

This treatment uses an acidic acrylic solution to passivate the galvanized surface, as well as promote paint adhesion. Acrylic passivation products should be applied according to the manufacturer's data sheet to a clean hot dip galvanized surface. The coating should be completely dry before painting.

A follow up article in the next issue of HDGT will discuss the selection of paint required for a Duplex Painting System.

The Association wishes to thank Mike Book for this article.

Zinc and Health:

European researchers study zinc supplementation for the elderly

Zinc intake among the elderly in Europe is generally low and European researchers are currently trying to discover the role of zinc in preventing the chronic and degenerative diseases associated with ageing.

In a recently started EU-project, scientists will try to determine the variances in zinc dietary intake among different European countries, as well as the response to nutritional supplementation of zinc in late middle-aged and elderly people from these countries.

Volunteers will receive a placebo or two levels of zinc supplement for 6 months. The effects on nutrient status and intestinal absorption of zinc will be evaluated at the beginning, and after three and six months of zinc supplementation. Scientists in this project expect to provide reliable scientific data about the beneficial effects of optimal zinc status to older consumers. Zinc is important for the body's defence mechanisms against inflammation diseases. Enrichment of the diet with this essential nutrient may be beneficial for health, but excess zinc may negatively interact with the metabolism of other minerals. A balanced diet is the best way to ensure adequate intake of zinc, write the scientists.

Practical applications from this research work in the future may be the formulation of public health recommendations on dietary zinc intake in aged Europeans, and the development of zinc-enriched products specially designed for late middle-aged and older men and women.

The research program is led by Dr Charles Coudray at INRA (Institut National de Recherche Agronomique) at Saint-Genès-Champanelle in France.

Source: www.nutraingredients.com

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AKZO NOBEL

Corrosion protection systems: an environmental comparison

When it comes to possible corrosion prevention systems for steel structures, the choice often lies between hot dip galvanizing and paint. In addition to classical criteria for selecting suitable systems such as service life, functionality or costs, ecological considerations are also increasingly important.

A study by the Environmental Technology Systems Department of the Institute for Environmental Protection Technology at the Technical University of Berlin involved a comparison between a paint coating (as EN ISO 12944) and hot dip galvanizing (EN ISO 1461) on the basis of a life cycle assessment.

Comparative life cycle assessment

The ecological life cycle assessment is a recognised method in accordance with EN ISO 14040 ff., which can be used to compare products or product systems in ecological terms. It is based on the entire life cycle of the product, i.e. manufacture, use, conversion and/or disposal. This involves analysing all environmentally relevant substances which are extracted from the environment (e.g. ores, crude oil) together with substances which enter the environment (e.g. wastes, emissions) and listing them in a life cycle inventory. The inventory data are converted into several so-called effect categories, which constitute the result of an LCA. The effect category best known to the public is the greenhouse effect, a measure of the emission of greenhouse gases and the global warming of the atmosphere.

Hot dip galvanizing and paint systems investigated

The central value for LCA comparisons is the functional unit – the reference quantity for the comparison. An objective comparison cannot be carried out without identical comparison variables. The way these values were defined in the study was that the two systems had to provide corrosion prevention for a steel structure which was to be used for 60 years, and which was applied to a steel structure such as a multi-storey car park with a steel area amounting to 20m²/t. It was assumed that the structure was externally exposed to a medium level of corrosion (corrosion category C3 from ISO 9223).

The hot dip galvanizing system is a 'one-off' corrosion prevention treatment by immersion in molten zinc.

With a zinc layer thickness of 100µm and an average corrosion rate for category C3 of 1µm/year, the calculated durability far exceeds the required 60 years.

The environmental impacts connected with this system (substance consumption, energy consumption and wastes) are shown in *figure 1*. To guarantee corrosion prevention for 60 years using the paint coating system, the components are first abrasion-blasted.

Then they are initially coated in the works with a three-coat application with a total coating thickness of 240µm. On-site maintenance operations are then needed after 20 and 40 years, involving partial cleaning and some renewal of the coating (*see figure 2*).

Results

The results calculated using the recognised CML 2 baseline 2000 method are represented by five different environmental effect categories. *Figure 3* shows these environmental impacts.

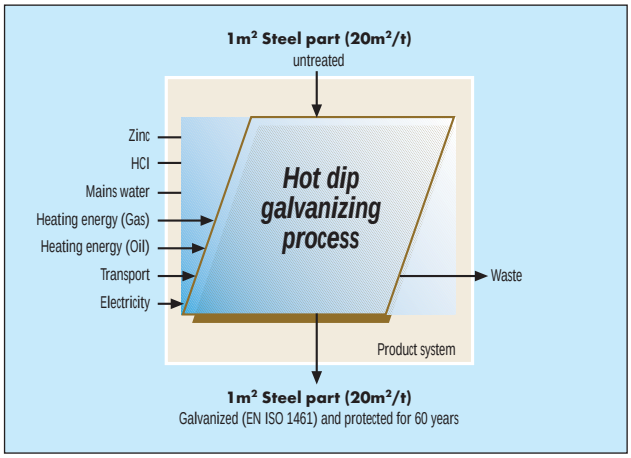

Figure 1: Hot dip galvanizing system.

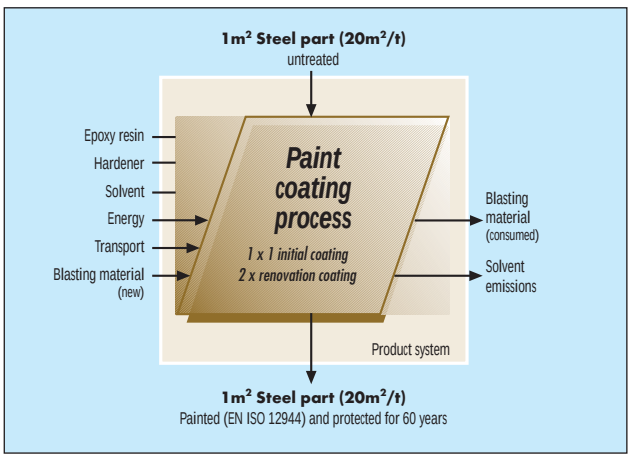

Figure 2: Paint coating system.

The percentage values are given for the systems under consideration, and the results are related to the largest contributory factor (consumption of resources).

The length of the bars is a measure of the environmental stress.

The contributory factors for the hot dip galvanizing system are lower in all effect categories than for the paint system. In several effect categories there are marked differences – thus, hot dip galvanizing's score in the category of eutrophication is only 18%, in the resource consumption category it is only 32%, and in relation to the greenhouse effect it is only 38% – all in comparison with painting.

Hot dip galvanizing is distinguished by lower consumption of resources and less emission pollution throughout its service life.

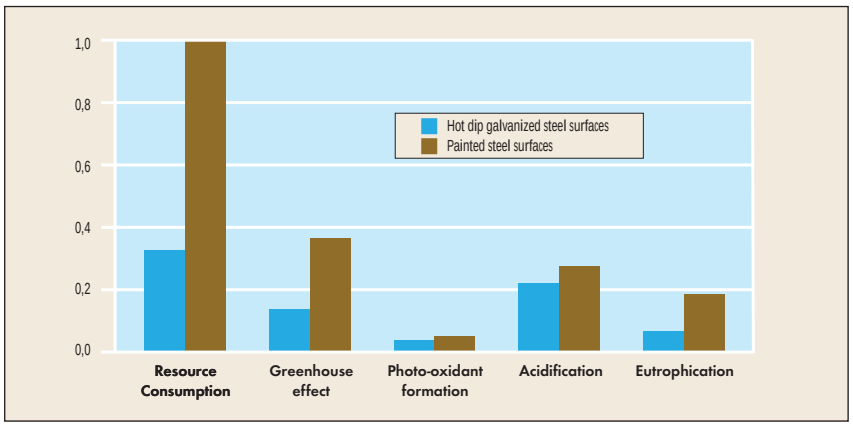

Figure 3: Environmental impact in various effect categories.

