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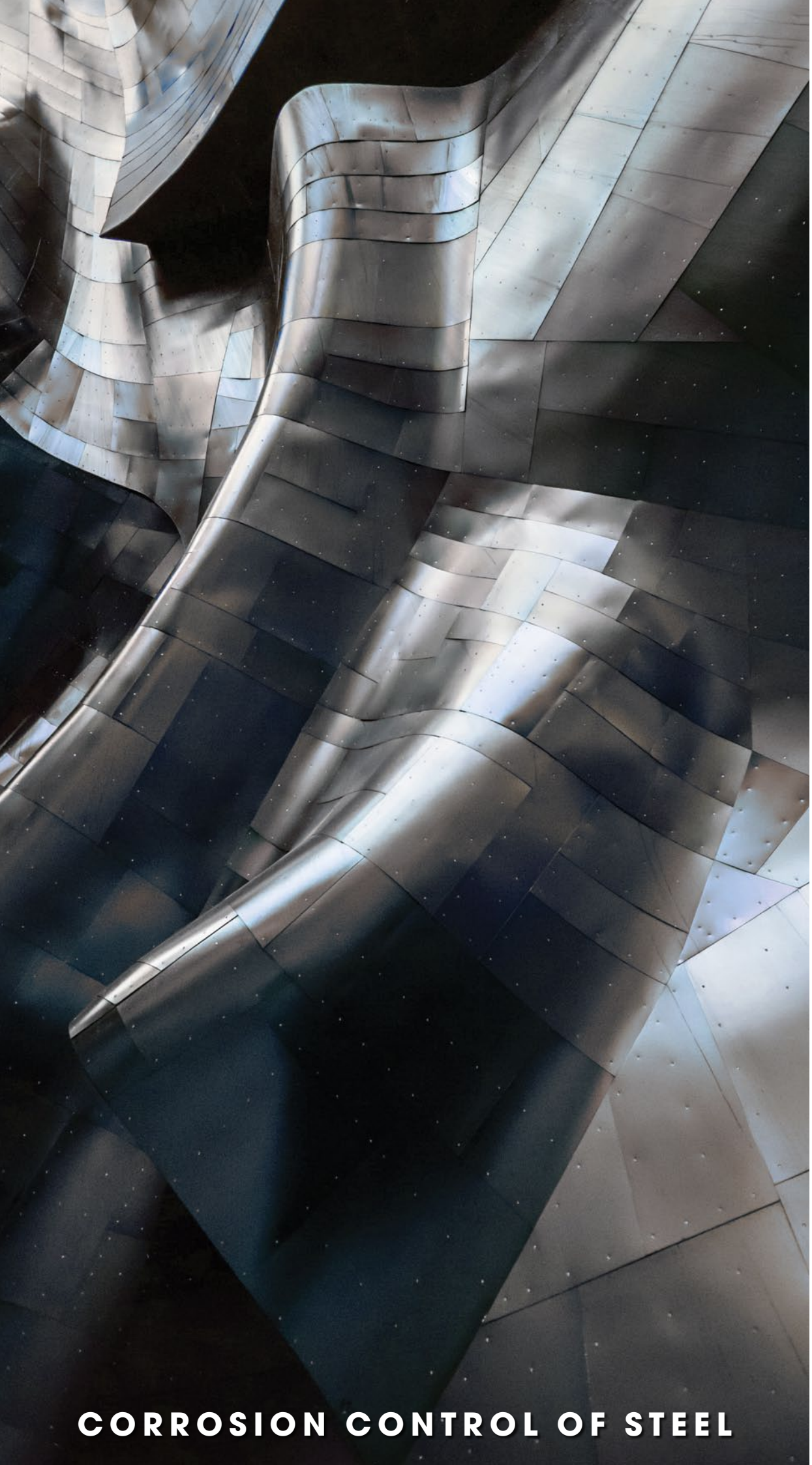

CORROSION CONTROL OF STEEL

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EXECUTIVE DIRECTOR'S Comment

The Association is at times drawn into post hot dip galvanizing discussions with customers during which time it becomes apparent that surface finish expectations are forged from the appearance of applied coatings such as paints or possibly zinc wiped products such as sheet or wire.

Whilst all international standards for the assessment of hot dip galvanized coatings are clear that the aesthetics of the coating are of secondary importance, there is little reason that coating appearance should disappoint the end user. The rider here is that the entire steel beneficiation chain has played their part in optimizing the finish of the product. At the outset the selection of steel must be a priority. Steel chemistry that falls within the Sebisty range of the Sandelin curve – see our *Steel Protection Guide* – will contribute to a uniform and predictable thickness of coating. Highly reactive steel in sharp contrast produces coarser and thicker coatings. Designers and fabricators are urged to follow the prescripts of ISO 14713. This standard is *Zinc coatings – Guidelines and recommendations for the protection against corrosion of iron and steel in structures: part 1- general principles of design and part 2- galvanizing.* Within this standard design issues related to best practice for ensuring steel cleanliness after fabrication, essential provision of ventilation and drainage, weld quality, cleanliness in and around weld areas and so forth are recommended. In the section related purely to galvanizing, the effects of surface condition, steel roughness, thermal cutting processes, introduction of internal stresses during fabrication are explained.

As a practical illustration inadequate vent and drain holes will cause blind spots in which no cleaning or fluxing fluids will flow during the galvanizers pre-cleaning processes. It is known that if the steel is not clean it will not galvanize. Worse is the risk of the ingress of liquids through porous welds. In such a scenario and with alack of adequate drainage, trapped fluids may flash over to steam causing damage and/or injury to personnel. For every m^2 of steel galvanized, approximately 200mg of ash may be generated. Well placed and adequately sized drain holes assist with run-off that prevents entrainment of ash on galvanized surfaces.

In parallel with the guidelines for good design and fabrication, the galvanizers naturally also have an important role in ensuring a good surface finish. Here the incoming inspection plays an important role in advising customers of any improvements that are needed regarding the ISO 14713 prescripts. Thereafter the galvanizer must pay attention to jigging practice – optimizing the flight bar for weight and angle of inclination to ensure effective run-off. Whilst the chemistry and condition of the degreasing and pickling tanks are reasonably simple to manage, these should be monitored to ensure continued effectiveness. Effective fluxing is important for a good outcome of the hot dip galvanizing process. The galvanizing pot man and his team must dip the steel with due attention giving to immersion time, speed and angle of withdrawal and good skimming processes.