Findings

The study shows that the life cycle assessment is a meaningful method, based on actual practice of ecological comparison of products. It brings out marked differences between two established corrosion prevention systems for steel structures. The hot dip galvanizing corrosion prevention system displays lower environmental impact for a steel structure with a long service life, as against a paint system. Long service life and freedom from maintenance, the well-known advantages of hot dip galvanizing, are the basis for the environmental benefits of the process.

The Association wishes to thank the UK Galvanizers Association for this contribution.

The effect of the insulation fixing wires on the hot dip galvanized purlins on the seaward side of the Assembly Hall at Cranston College – KZN

As part of the Association's effort to educate and improve the frequent ineffective communication between end clients 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.

The Association was requested to provide an opinion on the white powder (zinc hydroxide) on some of the hot dip galvanized purlins on the seaward side of the Assembly hall at a College along the south coast, where some insulated wire has been used to support the internal roof insulation. The Association was also asked to provide a recommendation to alleviate the situation. I report as follows:

Hot dip galvanizing was used to protect the structural steel supporting the roof cladding.

Photo left, showing the eaves from upstairs on the landward side and photo right, the eaves on the seaward side, indicating the different micro-climatical conditions that the hot dip galvanized coating is subjected to.

Choice of coating

In our opinion although as a rule of thumb hot dip galvanizing on its own within the first kilometre of the sea should be painted (duplex coating), the conditions at hand in this instance suggest that hot dip galvanizing on its own is acceptable for the following reasons:

- The site is easily at least 100 to 150m above sea level and about a kilometre from the sea. These physical conditions would have a reducing effect of the off sea chlorides.
- A pedestrian gate to the property in the front of the assembly hall was hot dip galvanized and installed in 2004. The surface of the coating is not showing any signs of zinc chloride salts # and the coating thickness readings

The pedestrian gate was installed in 2004 (left) and from coating thickness readings (right) the coating was hardly affected and in good condition. There were no signs of surface zinc chloride on the coating.

Top left, eaves purlin on the landward side and right, close up of the insulated wire, used to support the internal roof insulation. Note there is very little or no reaction between the insulated wire and the hot dip galvanized purlin, whereas, on the seaward the same cannot be said. Bottom left shows a general view of the eaves purlin on the seaward side with a close up, bottom right, showing the bulky zinc hydroxide product adjacent to the insulated wire.

taken indicate that the coating had hardly been affected by the conditions at hand. *See photo on page 18.*

Zinc chloride salt

In most instances when a hot dip galvanized coating is exposed to the direct conditions of the sea air, a white tenacious zinc chloride surface film develops which depending on the severity of the conditions at hand, may reduce the expected service life of the coating.

As an example, a diamond recovery company that owns vessels that get harboured outside Walvis Bay (extremely aggressive conditions) when extracting the diamonds, use hot dip galvanizing to protect their process related steel structures on the vessel. The coating lasts at least 10 years in this extremely aggressive

continued on page 20...

All fasteners were zinc electroplated providing less corrosion protection than an equivalent hot dip galvanized fastener.It was also noted that several hot dip galvanized components were subsequently welded and the coating insufficiently repaired, see photos.The areas of concern require attention using an appropriate coating repair material such as "Zincfix" or equal.

The insulating wires fixed to the hot dip galvanized purlins inside the building have no effect due to the mild interior conditions.

environment, before the metallic zinc is converted into zinc chloride, providing very little or no corrosion protection. The conditions on the seaward side of the assembly hall at Cranston College are far milder than those in Walvis Bay.

It is recommended, however, that the hot dip galvanized coating on the seaward side be annually assessed for its performance, starting say in 2008.

What is white rust (wet storage stain)?

Despite its use to prevent corrosion, zinc itself is a highly reactive metal. Inevitably on exposure to the atmosphere (e.g. withdrawal from molten zinc in the galvanizing bath) the zinc surface reacts to form zinc oxide and unstable zinc hydroxide (white rust), which may not necessarily be visible to the naked eye. At the same time, oxygen and carbon dioxide react with the zinc to form a stable and durable basic zinc carbonate surface film, which provides the durability for which hot dip galvanizing is reputed.

In conditions where carbon dioxide is depleted and moisture is present, the chemical reaction which produces soluble zinc hydroxide predominates while the development of the desirable zinc carbonate film is retarded but not necessarily entirely prevented. In some circumstances, white rust formation is exacerbated by the presence of significant quantities of other substances in the atmosphere or in water. In a marine environment, the presence of chlorides to a lesser or greater degree is inevitable. Sodium chloride, which predominates in sea air, reacts with zinc to produce zinc oxy-chlorides. This is why chlorides will always be present in white rust compounds removed from galvanized zinc surfaces, which have been exposed to a marine environment.

Zinc hydroxide (white rust) is voluminous and fluffy in appearance.

The fact is that the solid volume of this product is some 4 to 5 times greater than that of the zinc from which it has been formed thus, the visual perception that the zinc coating thickness has been significantly reduced is usually misleading.

Finally, if white rust deposits are removed, the underlying galvanized coating frequently remains discoloured with dull grey and even black patches present. Dark grey and black surfaces are normally identified as sites where, for whatever technical reason, a dense film of protective zinc carbonate has formed. With normal exposure, the coating eventually assumes a more uniform dull grey appearance, which is typical of weathered galvanized steel in service.

Recommendation

Although the hot dip galvanized coating adjacent to the wire is not in immediate threat of failing, the continued presence of the zinc hydroxide, will in time affect its service life, if not removed. Therefore we recommend that the wire be untied and the white corrosion products be removed.

After thorough preparation of the hot dip galvanized surface using an appropriate galvanized iron cleaner, which will also remove the white corrosion products of white rust. The metal treatment is to be applied using circular cleaning motions with a bristle brush both on application and during removal of the chemical with a running water hose to remove all traces of the chemical, according to the manufacturer's instructions. The silver / grey colour of the hot dip galvanized coating should turn a dull matt grey colour, if cleaning is successful.

Apply two layers of "Denso" Structural Steel Tape (of a suitable width, 25, 50 or 75mm) at the area where the wire is to be relocated, in accordance with the manufacturer's instructions. Apply a "Denso" Rubberized Basecoat & Scrim, followed up when dry with a coating of "Densoflex" Acrylic (preferably grey in colour), according to the manufacturer's instructions.

After the acrylic paint is fully dry, re-engage the wire and possibly apply one or two further coats of acrylic paint over the insulated wire.

Although periodically the condition of the acrylic paint may have to be assessed and if necessary repaired, the reappearance of the bulky white zinc hydroxide is unlikely.