From the above, it is apparent that the effective coating of the steel and the surface finish will be equally influenced by the effectiveness of steel selection and design as it will be by the galvanizing process. Both parties must collaborate for the best outcome. The Association is well positioned to assist in this regard.

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EDITORIAL COMMENT
in this issue

This issue looks at the industry from a few practical perspectives:

- The impact of loadshedding and the way forward are important factors going into 2024.
- The need for easy identification of material throughout the process can be improved with latest tagging technologies.
- Dross, the why, what and how we deal with it.
- Mining still remains a strong reality in South Africa and the sub continent with hot dip galvanizing corrosion control available to this key African industry.
- Steel cladding is a strong growth point with many benefits for owners and users we will be using this technology for many decades to come.
- The HDGASA had a day visit to AMSA Vanderbijlpark where delegates were taken on site to see the plate rolling mill and continuous sheet galvanizing facility, the event went well and more may be arranged in the future.

MINING ENVIRONMENT CORROSION CONTROL – Hot dip galvanizing

Hot dip galvanizing has been successfully used to protect small components as well as large structures in the Mining Industry in South Africa over several decades and accommodating extension of the life of mines beyond the original planned service life.

Hot dip galvanizing is a diffusion process and occurs when a suitably cleaned iron or steel article is immersed in molten zinc at ≈ 450°C. This is preceded by a cleaning phase which includes degreasing, pickling in acid and then applying suitable fluxing. Abrasive cleaning is generally not necessary, other than to remove weld slag or tenacious mill scale etc.

Through immersion, all surfaces are brought into contact with the molten zinc and resulting in the formation of a comparatively uniform, metallurgically bonded zinc and zinc-iron coating including internal surfaces, edges and corners. The general galvanizing process or Batch type hot dip galvanizing, of products other than sheet and wire, provides a dense coat which is capable of providing both abrasion resistance and corrosion control to iron or steel. The hot dip galvanized coating structure differs somewhat to the 'thinner' or wiped coatings applied to sheet and wire technologies. Zinc can be applied to steel and other metals by a variety of processes. These methods include electro-deposition, thermal spraying, mechanical plating, zinc rich pastes & paints and hot dip galvanizing.

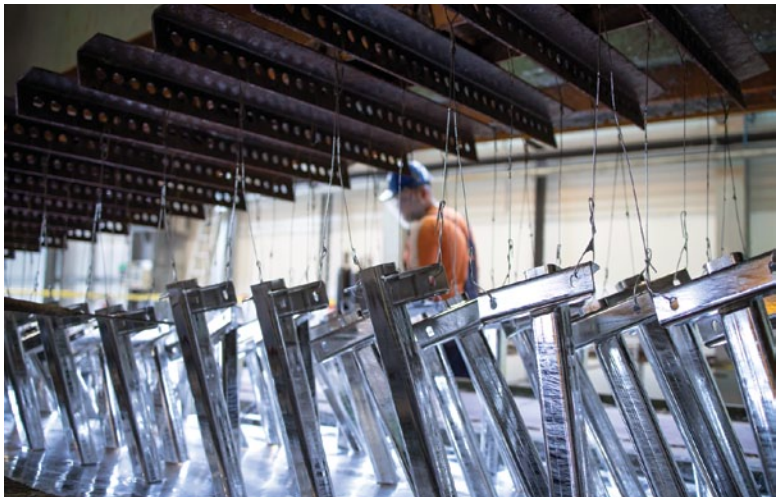
The formation of zinc-iron alloys i.e. metallurgical bonds between zinc and steel, are entirely absent in all other pure zinc coating technologies, used for corrosion control. The durability of a zinc coating is, in broad terms, roughly proportional to its thickness, regardless of the method of application. Hot dip galvanizing employs zinc's strengths as both a barrier and a sacrificial material.

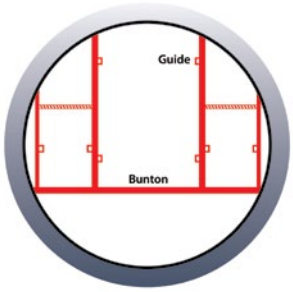
Applications of hot dip galvanizing for corrosion control include:

Structural steel applications

All structural steel is suitable for hot dip galvanizing. However the steel chemistry of a given batch will be the predominant determining factor of the thickness of the hot dip galvanized coating developed with the silicon and phosphorus content playing the major roles.

The preferred silicon equivalent* level is between 0.15% and 0.25%, and in this range, coatings are developed without such coatings becoming undesirably brittle. Not only do these thicker coatings provide longer corrosion free life but the abrasion resistant properties of the





zinc-iron alloys, which make up the greater proportion of these coating, are of considerable benefit in the case of buntons and shaft guides.

While steel suppliers are well informed in this regard, orders for shaft guide and bunton steel should state "material to be suitable for hot dip galvanizing, Si content 0.1% – 0.25%". This is not necessary in the case of normal structural steel such as angles etc.

** Silicon Equivalent SiE = Si % + (2.5 x P %) where Si = Silicon & P = Phosphorus*

Buntons

Streamlined buntons can be hot dip galvanized without distortion. An advantage is that internal surfaces are also hot dip galvanized. If buntons are not open-ended, drainage and ventilation holes must be provided on end plates to ensure satisfactory coating of internal surfaces and to prevent explosions during hot dip galvanizing. The hard zinc-iron alloys that constitute about 80% of the final hot dip galvanized coating are far more resistant to abrasion, which is experienced on the upper bunton surfaces, than that of uncoated steel or painted surfaces.

Shaft guides

Both top hat and square tube guides are suitable for hot dip galvanizing. The galvanizers who specialise in coating guides have installed equipment for checking tolerances and straightening should this be necessary. The main corrosion problem with guides is in crevices at bolted mating surfaces and the provision of a hot dip galvanized coating on mating surfaces reduces corrosion substantially.