General observations and concerns

It was noted that all the fasteners particularly on the inside of the building were only electroplated and not hot dip galvanized. The fasteners on the outside of the building were inaccessible to inspect correctly but they are expected to be the same as those used on the inside of the building. The difference lies in the coating thickness where the zinc electroplated coatings are usually below 10µm with the equivalent in hot dip galvanizing being about 70µm, providing at least 7 to 10 times the life. *See photos on page 20.*

It was also noted that several hot dip galvanized components were subsequently welded and the coating insufficiently repaired, *see photos on page 20*. The areas of concern require attention using an appropriate coating repair material such as "Zincfix" or equal.

Terry Smith.

Guest Writer

Our guest writer for this edition is Russell Thompson of Physmet.

The pool guy

One of the several positive aspects that are derived from analyzing the in-service failure of components is the education that it imparts. For the unfortunate beneficiary of an unexpected failure, this can result in expensive school fees for the sake of experience. For external observers of the event, there is a mixed bag of responses ranging from humorous chuckles, sarcastic comments and sympathetic clucks. We fail ourselves if we too, waste an opportunity to learn from others mistakes.

Recounting the experience of one unfortunate individual can hopefully, jolt some wisdom into the rest of us in our personal and professional capacities.

Our individual – James, for want of an identity – of technical background, although marginally misaligned by the demands of management, recently acquired a second property on a repossession auction. The property was described as being functionally challenged – but what a view. James, with true entrepreneurial blood flooding his veins and with the bargain buy in his grasp jumped at the prospect of being the weekend renovation warrior.

At this juncture, we fast forward to the swimming pool. Due to neglect, the swimming pool had degenerated to a half-filled cess pond (past the electric green stage) and the pump and filter were pushing up daisies (literally). Our warrior acquired a new pump, filter and pool lights and connected them all up. "Use these stainless clamps, the zinc ones will rust away in a couple of months" were the words of wisdom offered by the hardware shop assistant. At twice the zinc clamp price and with infinity and beyond as the downside for these expensive clamps, James had been offered another bargain he could not pass up. With the pump and filter stage set, James elected to top up the pool water level and dump in a full bucket of chlorine and several bottles of pool acid for good measure to clear up the green and nasties that existed in his oversized soup bowl. He tossed in an automatic pool cleaner to get on with it until the next weekend. With visions of a braai at the pool and sundowners whilst admiring the panoramic view on the following weekend, he retired off to the weekly corporate battleground. This visionary future was not to be. An irate new neighbour rudely interrupted our hero's blissful slumber at three in the morning on the following Saturday. The neighbour was clearly a xenophobic immigrant and after deciphering the minimal English from the extensive French communication, it was established that their separating vibracrete wall had collapsed onto three vehicles and that a flood of water had brought a premature delivery of roses – with roots and mud – into their bedroom. The appeasing argument to the neighbour was that one of the stainless steel hose clamps had come loose and the return pipe to the pool from the pump had blown off. The pump had drained the pool through the pool cleaner and that this water had accumulated up against the separating wall, eventually weakening the foundations and causing it to topple. This released a flood of water into the downhill neighbours property. The neighbour was unable to connect with the humorous side of the event and the insurance company were not willing to part with their hard-earned money without a reasonable argument. So, what went wrong and how do we learn and benefit from James's expensive school fees?

Investigation revealed that the hose clamp had not loosened or slipped, it had in actuality, broken. Some red rust was found inside the worm drive mechanism that suggested that it was not the recommended stainless steel clamp purported by the hardware store, but rather some cheap foreign imitation.

Adjacent to the position of the fracture, the surface of the clamp was noticed to have a roughened and etched surface texture and at the point of fracture, the clamp tongue had thinned. No stretching or deformation was associated with the thinning phenomenon.

A chemical analysis exonerated the manufacturer and our foreign trading partners. The clamp had been manufactured from the ubiquitous AISI 304 stainless steel grade.

Why did our hero's Rolls Royce clamp fail so rapidly when the cheap and nasty zinc coated clamp might have lasted months before turning into a lump of red powder? During the installation of the pump and the subsequent inauguration of the pool

recovery, some of the chemically enriched pool water had soaked the soil where the clamp had been installed into a partially buried location.

Stainless steels earn their classification by virtue that they 'do not rust'. This behaviour is due to the formation of a thin, adherent and tenacious passive oxide skin that is the consequence of their high-alloyed chromium content. This behaviour however, only prevails whilst the passivated surface is exposed to oxidizing conditions. Should the surface be starved of oxygen, the protective oxide cannot be maintained and the 'stainless steel' rusts in the same manner as a conventional carbon steel. In this instance of clamp failure, the worm drive housing and a portion of the clamp tongue were encastered in a mud environment that was heavily laced with ionic chlorides. Whilst chlorine does not enter the general corrosion reactions of iron, a primary role is to catalyze those reactions. The occlusion of a portion of the stainless steel clamp within the mud resulted in the exposed area becoming the cathode in closed corrosion cell, with the buried region being attacked. The appearance of the red corrosion products upon the covered surfaces of the clamp was largely the consequence of this occluded corrosion attack mechanism. As observers to our hero's misfortune, the first lesson we take away for our future benefit is that as attractive as stainless steels may be, they too have their own Achilles' heel and this rests with the susceptibility of this family of steels to crevice corrosion. Starve the stainless steel surface of oxygen and it will reward you with an instance of localized attack.

Observant critics would have noted the absence of the general 'rusting' to the clamp at the etched fracture face and that a single edge of the clamp tongue had thinned. The five-day life of the clamp is also inordinately short, even for a severe case of accelerated crevice corrosion. The woes of our hero are about to go into overdrive. It was found that the pool lighting system was driven using low voltage direct current. For immediate convenience, the lighting wiring had been routed alongside the return pipe from the pump to the pool. When the lighting circuit was energized, a potential difference of several volts was measured between the in-situ hose clamp and an earth spike inserted into the adjacent ground. The lighting circuit power supply induced a voltage imbalance, stemming from a current leak to earth via the clamp, which served to produce an additional mechanism of insidious corrosion attack. Our second warning lesson is that of stray current corrosion. Pipeline engineers are well aware of its effects and plant maintenance engineers learn of existence via burnt motor bearings. Welders too, are advised of its potentially severely damaging consequences.

In a final effort to bury our weekend warrior below the prescribed limit, to somewhere near the opposite side of the planet, it was found that through the course of his in-house renovations, the wiring inside the main electrical distribution box had been temporarily modified. The earth leakage unit had been degraded to an interesting and disconnected feature. The final technical lesson to be gleaned is common sense – water and lights only happily share the council's bill.

To close the tale upon James's woes. The insurance company, after much soul searching and deliberation, were unable to find a sub-clause whereby they could assist. The 'renovator's dream' house was resold at short notice. Our hero has survived, his ego, reputation and finances somewhat in tatters. Returning to our opening notes, disasterous events are always best when they happen to some one else. Whatever our opinion of the 'victim', we would be well advised to learn from their experiences and apply them to our own peculiar circumstances.

Walter's Corner

The diversity of zinc

Zinc which has been described as mans friendly metal has many beneficial attributes. As a trace element, it is essential for healthy plant and animal growth and continued survival. It also limits the spread of infection and last, but not least, it is considered to be an effective aphrodisiac!

Zinc is no doubt best known for the role that it plays in the control of destructive corrosion. Apart from its use in zinc rich paints, as a thermally sprayed coating, zinc electroplating and as sacrificial anodes for cathodic protection, it is best known protection in the form of a hot dip galvanized coating.

Zinc is a reactive metal which will readily combine with other elements in its environment. It is described as amphoteric, i.e. it is subject to corrosive attack at both high and low pH levels. Despite this it is the most frequently used metal in one form or another for preventing corrosion. The reason for this is that by reacting with both oxygen and carbon dioxide, in the atmosphere, a stable surface film of basic zinc carbonate is developed. If sufficient carbon dioxide is not present, unstable zinc hydroxide is formed and not zinc carbonate. This is generally referred to as white rust or wet storage stain, which can occur on closely packed steel components where air circulation is excluded.

Contrary to the view frequently expressed, white rust is not an uncontrollable corrosion problem in that once the cause is eliminated, the white rust formation will cease. In most cases, the deleterious effect of white rusting does not reduce coating thickness to any significant extent. Conditions which are conducive to white rust development should, however, be avoided since in extreme cases, severe attack of the zinc coating can develop while aesthetically, the coating appearance can be affected detrimentally. Once the basic zinc carbonate film has formed, the zinc surface is stable and resistant to most forms of attack. This is evident in that the initial shiny silver appearance of the coating is replaced by a dull grey finish.

Freshly galvanized steel surfaces can display traces of thinly deposited white rust even when stacked correctly, particularly if stored in a humid environment. This is during the time that it takes for the conversion of the zinc surface into stable zinc carbonate ($ZnCO_3$) as opposed to zinc hydroxide ($Zn(OH)_2$).

An interesting aspect is the presence of aluminium in a galvanized coating. In the case of general galvanizing of structural steel components, a small quantity of aluminium (0.005%) is added to the molten zinc for several reasons. The aluminium promotes better drainage of excess zinc during the withdrawal process after galvanizing, while it also promotes the formation of a smoother initially shiny coating finish. A further benefit is that even at such a low aluminium content, excessive formation of undesirably thick iron / zinc alloy layers within the coating is reduced in the case of steels containing reactive levels of silicon, carbon, phosphorus and manganese.

The presence of small quantities of aluminium in the coating is not detrimental from a corrosion aspect and if anything, overall corrosion resistance is enhanced. Initially, however, aluminium present on galvanized surfaces can slow down the formation of stable zinc carbonate with the result that the potential for initial white rust formation is increased somewhat. This is particularly evident in the case of hot dip galvanized steel coil where the aluminium content of the zinc is about 0.02%. This relatively high aluminium content in the zinc coating slows down the rate of formation of the zinc carbonate layer to a greater extent. Contrary to the misconception sometimes expressed, the white powder so formed is mainly zinc oxide or hydroxide and not an aluminium oxide, which in fact is dull grey as opposed to white.

In order to avoid white rusting on freshly galvanized surfaces, most galvanizing operations include a quench in water containing a passivating chemical e.g. sodium dichromate.

It must be emphasised that apart from a possible adverse impact on appearance, the temporary white rust formation under these circumstances rarely has any detrimental impact on corrosion resistant life of a hot dip galvanized coating. Apart from the influence of the somewhat higher aluminium content in the case of continuously galvanized sheet, it must be borne in mind that the coating is substantially thinner than that applied by the general galvanizing process while iron / zinc alloys are virtually absent. For these reasons, the formation of wet storage stain can have a more significant impact on the corrosion protection provided by these thinner coatings.

Aluminium as such, can also provide excellent corrosion resistance in many environments. As with zinc metal, aluminium also oxidises readily but it also forms a stable surface film which is known as Bohmite. Aluminium is more resistant to corrosion than zinc at lower pH levels but it does not provide the same degree of cathodic protection as does zinc.

The prime objective for applying a hot dip galvanized coating to steel is to provide barrier protection from attack by corrosion. The second significant attribute is the ability of zinc to provide protection at small uncoated surfaces while corrosion creep under a hot dip galvanized coating is not possible.

It must be borne in mind that the mechanism of cathodic protection is only operative where exposed steel is in electrical contact with zinc in the presence of an electrolyte (e.g. water). The zinc (anode) is sacrificed to protect the steel (cathode) with the result that, depending on the intensity of corrosion attack, the zinc coating will eventually be consumed. It is for this reason that uncoated steel surfaces in contact with freshly hot dip galvanized coatings is to be discouraged.

In order to achieve a continuous coating which is free from defects in the form of uncoated spots, a spotlessly clean rust free surface is essential. This ensures that the molten zinc comes into direct contact with the steel and the alloying process takes place. The result is the uniform development of the zeta, delta and gamma layers within the coating, all of which have a significant role to play in the overall control mechanism of the coating.

If contaminants are present, alloy formation cannot take place since the contaminant acts as a barrier between the molten zinc and the steel. The result is uncoated areas on the galvanized product which are often referred to as "black spots".

In summary, we are aware of the unique attributes of zinc in the form of a hot dip galvanized coating, nevertheless this is not a valid reason for ever accepting a coating which has not been applied in accordance with the specified coating quality standards.

Hot dip galvanizing can be described as a "wasting" form of protection since the coating thins out gradually over a period of time. The rate at which the thickness is reduced will depend on the level of corrosion in a given environment. When assessing atmospheric corrosion rates, we need to consider factors such as industrial pollution where low pH levels are encountered and marine environments where the impact of chlorides can be severe. The corrosion rate of zinc varies considerably depending on the environment to which it is exposed, while the life of the coating is more or less proportional to its thickness in a given environment.

To illustrate, in the average rural environment unaffected to any extent by corrosive industrial pollution or chlorides (C1 to C3), the corrosion rate of a hot dip galvanized surface is as low as one or two micrometres per annum. Where aggressive coastal or severe atmospheric pollution pertains, (C5 Marine or Industrial) the zinc corrosion rate can be substantially increased.

Meanwhile, there are severely corrosive natural environments where most protective systems will provide a distinctly limited life. Perhaps the best example of this is atmospheric corrosion along the Namibian coast at

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Walvis Bay where the corrosion rate of unpainted galvanized coatings can reach about 20 or 30 microns per year.

Atmospheric corrosion in the vicinity of Walvis Bay is somewhat unique. It is an arid dry desert land where one would normally expect atmospheric corrosion rates to be low. The cause of the intense corrosion in this area is due to emissions from the seabed of aggressive gases developed by subterranean volcanic action. To judge the cost effective value of a protective system by its performance in rare extreme circumstances is, however, misleading and should be avoided.

A distinct advantage of a hot dip galvanized protective system is that its undoubted protective attributes can be combined with those of an organic coating system to provide duplex protection.

Contrary to the frequently expressed opinion, hot dip galvanizing constitutes an excellent surface on which to apply most paint systems provided that surface contaminants are removed. There are some generic paints which are not recommended for direct application onto a zinc surface. Among these are the alkyd based paints which react detrimentally with the zinc surface, resulting in de-adhesion.

Research has shown that the synergistic effect of combining the protective properties of hot dip galvanizing with those of a paint system frequently results in an overall protective life which is normally equal to at least 1 and a half times the sum of the paint's durability and that of the hot dip galvanized coating when used separately.

Duplex coating systems provide excellent cost effective corrosion control in numerous corrosive marine and industrial environments where either organic coatings or a galvanized zinc coating when used separately would not be effective. This also applies in applications where a structure is permanently subjected to immersed conditions.

NOW WITH CPD POINTS

Coating Inspectors Course

Hot dip galvanizing is one of the most widely used methods of protecting steel from corrosion. As a final step in the process, the hot dip galvanized coating is inspected for compliance with the appropriate specifications.