Corrosion on riding surfaces is normally not severe, due to the wiping effect, but, the abrasion resistant zinc-iron alloys in the coating usually remain present, even on riding surfaces, for several years after installation. Guides are usually hot dip galvanized prior to cropping, drilling and matching but straps are hot dip galvanized after drilling. The drilling, cropping and matching may be performed by a specialist galvanizer, in-house, alternatively, the galvanizer is a sub-contractor to the fabricator in which case the galvanizer is only responsible, to the fabricator, for galvanizing and supply to the specified degree of straightness. Orders must specify that all cropped ends and uncoated bolt holes shall be coated by zinc thermal spraying in accordance with SANS 121: 2011 (ISO 1461: 2009).

Station steel structures

Screens, grid flooring and structural steel components, used in stations, are hot dip galvanized without difficulty. These structures are often test erected either at the galvanizer's or fabricator's works or even at the mine site to ensure correct fabrication has been carried out and to avoid the need for costly and time consuming modifications during installation underground.

Hydro-power piping

Organic coatings are generally unsuitable for protecting this equipment and either hot dip galvanizing or a material such as 3CR12 should be considered. When hot dip galvanizing is selected, the galvanizer must be instructed to remove excess zinc and protuberances from gasket grooves either by re-matching or melting out excess zinc. Another method is to mask grooves with a silicon based material which will prevent the formation of a coating in the grooves during galvanizing. The masking material is then removed after galvanizing.

Air columns

Galvanizing can be an effective method of protection for both internal and external surfaces of air-columns. Added external protection at deeper, more corrosive mine shaft levels, can be provided by duplex coating with an appropriate paint system.

Pump columns

The degree of corrosion control of a hot dip galvanized coating, applied to internal surfaces of high pressure pump columns, will depend on the level of corrosivity of the water being pumped, the amount of abrasive suspended solids present and the flow rate which, if higher than 0.5m/s, will reduce the service life of the coating.

External surfaces can be provided with additional protection by duplex painting at levels in a shaft where corrosion is severe but internal duplex coating is not recommended since it is difficult to determine whether paint coatings applied onto internal pipe surfaces possesses the required adhesion properties and dislodged paint films can result in damage to mechanical equipment in the pipeline system.

Flanged piping

When flanged piping systems are used under high pressure conditions, the galvanizer shall be required to ensure that the 'gramophone grooves on the flange faces, are clearly visible after the galvanized coating has been applied. Certain high pressure gaskets, however, do not require grooves to be present on flange faces. Hot dip galvanized high strength fasteners, with suitably lubricated threads, should be used to connect flanges.

Flangeless piping

Hot dip galvanizing has an advantage over organic coatings, in the case of flangeless piping, in that, provided the weld metal is deposited in a continuous, flowing and uninterrupted run, damage to the zinc coating, on internal surfaces, will be insignificant. If a second pass is required after the route run, the deposited metal must first be allowed to cool down in order to avoid excessive temperature build-up which could result in localised melting of zinc on internal surfaces. Both shielded wire and stick welding is suitable.

Ventilation ducting

This product was conventionally fabricated from 'thinly' coated pre-galvanized sheet to which ungalvanized flanges and attachments were welded. Ducting, which is fully galvanized with a heavy duty coating after fabrication, is now available and this should be specified. Ducting up to 1.5m diameter can be galvanized after fabrication.

Buried pipelines

The durability of external surfaces of buried pipes will depend on the corrosivity level of the soil. If soil conditions are corrosive and foreign non-corrosive back-fill is not available, the application of a low cost bitumen or tar coating, to galvanized external pipe surfaces not only prevents rapid thinning of the zinc coating but also reduces the propensity

for localised bacterial corrosion. However, a comprehensive evaluation of soil analysis etc, should always be carried out before using buried pipes.

Chute bodies

Hot dip galvanized structures are frequently used in conjunction with removable liners, in severely abrasive applications, and the ability of this coating to withstand fairly rough handling in service and when maintenance takes place, is an advantage. Contact between hot dip galvanized surfaces and uncoated steel may have the tendency to diminish the coating life at contact surfaces in moist conditions due to cathodic protection by the coating of the uncoated steel. This may be avoided, in some applications, by providing an insulating paint film prior to attaching the lining.

Headgears

Hot dip galvanizing of structural steel for sub-vertical headgears is a practical solution to the corrosion of these structures. Even for surface headgears there is a case for employing hot dip galvanizing. Hot dip galvanizing will provide indefinite maintenance free corrosion life for such surface structures at more or less the same initial cost of painting with a dependable paint system.

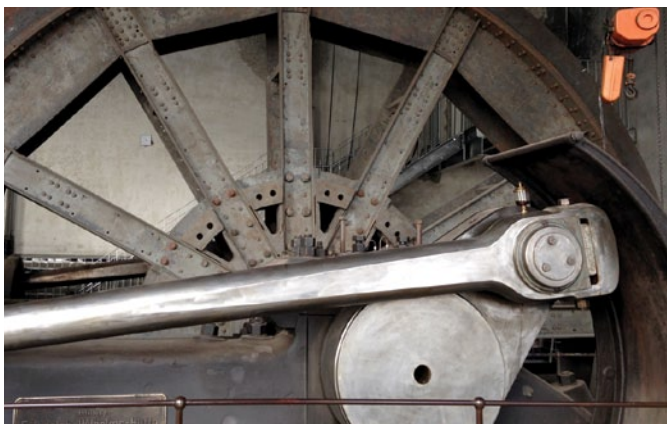
The plate girders on which these structures are mounted can distort during galvanizing unless they are designed with subsequent galvanizing in view (ISO 14713 parts 1 and 2). An alternative to galvanizing, for plate girders, is zinc thermal spraying or the application of an inorganic zinc-rich paint primer after abrasive blast cleaning and followed by a compatible paint top coat.

Gold plants

Structural steel, for the construction of gold plants, is effectively protected by hot dip galvanizing but, as zinc forms an amalgam with gold zinc coated steel should not be permitted where recoverable gold dust is present.

Refrigeration plants

Refrigeration and ice plants are effectively protected by hot dip galvanizing and no additional paint protection is necessary. The coating is not affected by sub-zero temperatures and it can be expected to provide maintenance free life when used in this application.



Cooling towers and storage tanks

Under most conditions hot dip galvanizing after fabrication provides adequate protection. Where corrosive water is used, added protection by means of a duplex system is recommended by using a product such as epoxy tar. In the case of storage tanks which will contain portable water specially formulated bituminous paints, which are "taint" free are available for internal lining.