This Coating Inspectors Course has been designed to provide delegates with sufficient knowledge to test, inspect and interpret test results.

Following the course and successful result in a three-part exam, the delegate will be issued with a certificate, and if required, registered as an approved HDGASA inspector. Registration will be confirmed on an annual basis. Successful inspectors will become Individual members of the Association for the year.

The course will be run from the Hot Dip Galvanizer's Association Offices in St. Andrews, Bedfordview. Bookings are limited (maximum 20 people) and will be treated on a first-come-first-serve basis.

COURSE CONTENT

- Introduction to corrosion
- Inspection before hot dip galvanizing
- Quality assurance in coating applications.
- Understanding zinc coatings
- Inspection after hot dip galvanizing

COURSE DURATION

This is a 2-Day Course comprising lectures on the first day, a Plant Tour in the morning of the second day, and the qualifying examination in the afternoon.

DATE AND TIME

Courses commence at 08h00 sharp and end at 16h30, on the following dates in 2008: April 8 & 9; June 10 & 11; August 5 & 6; October 7 & 8 and Nov 25 & 26.

Lunch and refreshments will be provided. Comprehensive course notes can be collected from our offices two weeks before the course.

COURSE COST AND PAYMENT TERMS

R2 394.00 per person inclusive of VAT. Should you have 2 or more delegates from the same company, course costs will be R2 166.00 per person inclusive of VAT. Please note that payment is due on the first day of training. Cheques to be made payable to "Hot Dip Galvanizers Association SA". Members qualify for a discount.

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

NOTE: All professional Engineers, Technologists, Technicians and Certificated Engineers are required to achieve a certain number of points for Continuous Professional Development (CPD). By attending the Association's two day Coating Inspection Course, you will obtain 2 points (accredited by ECSA).

MISCONCEPTIONS

Miss Conception puts it "straight"

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

As is the case with all protective coatings, discontinuations and thin areas on an applied hot dip galvanized coating will inevitably lead to disaster in all but the most benign environments.

True or false?

It must be emphasised that for satisfactory performance, coatings applied in accordance with the requirements of National or International quality standards or specifications should always be insisted upon. Unfortunately, we do not live in a perfect world and, inevitably, defects or modest faults in a coating can be overlooked despite stringent quality control methods.

There is also the possibility of coating damage occurring subsequent to final inspection either during transportation, storage or during installation. The mechanism whereby zinc in the form of hot dip galvanizing provides protection to steel is somewhat unique in many respects. Apart from good adhesion and durable barrier protection, the zinc and, to a lesser degree, the iron/zinc (Fe/Zn) alloy layers within the coating also provide cathodic or sacrificial protection to the steel since zinc is electro-negative to steel in terms of the galvanic series of metals. This ensures that at exposed steel surfaces, corrosion cannot creep underneath the surrounding coating and corrosion will not progress at such small exposed steel surfaces where the result is invariably limited to the presence of a thin film of rust staining.

Rust staining as opposed to severe rusting of a steel surface is the result of a mild initial reaction between the steel surface and the environment. It is invariably non-progressive where the

continued on page 28...

environment can be described as mild to moderately aggressive. Uncontrolled corrosion of unprotected steel results in surface pitting with the volume of the corrosion products of iron (rust) of up to 3 times the volume of the original steel being formed. This is the reason why reinforced concrete spalls if corrosion of the reinforcing steel (ungalvanized) occurs.

Coating thickness is of prime importance with all protective systems. Hot dip galvanizing specifications define acceptable minimum coating thicknesses which are determined by the thickness of steel components with thicker steel sections requiring thicker minimum coating thicknesses than thinner sections. The galvanizer can implement certain measures to control the formation of the coating, but the composition of the steel to be galvanized with silicon and phosphorous content playing a major role as well as steel thicknesses are no doubt the most significant factors. The result is that applied coatings are invariably up to 50% thicker than those called for in hot dip galvanizing specifications. The advantage of this to the end user is that the galvanizer cannot easily reduce coating thicknesses and hence coating life in order to compensate for increases in the cost of zinc. Zinc can be described as a wasting protector which thins out gradually over a period of time depending on the level of corrosion to which it is exposed.

Contrary to most other heavy duty coatings in general use, a hot dip galvanized film is virtually impermeable, (non-porous), as long as the coating has not been penetrated entirely. As far as adhesion is concerned, the Fe/Zn layers between the steel substrate and the relatively pure surface zinc layers, not only provide good corrosion resistance but they also ensure the provision of a coating that is metallurgically bonded to the underlying steel. The mechanism that provides this excellent form of adhesion is governed by the laws of nature and provided that a few simple rules are adhered to, a coating with consistently acceptable adhesion properties will always be provided. A further significant benefit is that in the event of mechanical damage as a result of severe impact, a portion of the Fe/Zn alloy layers is not removed from the steel surface. Hence a degree of protection is retained from the remaining coating. This is in contrast to most other protective coatings where severe impact invariably removes the entire coating.

To sum up, while a good quality coating applied correctly is important for long term corrosion control regardless of which system is selected, there is no doubt that the somewhat unique properties of a hot dip galvanized coating render it to be less susceptible to premature failure in the event that defects in the applied coating are present.

Definitely not a trashy affair....

A week before Steph Strydom wed Tilly Kritzinger in June 1968, he made a trip down to Port Elizabeth Municipality to purchase an item that they would need for their new home – a hot dip galvanized metal rubbish bin. The pressed metal bin, embossed with the date “1968 and PEM” (Port Elizabeth Municipality) has been with the family ever since.

The couple recalls that the bin got “no special treatment” and stood exposed in Port Elizabeth for its first 7 years of service. The bin relocated with the family to Durban in 1975 where, after some home renovations, it finally got a “roof over its head” (or shall we say lid?). The bin however did not stay put all the time – thanks to the couple’s only son Alex. Now aged 35, Alex fondly recalls the rubbish bin doubling up as wickets in his childhood during neighbourhood cricket matches and target practice during a “Ninja Star” phase. He laughs that history will probably repeat itself soon with the Strydom couple’s grandchildren now aged 9 & 10.

This remarkable piece of hardware has withstood the test of time. Recent coating thickness tests reveal that the hot dip galvanized coating is still in a remarkably good condition and the bin, unlike its pensioner owners, will not be going on retirement anytime soon. The trusty bin will be celebrating its 40th year of service a week before the Strydom couple’s ruby wedding anniversary in June 2008. Our warmest congratulations to all concerned!

The Association wishes to thank Desere Strydom for this article.

Report on site visit to Komatipoort Farms

"Galvanizing Failures" has been introduced as a regular feature to mostly highlight inappropriate use of hot dip galvanizing and hence its failure to provide the sustainable service life that the coating is known for. Other zinc coatings that are often inappropriately specified or incorrectly used when general hot dip galvanizing is preferred, will also from time to time be highlighted in this feature.

Further to our site visit to TSB's farms and the inspection of the water reticulation system to certain "centre pivot machines", I report my findings.

Questions were asked relating to certain centre pivot irrigation machines, one of which was reported as having been imported from the USA (Zimmatit) and that had been in continuous service for the past 20 odd years. It was further stated that a local machine had been in service for the past 12 years and unlike the USA machine, it was showing serious corrosion attack. The question was asked as to why the USA unit had lasted 20 years whereas the locally produced machine had been in service for 12 years and showing internal corrosion of the pipes?

Corrosion and the effects of corrosion, and hence the answer to this vexing question, is dependant on many and varied issues. In order to address the specific issue of internal pipe corrosion, found in this instance, it is clear that the corrosive attack is being initiated from the waterside, or internal surfaces of pipes. With this in mind we will restrict this report to an investigation of the possible causes of corrosion that could arise from the pipe's internal conditions.

Review of the water reticulation system

Having reviewed and being briefed as to the reticulation system on the farm, I have summarised the systems as follows:

1. Water is drawn from either the Komati or Crocodile rivers and fed to holding dams, usually located closer to the irrigated area. These dams could be considered as "settling ponds" where any suspended solids would be allowed to settle out of the pumped water. The draw off from the dams should be from the upper levels so as to ensure that

Sample No.	1	2	3	4	5	6
Description	Malelane Canal	Middenin Farm	Farm Dam	Crocodile River	Komati River	Centre Pivot

Table 1.

solids, in suspension, are not transferred into the irrigation reticulation system.

2. From the dams, water is directed to the various centre pivot irrigation machines. The header pipes are reported to comprise various materials including, steel, steel castings, cast iron and PVC pipes. Information as to the condition or degree of corrosion, within this equipment, i.e. from the rivers to the dams and leading up to the centre pivots was unknown, but is reported as being in "sound" condition. Corrosion within these pipes needed to be confirmed.

Condition of Pipes

Inspection of hot dip galvanized pipes, removed from certain centre pivots, after a reported service life of 12 years, it was evident that the zinc coating had been removed and that "serious" corrosion of the steel was evident. The photographs below illustrate the condition of these pipes.

The state of the pipes inspected varied from severely corroded, *figure 1*, to that indicated in *figure 2*, which had a zinc coating of 38.2µm. These two pipes were reported to have been taken from different centre pivot machines and to have been in service for similar periods of time.

The condition of the external surfaces of the hot dip galvanized pipes were examined and found to be in excellent condition. In addition, one of the operational centre pivots, reported to have been in service for approximately 10 years, was examined and likewise found to be in excellent condition.

As stated, it was evident that the corrosion found on all the pipes, occurred on the internal "water side" of the pipes. In order to establish the probable causes of such corrosion, water samples were taken for analysis. *Table 1* lists the various water samples taken on 18 September and sent to our materials consultant (Physmet) for analysis and report as to quality and corrosivity of the water.

Water samples collected, as identified within this report

Note: It is commonly accepted that the corrosive behaviour of natural water is influenced predominantly by pH and calcium carbonate saturation, frequently expressed by the Langelier Saturation Index (LSI). The results of extensive studies involving both field and laboratory investigations indicate that this concept presents an oversimplified picture of the problem. Corrosion in natural water depends on many interdependent variables, no simple equation or index is capable of adequately describing the corrosive potential of a given water sample.

In addition to the water samples, a section of pipe was recovered from a centre pivot that had been mechanically damaged. The section of pipe was also reported to have been in service for approximately 10 years. This particular machine was on a farm located approximately 10kms from Malelane.

Interpretation of the water test results

It should always be born in mind that the above test results are a "snap shot" taken at a specific time in the history of the system. It is known and accepted that the results can vary over time. This in turn will result in the water reticulation system being subjected to varying corrosive conditions throughout its lifetime.

The test results, shown in *table 2*, illustrate how the quality of water changes from one location to another, i.e. the water quality leaving the rivers is subject to change by the time it arrives at the centre pivot.

This report will however, concentrate on the water tests results obtained at the Centre Pivot (Sample No. 6).

The following discussion points are highlighted as being possible contributing factors to the corrosive attack on the centre pivot pipes:

- The pH (7.97) and hardness (612ppm) and LSI (0.157) indicate that the water is not corrosive to hot dip galvanizing and has the tendency to be scale forming.

Figure 1.

Figure 2.

Coating thickness reading taken on the cleaned internal surface of figure 2 measured 38.2µm.



Sample pipe recovered from a 10-year-old centre pivot. Pipe was removed from service due to mechanical damage to the machine.

- Of concern is the Chlorides in the water that appear to either accumulate within the dam or are being introduced from the Komati River. Chlorides in excess of 200ppm will cause zinc to be dissolved over time, i.e. the corrosive attack on zinc will increase due to the chlorides within the water.
- The Sulphates (40ppm) are low and will in all probability exclude sulphate induced corrosion. This fact has been confirmed by way of an e-mail from the client, in which he states that *"The rust flakes inside the pipes did not give the slightest smell of sulphur when I loosened them - the steel underneath was quite black and I would say clean"*. Not withstanding this comment, Sulphate Reducing Bacteria (SRB) cannot be totally excluded as it may have initiated the problem and has subsequently died and no longer evident in the system.

Examination of the pipe section *(Figure 1)*

1. Water had been lying dormant on the invert of the pipe resulting in a greater degree of corrosion in this area.

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Zinc usually corrodes uniformly, but when localised or "pitting corrosion" is in evidence, it is found that one or other form of bacterial corrosion is the underlying cause. The two photographs shown above are taken from within the same pipe.

2. There is evidence of "pitting corrosion" typical of bacterial corrosion, such as sulphate reducing bacteria (SRB) or alternatively "iron oxidising bacteria" (IOB). It would appear that we can exclude SRB as a possible cause of corrosion, but the evidence is typical of bacterial attack, for which there are numerous types.
3. It is also possible that "iron products of corrosion" from upstream in the reticulation system, are washed down into the centre pivot, where it will cause the zinc to work "twice as hard" in protecting not only the pipe, but also the iron residues from elsewhere in the system. Such residues tend to settle within lower sections of pipe and tend to cause more severe corrosion within the pipes nearer the centre of the machine, decreasing as one moves towards the ends or overhang. This consideration would appear to be confirmed by the two questions contained in the client's e-mail, re the Tenbosch machine, which I quote.

Questions:

Why does the 6" pipe span have significantly less deterioration compared to the 8" pipe spans?

Why does the overhang have almost no signs of deterioration?

Additional factors considered

In addition to the various factors highlighted above, a further consideration relates to "solids in suspension" (solids washed down from upstream in the system) and the entrance velocity of the water into the centre pivot. The combination of these two factors could result in erosion of the pipe at its entrance and through pipes located towards the centre of the machine. As the solids are deposited and the velocity dissipates, the erosive effects will deminish. Based on 1litre/sec/hectare, through an 8" diameter pipe, I calculate the entrance velocity at 4.317m/sec. This water velocity, together with any solids in suspension, can cause erosion/corrosion of the zinc coating.