Concrete rebar

Hot dip galvanizing of steel embedded in concrete does not adversely affect bond strength in any way and hot dip galvanized coating is being increasingly used to prevent concrete spalling caused by corroding reinforcing steel. Anchor bolts and other connecting devices, which are case into concrete, should be fully galvanized, not just the protruding portion.

Conveyor steel

Hot dip galvanizing of conveyor steel structure, including idler bases, is recommended and usually more cost effective than painting. This applies to both surface and underground conditions. It is, however, not practical to galvanize idlers.

Brackets, clamps and sundry fittings

Small components, including castings, forgings and hot and cold pressings are suitable for hot dip galvanizing. These products are galvanized by specialists who utilise a centrifuging process which removes excess zinc deposits. Provided that accepted engineering standards are applied in the manufacture of cold worked components, such as pipe brackets and cold headed bolts etc. the possibility of subsequent fatigue failure, during service, can be discounted. Maximum coating thickness standards for components falling into this category are provided in SANS 121: 2011 (ISO 1461: 2009) and this should always be specified in order to avoid receiving thinly zinc electroplated components by misconception.

Heat exchangers

These are often partially hot dip galvanized with a coating applied on the outside only. This is achieved by attaching a snorkel tube to the heat exchange header and then (because it will float) forcing it under the surface of the molten zinc.

Hot dip galvanizing is an effective method of protecting heat exchangers which would be difficult to coat uniformly by spraying or brushing with a paint system. Units are frequently removed after several years in service and regalvanized before being returned to service.

In all the aforementioned applications the corrosion control of iron and steel is achieved by firstly enveloping the articles in a tough imperviable barrier of the Zinc-Carbonate film, or zinc patina, and in parallel cathodically protected by the sacrificial anodic layer of the zinc and zinc-iron alloys. As we grow and re-establish the strength of the sector let us ensure the best practices in corrosion control to deliver the lowest Total Cost Of Ownership (TCO) of mines for the initial planned lifespan and potential extensions beyond.

METALS AND ENGINEERING SECTOR:
Load shedding impact assessment

1

1 Tafadzwa Chibanguza.

2 Employment and production trends *(Source: SEIFSA, Statistics South Africa)*

The energy crisis gripping South Africa is the most significant risk and binding constraint to the economic prospects of the country and is particularly damaging to the metals and engineering sector, which is the backbone of industrialization and to which electricity, is fundamental to survival.

The M&E sector constitutes 26.5% of the manufacturing sector, based on output, and 2.6% of the country's gross domestic product (GDP) on a value-add basis. The sector employed 374 496 as at December 2022, through some 1 000 companies.

The Metals and Engineering sector has been in a structural recession since the global financial crisis of 2008/9. Production in the M&E sector recorded a 1.2% contraction on a compound annual basis over this 15-year period. Considering the less supportive global economic environment and the impact of domestic rigidities of the energy crisis, production in the sector is expected to contract further by 2.2% in 2023. Employment in the sector mirrors the production trends contracting at -1.1% (CAGR) and contributing to the country's unemployment crisis.

The Covid-19 lockdowns were a major economic shock to the sector. While production levels recovered somewhat they are still 1% below pre-covid levels, employment trends have not responded positively, remaining at 4.6% below pre-covid levels. The weakening relationship between production and employment underscores that even with improving production outcomes conditions for employment creation are not roused.

The intensifying electricity crisis now presents the most prevalent economic risk to the sector.

SEIFSA undertook to survey its affiliated membership and developed this load-shedding impact assessment. The survey measures the impact of the energy crisis over a 12-month period (February 2022 to February 2023) across four main parameters:

1. Employment;
2. Production;
3. Investment;
4. An analysis of the alternative energy investments made by the sector; and
5. Impact to Input costs.

It is necessary to bear in mind that these results are from a sample representing 10% of the sector (measured on an employment metric). Theoretically, the outcomes, particularly the absolute numbers, could be multiplied by 10 to get the full impact on the sector.

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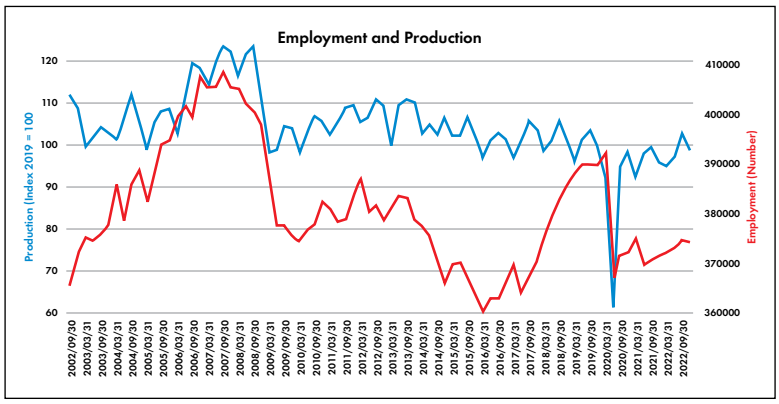

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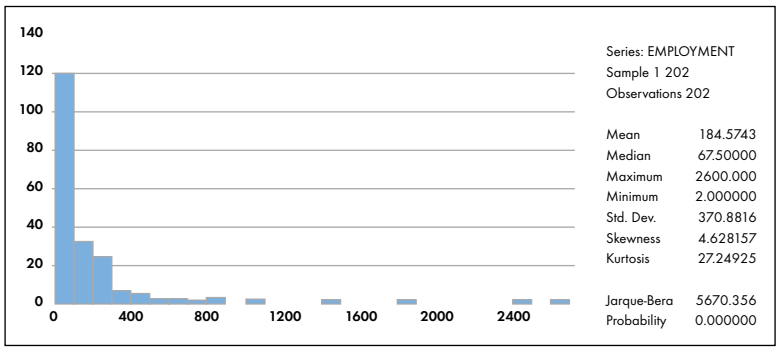

3 Histogram indicating the distribution of the company sizes relative to employment.

4 Consolidated results of the survey.

5 Outputs domestic and export, metals and engineering sector as a % of South Africa's GDP.

See consolidated results of the survey below.