Conclusions

Corrosion, evident in the pipes inspected, can be the result of a number of different aspects. In considering the evidence gathered on site and illustrated above, we believe that there are three possible reasons for the internal corrosion of these pipes:

1. Corrosion due to the quality of the water being used in the system, that could and does vary according to time and conditions. The "snap shot" of water samples were found to be

	Sample No.	1	2	3	4	5	6
	Description	Malelane Canal	Middenin Farm**	Farm Dam	Crocodile River	Komati River	Centre Pivot
pH		7.51	7.55	8	6.74	7.77	7.97
Conductivity	Micro-mhos/cm	230	405	450	270	470	500
Total Dissolved Solids	$CaCO_3$	100	162	180	110	188	200
Total Hardness	$CaCO_3$	204 Hard	524	664 Hard	280	644 Hard	612 Hard
Calcium Hardness	$CaCO_3$	≤10	108	120	≤10	≤10	44
Alkalinity	$CaCO_3$	240	680	592	288	302	290
Chlorides	Cl^-	112	164	504	108	508	504
Sulphates	SO_4^{++}	80	65	65	95	75	40
Nitrates	NO_3^-	≤10	≤10	≤10	≤10	≤10	≤10
Langelier Saturation Index	(LSI)	-0.998	0.507	0.937	-1.693	-0.665	0.157
Corrosivity		Not Scale Forming	Scale Forming	Scale Forming	Not Scale Forming	Not Scale Forming	Scale Forming

** Middenin Farm = Tenbosch Farm

Table 2.

good with the possible exception of the chloride content.

2. Evidenced by the fact that we have found “pitting corrosion” or very localised corrosion, (zinc normally corrodes uniformly) it suggests a form of bacterial corrosion (which may not SRB, which cannot be totally ruled out), or alternatively, but not proven, “iron oxidising bacteria”.
3. The erosive effect of solids in suspension being carried, at velocity, from upstream down into the centre pivot. Solids in suspension resulting from upstream corrosion products, being washed down through the system to the two centre pivots where the problem is being experienced. One needs to examine this aspect of the reticulation system as it may hold the answer as to why one particular machine has performed better than another.

Recommendations

- Generally, there is not too much one can do to change the quality of the water. Is it routinely possible to “back-flush” the machines and eject any solids and corrosion products from within the pipes?
- Investigate the corrosive condition of equipment upstream of the “worst” machine and establish what solids are being washed down into the machine?
- Introduce a catch screen at the entrance to a machine in order to prove or disprove the possibility of solids in suspension.
- It is recommended that when the system is not in use, it should be drained to help prevent the possible development of bacterial corrosion, which can result in standing water. Any bacteria will be destroyed when pipes are dried out.

Bob Wilmot.

Zinc and Health:

New study examines combined iron-zinc supplements for children

A new study in Indonesia led by the Department of Public Health and Clinical Medicine at the University of Umea, Sweden, concludes that combined iron-zinc supplements may be less effective in preventing deficiencies of the minerals than individual supplementation. The study set out to compare the effect in infants of combined supplementation with iron and zinc and supplementation with single micronutrients on the children's iron and zinc status. Nearly 700 infants were given daily supplementation of either 10mg iron, 10mg zinc, a combination of 10mg iron and 10mg zinc or a placebo. The researchers concluded that supplements of iron and zinc together might be less effective than single supplements in improving iron and zinc status among infants. They suggest that the interaction between iron and zinc decreases the effects of a combined supplement.

Source: American Journal of Clinical Nutrition 2003, Vol. 77, No. 4, 883-890

Hot dip galvanizing making a difference at grassroots level...

EThekwini Municipality has come up with a novel way, incorporating hot dip galvanizing, to help informal settlements in need. The EThekwini Housing Department explains their challenge as two-fold; available land occupied by informal dwellers is congested, making it virtually impossible for the EThekwini Housing Department to clear and pack sites with machinery for new housing schemes. Secondly when informal settlements develop, they tend to be crowded and make extensive use of wood as primary building material, which makes the occupants exceptionally vulnerable, particularly in the event of fire. Due to the lack of space many informal dwellings are also built on flood-plains which in many instances have had tragic consequences.

The challenge was to come up with a cost effective way which would house families either displaced to make way for new housing schemes or affected by natural disasters. According to the EThekwini Housing Department the need was so great a simple wood and iron structure was designed literally "on paper" and implemented approximately two years ago. These structures which have sprung up all over EThekwini are known as "Transit Camps". The wooden framed, hot dip galvanized sheeting clad structures house 5 - 6 units each – depending on the available space. The key to the design was rapid erection as one squatter camp fire could potentially leave as many as 200 families homeless! Hot dip galvanized sheeting was the natural choice of material, due to its resistance to the corrosive Durban environment. The longevity of the hot dip galvanized coating is also an advantage as the units are re-used once families move on to their new homes. Dealing with the sweltering Durban heat has also been dealt with effectively as all the units are clad with masonite boards inside, which act as insulation. Converted containers are implemented as ablution facilities.

The project is in its 2nd successful year and has seen Transit Camps erected in Chesterville, Cato Manor, Umlazi and Chatsworth. The project has provided shelter for close on 1 000 families since its inception.

Editors comment: Although not 100% accurate for sheeting, the coating thickness readings taken by means of an electro magnetic coating thickness guage, indicates that the sheeting conforms to a Z200 class of coating.

Personality Profile

Entrepreneur extraordinaire – Mokena Makeka

A 500 word Personality Profile is virtually impossible when covering an illustrious character such as Mokena Makeka of Makeka Design Lab in Cape Town. Just the list of accolades that this 33 year old entrepreneur has raked in thus far, consumes the entire "word budget". There's also no disputing that Mokena is a busy man – considering this newly married architect hasn't been on honeymoon yet (too busy) and this profile has taken all of 5 months to happen!

Mokena Makeka was born in Maseru Lesotho and grew up in Matatiele in the Eastern Cape. He had no idea about architecture and in fact enrolled for a degree at UCT in Electro-Mechanical Engineering. Engineering's loss was Architecture's gain when a colleague persuaded Mokena after a year to change to Architecture. Mokena hasn't looked back, raking in awards and high profile commissions in his wake. When asked to single out two awards/achievements that meant the most to him personally, Mokena doesn't hesitate – receiving the S.A.C.A.P. medal for best work over six years of academic study – he laughs; "they don't part with that one often". Also a CIFA 2007 Award for cutting edge design on the Retreat Police Station. Mokena is not big on role models and admits that he is inspired by everyone around him, whether they are lecturers or his students: "I take the best from those around me."

Mokena needs no encouragement to talk about hot dip galvanizing, which he always specifies – "even when I am going to paint over it!" He feels that hot dip galvanizing offers a particularly good solution in terms of budget constraints. "In this country, we simply do not have the resources in a majority of projects to use stainless steel or aluminium. Hot dip galvanizing is a useful resource and by no means inferior. It actually can provide a very aesthetically satisfying finish, all on its own." Mokena feels the only drawback of hot dip galvanizing in South Africa is the limitations in terms of sizing due to local kettle constraints. An exciting hot dip galvanized project that he was personally involved in as Chief Designer was the Mitchell's Plain Interchange, also winner of

the Architectural Category in the 2006 Eskom HDGASA Awards. An exciting project on the cards this year is Cape Town Station, which will take up a fair amount of his time and promises to feature "lots of hot dip galvanizing".

Mokena feels that GREAT South African architecture exists, but feels that most buildings and developments don't qualify to be classed as architecture and here he refers specifically to developments that embrace other styles of architecture, not indigenous to South Africa, such as Tuscan. "It's like a bad lipstick on a fairly ugly woman. It is essentially cutting and pasting. True South African architecture, now that's a Beauty Contestant!" South African architecture should be rooted and in context and show a keen understanding of cultures – only then can it be critically appropriate.

Mokena enjoys reading, sketching and drawing in his spare time and we sincerely hope that newlyweds, Mokena and Mathusi, find the time to go on honeymoon soon – wishing them all the best for the life together!

For more info on Mokena Makeka go to www.makekadesigns.com

The Association wishes to thank Desere Strydom for this contribution.

Team work does not have to be an illusion

Derren Brown is a British illusionist, well known for his startling mind-reading acts shown on television around the world. Although he says his results are a combination of "magic, suggestion, psychology, misdirection and showmanship", he does appear to be able to predict and influence people's thoughts with suggestion, manipulation and a great talent for reading body language.

One of his star acts is to get a symphony orchestra playing a piece of music through a conductor who is gagged and has his hands tied. After writing down the name of a piece of music and placing it in a sealed envelope, Derren instructs the orchestra to start playing individually anything they want to but to be aware of what the others are playing and to try to relate musically to them. He also instructs the conductor to mentally focus on a specific piece of music. In the beginning, the sounds emanating from the orchestra are mostly jarring and very unpleasant to listen to, but slowly, as the members of the orchestra better relate to each other, wonderful coherent music is played and it then turns out that the name of the piece is exactly what was written on the paper in the sealed envelope and amazingly exactly what the conductor was thinking of.

To the viewer, these happenings are all quite strange and perhaps a bit scary too. Does Derren hypnotise both the conductor and the orchestra or is it just cheating and showmanship for the sake of good TV ratings? Without getting to understand everything that's going on, it is most apparent that the members of the orchestra, who are trained to work together, were able to combine their individual musical outpourings so as to converge and produce a good piece of symphonic music.

Effective teamwork is not an illusion, with collaboration producing results that would not have been possible without a team. We have gone beyond those days where people achieved great results on their own, like Einstein, Newton and Michael Faraday. In today's world, where action is critical, individuals may still be able to dream up great ideas but it is very unlikely that they can implement these on their own. The ability of teams to turn shared knowledge into economic value is a cornerstone of business and industry. It's not what you as an individual know but what you in a team can do.

The concept of a team can, however, often be an illusion. Teams are set up in an autocratic fashion, thinking that if we call it a team and appoint what we think are team players, then by hook or by crook it must be a team and it better perform or else. As Ram Charan (Know-How) has described it: getting people to align their ideas in a team environment is a lot like herding cats. You put a lot of energy into it and they still do as they damn well please. How to produce effective teams has been written about in hundreds of business books and yet it would appear that most teams are not all that effective. In essence, teams often fail because the 'social system' of the team and the organisation are either not understood or ignored. Every company and every team within a company has a 'social system', which can best be described by the ways in which people come together to do their work. Like a symphony orchestra, they meet; they develop relationships with each other and in doing so they influence each other. How they work together creates energy and determines what decisions and trade-offs must be made.

In Derren Brown's case, the orchestra started out with nothing. By listening to each other they were able to share energy, harmonise their decision making and produce a collaborative effort. How Derren Brown knew what they were going to play remains a mystery!

The Association wishes to thank Bob Andrew who is a consulting value engineer and honorary member of the Association for this article.

HOT DIP GALVANIZING MEMBERS

GALVANIZER	LOCATION	TEL. NO	SPIN	NO. OF LINES	BATH SIZES (L x W x D) (m)
GAUTENG					
Armco Galvanizers	Isando	011 974-8511		1	13.2m x 1.5m x 2.2m
Armco Galvanizers – Dunswart	Dunswart	011 914-3512	●	3	5.2m x 1.2m x 2.0m 3.0m x 1.0m x 1.5m 2.0m x 1.0m x 1.5m
Babcock Nthuthuko Powerlines (Pty) Ltd	Nigel	011 739-8200		1	12.0m x 1.4m x 1.8m
Cape Gate (Pty) Ltd	Vanderbijlpark	016 980-2270		#	Wire galvanizer
DB Thermal SA (Pty) Ltd	Nigel	011 814-6460		In-line	16.0m x 1.0m x 1.0m
Galvadip (Pty) Ltd	Waltloo	012 803-5168		1	7.2m x 1.5m x 1.8m
Galvrite Galvanising (Pty) Ltd	Randfontein	011 693-5825		1	6.5m x 1.3m x 2.0m
GEA Air Cooled Systems	Germiston	011 861-1571		In-line	11.5m x 1.0m x 1.0m
Lianru Galvanisers cc	Nigel	011 814-8658		2	7.2m x 1.3m x 1.6m 4.5m x 1.3m x 1.6m
Macsteel Tube & Pipe	Boksburg	011 897-2194		In-line	13.5m x 1.6m x 2.4m
Mittal Steel SA	Vereeniging	016 889-8816		#	Sheet galvanizer
Pro-Tech Galvanizers (Pty) Ltd	Nigel	011-814-4292	●	2	3.2m x 1.1m x 1.5m 3.0m x 1.1m x 1.2m
Robor Galvanizers (Pty) Ltd	Germiston	011 876-2900		3 Tube	14.0m x 1.35m x 2.5m 10.0m x 2.0m x 4.0m Dia 42mm to 114mm max tube length 6.7m
Robor Tube	Elandsfontein	011 971-1600		1	Tube & pipe galvanizer
Supergalv	Alrode	011-908-3411		1	6.0m x 1.2m x 1.8m
MPUMALANGA					
Chevron Engineering (Pty) Ltd	Barberton	013 712-3131		1	0.7 x 1.2d
NORTH WEST					
Andrag Agrico	Lichtenburg	018 632-7260		#	In-line galvanizer
FREE STATE					
Harrismith Galvanizing & Steel Profiles	Harrismith	058 623-2765		1	12.0m x 1.2m x 2.5m
WESTERN CAPE					
Advanced Galvanising Corp.	Bellville	021 951-6242		1	8.0m x 1.5m x 3.0m
Cape Galvanising (Pty) Ltd	Parowvalley	021 931-7224		1	14.0m x 1.6m x 2.6m
Galvatech (Pty) Ltd	Bellville	021 951-1211		1	7.5m x 1.5m x 2.6m
Helderberg Galvanizing	Strand	021 845-4500		1	5.5m x 0.8m x 2.4m
Pro-Galv cc	Stikland	021 945-1803		1	7.2m x 1.3m x 2.6m
South Cape Galvanizing (Pty) Ltd	George Industria	044 884-0882		1	3.7m x 0.94m x 2.3m
EASTERN CAPE					
Galvanising Techniques cc	Port Elizabeth	041 486-1432		1	12.0m x 1.3m x 2.3m
Galvaspin (Pty) Ltd	Port Elizabeth	041 451-1947	●	1	3.0m x 1.2m x 1.8m
Morhot (Pty) Ltd	East London	043 763-1143		1	6.0m x 1.2m x 2.5m
KWAZULU/NATAL					
A&A Galvanisers	Pietermaritzburg	033 387-5783	●	1	3.3m x 0.9m x 1.9m
Bay Galvanisers	Richards Bay	035 751-1942		1	5.0m x 1.2m x 2.5m
Phoenix Galvanizing (Pty) Ltd	Phoenix	031 500-1607	●	2	14.0m x 1.4m x 2.5m 3.0m x 1.2m x 1.2m
Voigt & Willecke (Pty) Ltd	Durban	031 902-2248		1	9.0m x 1.2m x 2.5m

The bath dimensions provided in this schedule are actual dimensions. Please check with your galvanizer the actual component size that can be accomodated, either in a single dip or by double end dipping.

 # Sheet, Wire, Tube and In-line galvanizing members dedicate their plants to the galvanizing of their own products.

For specific contact names (eg. sales or production personnel) and mobile telephone numbers, kindly contact the company receptionist.

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