Employment

- The employment losses, mostly attributable to companies responding to the energy crisis over the reference period, indicate some very concerning trends.
- A quarter of companies indicated that they have had to reduce head count in response to the electricity crisis, by as much as a quarter of their employment, equating to 9 432 people.
- A third of the sample indicated that they are working short-time due to the electricity crisis.
- An even more concerning outcome is the fact that half (16.9%) of those companies that are implementing short time have already reduced head count.
- We assign the status of "vulnerable" to these companies, while the other half (17.3%) have not reduced head count, however, short time is a good leading indicator to track for potential future job losses.

4

EMPLOYMENT	OUTCOME
Number of companies indicating that they have reduced head account as a result of the energy crisis	24,2%
Weighted average employment reduction	-25,32%
Employment reduction (number)	9432
Number of companies that have implemented short time	33,20%
Vulnerable (companies that have already reduced head count AND are working short time)	16,90%
Number of companies that have not reduced head count, but working short time (leading indicator for job losses)	17,30%
PRODUCTION	
Impact to production (over the last 12 months) – attributable to the energy crisis (Weighted)	-34,30%
INVESTMENT	
Companies that have cancelled investment/expansion plans (motivated by the energy crisis)	42,70%
Value of Investment Cancelled	R2,64 billion
Potential jobs not created due to cancelled investments	1620
INPUT COST	
Increase in monthly operating costs (from companies operating generators)	24,90%
ALTERNATIVE ENERGY SOURCE INVESTMENT	
Companies that have invested in alternative energy solutions (in the last 12 months)	79,20%
Capital Cost of alternative energy	R985,9 million
Extent to which alternative power source meeting consumption	53,60%
Installed capacity (Generator)	116,6 MW
Installed capacity (Solar)	36,2 MW

Production

- The respondents to the survey indicated production declines as much as 34.2% (weighted) as a result of the electricity crisis.
- Based on the model in *Table 5*, SEIFSA has calculated that production in the sector is estimated to contract by 2.2% in 2023.
- However, factoring in the results from this survey, the forecast for the 2023 year deteriorates to – 5.3% for the 2023 year.

Investment

- The long-term implications of this energy crisis to the future prospects of the sector are devastating.
- Over the last 15 years, net investment into the sector has been on the decline, which has led to the value of fixed capital stock deteriorating at -0.3% (CAGR), threatening the competitiveness of the sector.
- It is therefore concerning that 42.6% of companies have indicated that they have cancelled investment and/or expansion plans owing to the uncertainty presented by the electricity crisis.
- The value of these investments amounts to R2.64 billion with the potential of creating 1 620 new jobs. The split of the nature of investment is shown in the 'Nature of the investment cancelled' chart.

5

		DOMESTIC ECONOMY 61,8%				EXPORT 38,20%	
M&E %	= SA GDP	+	Primary Sector	Agriculture	6,8%		
				Mining	21,0%		
			Secondary	Basic Iron and Steel	23,3%	+	
				Machinery and Equipment	19,8%		
				Chemicals	4,2%		
				Construction	16,7%		
				Automotive	4,9%		
			Tertiary	Government (direct)	3,2%		
						Africa	39,6%
						Asia	24,7%
						Europe	21,8%
						Americas	12,2%
						Oceania	1,3%
						Antarctica	0,0%
						Not Allocated	0,4%

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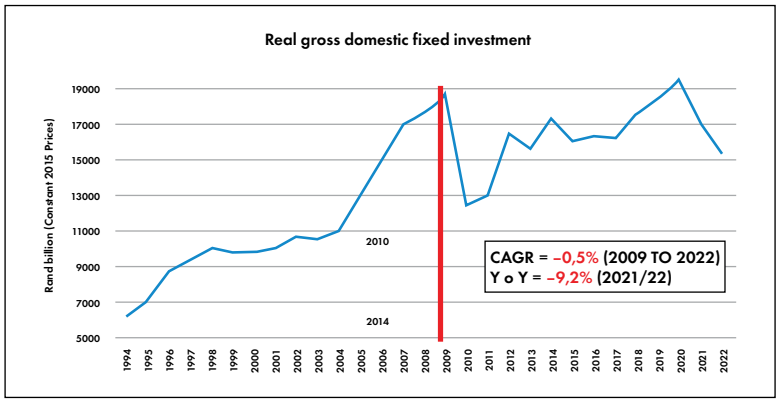

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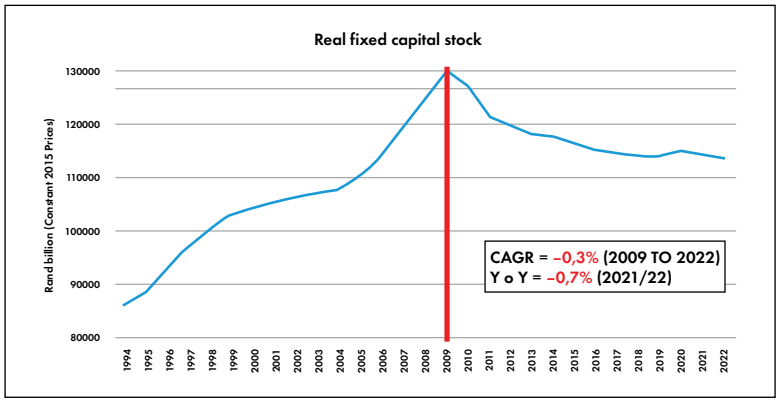

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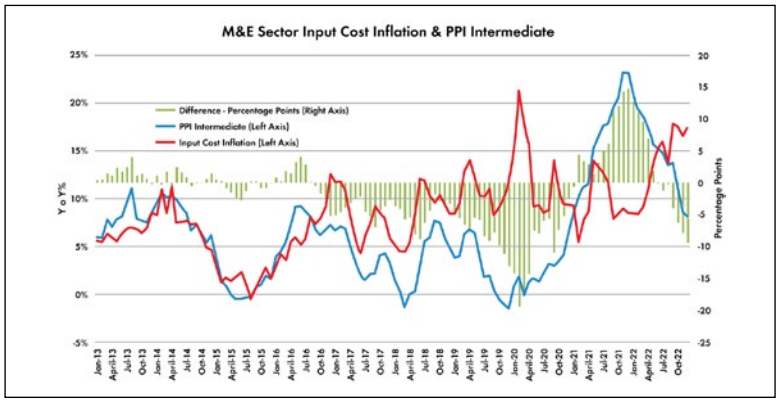

An analysis of the alternative energy investments made by the sector

- The breakdown of the alternative technology source invested in is contained in the pie chart. It is not surprising that given the relatively intense electricity consumption nature of the sector, the most practical alternative energy sources are generators representing 67%.
- 79.2% of companies indicated that they have had to install alternative electricity sources in the last 12 months to counter the pressing challenge presented by the electricity crisis.
- The combined value of this investment is R985 million. This number is considerable when taking note that it accounts for 37% of the value of investments cancelled. SEIFSA has repeatedly stressed that companies are sacrificing scarce long-term capital to fulfil immediate survival, presenting long-term adverse implications regarding the sustainability of the sector.
- Solar accounts for 20% of the investment made. It should however be borne in mind that this survey was done prior to the announcement of the tax incentive afforded to companies in the February 2023 National Budget. This incentive should result in an increase in the uptake of solar as an alternative source, however, the electricity consumption profile of the sector remains a limitation to solar being a full-scale option.
- On aggregate the companies have a

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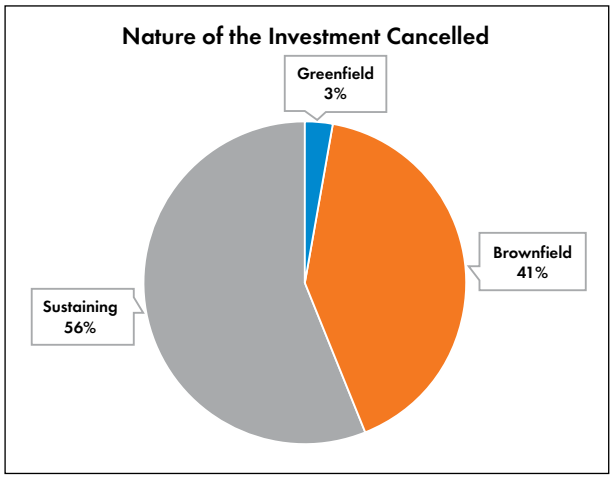

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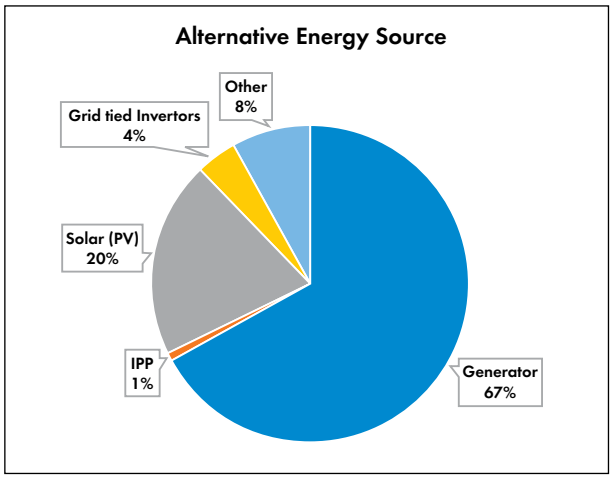


6 Real gross domestic fixed investment.

7 Real fixed capital stock.

8 M&E sector input cost inflation and PPI intermediate.

9 Nature of the investment cancelled.

10 Alternative energy source.

generator installed capacity of 116MW, while that of solar is 36.2%.

- The survey respondents registered their limited ability to feed in any excess electricity generated from their solar installations, largely due to the fact that the solar installations have been installed as a marginal hedge or top-up to their organization's baseload needs. This picture may well change given the tax incentive, although to a limited degree, as the sector's electricity consumption pattern is the main determinant for the technology deployed.

Input Costs

- On a weighted average basis, companies have indicated increases to monthly operating costs to the extent of 24.9% from the extensive use of generators.
- This does not bode well for a sector whose input costs are running at 17.6% (y o y – February 2023).
- Factoring in the results of the survey to the input cost model results in input costs increasing by 1.7 percentage points to 19.3% for the sector.
- The less supportive demand environment means that these companies cannot easily pass on these costs, thereby resulting in considerable margin squeeze and ultimately long-term sustainability.

The outcome of the survey is extremely valuable in providing tangible and quantifiable results necessary for upcoming engagements between SEIFSA and key stakeholders responsible for resolving South Africa's devastating electricity crisis.

Issued by SEIFSA

TOUR OF ArcelorMittal SA

ArcelorMittal South Africa in collaboration with the Hot Dip Galvanizers Association Southern Africa (HDGASA) recently hosted an industry forum at its Vanderbijlpark operation around the importance of the steel industry, particularly galvanized steel such as the Key Developments & Capabilities Dedicated towards Galvanized Steel.

Members of the delegation included:

Dale Kent and Francesco Indiveri – Transvaal Galvanisers; Petra Mitchell – CorriSA; Andrew Scott and Donavan Jones – PTL Products; Sherrit Kunene and Marius Scheepers – Central Support Systems; Anthonie De Wit – Durban Galvanizing; Kingsley Corbett – Rand York Castings; Jasen Carl Van Der Merwe – Louwill Lefa; Christopher Zamaos and Duncan Ackerman – ARMCO Superlite; Carlo Martemucci – CIS Engineering; Duane Ramos – Abeco Tanks; Robert Watchorn – METSEP SA; Gregory Combrink and Justin Carter – Corrosion Hub; Anthony Botha, Chantell Aucamp and Robin Clarke – HDGASA; Herman Jansen Van Vuuren, Riaan Eben De Beer and Alfred Mark Venn – Galferro Galvanisers.

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

STEEL CLADDING IN Southern Africa

Steel cladding has always been the dominant material for industrial buildings, albeit purely functional rather than aesthetic – however, it is increasingly being installed as both roof and side cladding on upmarket residential and commercial buildings across the country.

South Africa has already been ahead of other global players for decades, as on-site steel rolling for cladding purposes was a local innovation back in the late 1960s and early 1970s.

"More recently, sky rolling has been introduced to facilitate the rolling of exceptionally long, single lengths of cladding directly onto the roofs of structures. A local profiler recently achieved the world record for a single length of 240m."

Architects can make a big difference with cladding from a visual perspective, which is increasingly regarded as being worth the extra cost. Industrial buildings previously were built largely to be functional 'boxes'. The innovative use of cladding makes them more distinctive and aesthetically pleasing.

From an energy-saving perspective, the use of insulated metal cladding is still in its infancy in South Africa in this regard although the market is seeing examples coming through.

A trend was evident at the 2022 Steel Awards, which showcased several uses of cladding across categories, including in homes, offices and warehouses. One such project, a citrus processing warehouse located in the Eastern Cape, which used steel cladding in its roofing, won the Popular Choice vote at the Steel Awards event. Due to the unique combination of steel cladding and vents this building does not require any artificial heating or cooling, saving energy costs and cutting carbon emissions.

The opportunity of energy conversion using solar photovoltaic (PV) panels has shown the longevity of claddings as evaluated prior to the installation of PV Panel systems as electrical load spreading solar capture systems.

With the rapid trend towards a preference for steel cladding, Dennis White, Executive Director of the Southern African Metal Cladding and Roofing Association (SAMCRA) a sub-association of the SAISC – has for the past ten years been developing local product specifications and standards to ensure product quality.

"Our technical industry experts have been working on product specifications and certification to create a reliable testing regime for cladding properties, such as wind and gravity-induced loads, and to develop technical standards for products and the installation thereof. There were previously only outdated, adopted basic standards for cladding – but now as an industry, we have been able to contribute to this vital technical aspect of product certification," he says.

Furthermore states Dennis White, "Locally we face the challenge of a market, divided into formal and informal sectors, the latter being driven purely by price – with structural integrity and durability frequently disregarded. Substitution of inferior materials rather than using those specified is rife – particularly in the emerging contractor sector. This is, unfortunately, a challenge that can potentially damage the industry as in the quest to be 'all things to all people', emerging contractors install cladding without using appropriately trained and experienced cladding contractors.

In summary, the use of steel cladding will continue to be used extensively bringing with it impressive energy efficiency, safety, and aesthetic improvements to the built environment – provided the correct standards of safety and quality are adhered to. Standards and appropriately trained specialists are keys to the ongoing development and growth of this sector.

UNDERSTANDING galvanizing outcomes

DROSS

How does dross form?

Dross pimples may appear as small, hard lumps on a galvanized surface. This formation of dross arises from zinc reacting with 'free' iron particulate (Fe). Iron has limited solubility in molten zinc. For example, at a temperature of around 450°C, the iron solubility is about 0.035% Fe. This means that any additional iron that enters the kettle above this value reacts with the molten zinc and migrates through the melt, *Floating Dross*, to the bottom as *Invert Dross*.

The introduction of loose 'free' iron particles may be from newly cleaned steel, fixtures, pickle salts, the kettle wall, or temperature inversions that change the solubility level. This solubility correlation is temperature dependent and almost linear; as the temperature rises so does the solubility of iron. Floating dross may occur when the surface regions of the galvanizing bath are colder than the deeper regions. In this case, dross crystals separate out in the colder regions of the melt and remain floating in the bath or are deposited as pimples on the article being galvanized. The thermal discrepancy often occurs when the kettle is on 'low-burn'. In South Africa; this may arise under current load-shedding conditions when a galvanizing plant is subjected to thermal reduction due to the supply of energy being curtailed. When this occurs, the dross precipitates within the upper part of the bath and most commonly on the "cooler" upper wall of the kettle. When the burners are restored to 'high-burn' these dross crystals may then be mobilized by convection currents into the operating section of the bath and picked up on the work as it is withdrawn. The temperature gradient problem also is influenced by the wind chill on the surface of the bath, leading to floating dross. Bearing in mind that the direction of energy transfer is always from the higher temperature body to the lower temperature one. This creates convection currents towards the top of the kettle as the hot air evaporates to cool the surface while heat is transferred into the kettle nearer the bottom.

Another cause of floating dross can be unevenly distributed or high levels of aluminium (Al) or nickel (Ni). Bath element additions influence the formation of floating dross by changing the effective solubility of iron in zinc. At certain Ni levels in the bath, two types of dross co-exist floating dross and bottom dross. The floating dross consumes a lot of Ni and can reduce the operating efficiency of the bath. Bath addition management that allows abundant Ni-level oscillations can produce floating dross. When Ni is added to the kettle, the Fe solubility in zinc is reduced. If the bath is saturated in Fe, the excess Fe will precipitate out of the solution and combine with Zn and Ni to form dross, which will float in the bath and cause problems until it settles to the bottom of the kettle. Kettle size, geometry, the type of firing system, burner locations, and flue-gas paths all affect the solubility of iron in zinc It has been stated that floating dross is rarely observed with zinc-nickel baths, it is on the contrary very frequently present in

1 Dross on a galvanized surface.

zinc-aluminum baths. In reality, both aluminum and nickel help precipitate out of the solution to cause floating dross. These element additions are considered a more controllable variable when compared to temperature differentials.

Reducing dross formation

The reduction of dross formation can be accomplished by minimizing loose 'free' iron particles in the kettle, maintaining upper wall temperature, and maintaining zinc melt addition levels. Temperature differentials within the kettle are the most likely culprit for causing the unwanted floating dross. This requires that the kettle either be run on high-burn continuously to maintain the constant temperature on the top part of the bath or deal with the floating particles by repeated drossing and skimming after periods of bath inactivity.

Floating dross

Most publications and research describe bottom dross (invert dross) while disregarding the zinc-iron clusters known as floating dross. Consequently, no concrete solutions are available for floating dross. There are, however, several theories of how to rid the bath of the floating dross, once its presence is discovered. Thoughts are that bubbling nitrogen gas throughout the zinc melt will reduce floating. In extreme cases, the addition of lead to an SHG or HG bath has been used to eliminate the floating dross.

Besides taking the precautionary steps to avoid the formation of the floating dross, the best solution may be to wait for it to settle down to the bottom or to run a product that is only marginally affected by floating dross on the part.

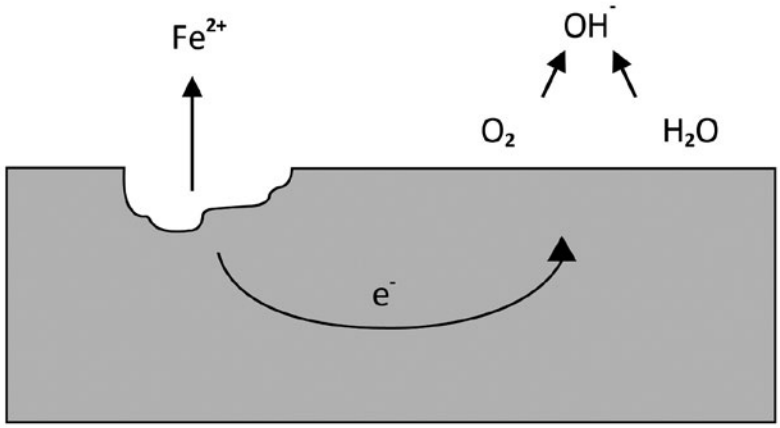
Conclusion

The formation of dross can be inhibited by practicable means, however, due to the nature of conditions affecting thermal variances in the zinc-melt dross will always arise. Floating Dross itself is a zinc-iron alloy particulate adhering to a coating comprised of zinc-iron alloy phases and poses no deleterious effect on the corrosion control efficacy of hot dip galvanizing. Smooth the surface unevenness if the pimples are sufficiently sharp so that they may cause injury.

PITTING CORROSION

Pitting corrosion is a highly localized form of corrosion and, as the name implies, a localized cavity or pit can develop with the surrounding metal remaining un-attacked. It often occurs on the more corrosion-resistant materials such as stainless steel and Aluminium but is also found on carbon steel. Pitting of stainless steel is often caused by chlorides (salt). Once a pit has formed, the corrosion within the pit is accelerated.

Compounded mechanisms drive pitting corrosion. This is because the corrosion reaction causes the fluid in the pit to become more acidic. In addition, the pit is the anode (electro-negative and corrosion always occur at the anode) in relation to the surrounding steel and so there is a small anode and a large cathode which usually results in rapid corrosion of the small anode.



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2 Schematic diagram showing the mechanism of localized corrosion.

Pitting corrosion is a common cause of failure of components where a pit leads to a hole or a perforation in the wall of the component although only a small amount of metal has been lost. This localized corrosion is not always obvious and if not detected in time, serious and sometimes dangerous failures can arise. Pitting corrosion is a localized form of corrosion by which cavities or "holes" are produced in the material. Pitting is considered to be more dangerous than uniform corrosion damage because it is more difficult to detect, predict and design against. Corrosion products often cover the pits. Pitting corrosion can also help initiate stress corrosion cracking.

Anodic zone (Fe oxidized into Fe^{2+} inside the pit) and cathodic zone (O_2 reduced into OH^- elsewhere outside the pit) develop on a metal immersed in an aqueous solution containing dissolved oxygen. Here, the pH conditions are neutral or alkaline (presence of OH^- ions in solution). The transport of ions occurs into the aqueous solution while electrons are transported from the anode to the cathode via the base metal (electrical conductor).

Prevention mechanisms

There are a number of ways to prevent pitting corrosion:

- changing the material to one that is more resistant to pitting
- by the application of a coating that will form a barrier between the material and the environment.

GALVADIP: Hot dip galvanizing resistant tagging

By Boris Pribil, GD Development at Industry-Connect

Traceability that survives the entire hot dip galvanizing process used to be an expensive and complicated problem. Physical laser or punch engraving was required. With GalvaDip, commonly used therma-transfer machines can now be used for full client → factory → site tracking.

Poor product identification during the galvanizing process can increase costs for companies, complaints from clients and loss of profitability. In these challenging times companies cannot afford to lose clients or increase energy costs by rerunning customer orders.

The idea

The initial concept of GalvaDip was to resolve traceability concerns at a hot dip galvanizing site. The client used heat and weather resistant tags printed from a thermal-transfer printer. These tags could not survive any acid treatment or zinc coats and products were misplaced and lost. With no capital allocation left a solution had to

Scenarios found to benefit from GalvaDip:

1 Receiving materials.

2 Automated scheduling.

3 Live tracking.

4 Post-Galv stick.

5 Customer notification.

6 Automated collection.

be developed using their existing thermal-transfer machine.

GalvaDip was developed to replace existing tagging from any basic thermal-transfer machine. The material can be used to print any QR, barcode or alphanumeric information. The roll format of GalvaDip also allows for tag sizing to be customized on-site.

Initially starting with a 1:1 replacement of existing tagging, GalvaDip will support any eventual ERP system upgrades. Through regular test and trials, different sizes, shapes and formats can all be designed on-site to fit specific requirements.

How it works

GalvaDip survives through its unique combination of steel and ceramic coating. All acid types and temperatures are resisted while the ceramic coat will prevent any zinc coating the tag. The black carbon ribbon is applied thermally in the printer, an easy and clean process. It will be clearly visible throughout galvanization.

Scenarios solved

Through continued use and further development with both hot dip galvanizing sites and fabricators there have been many scenarios found to benefit from GalvaDip:

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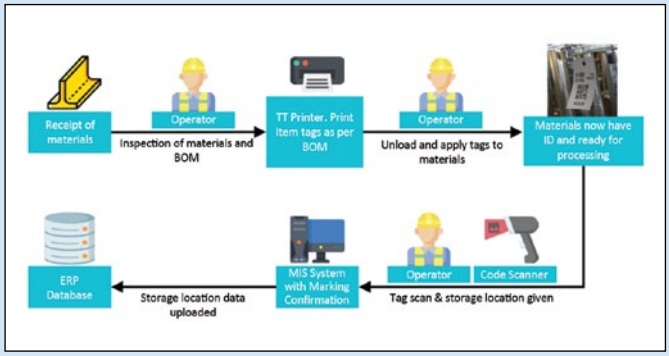

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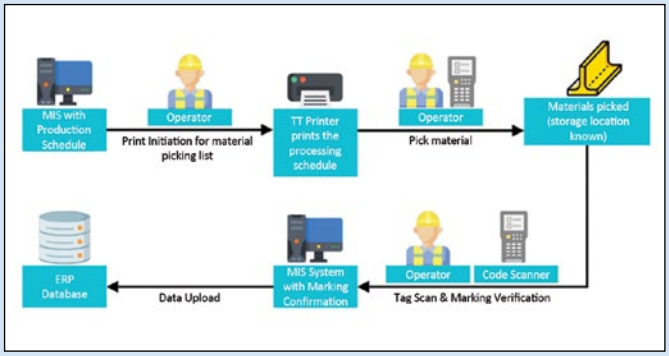

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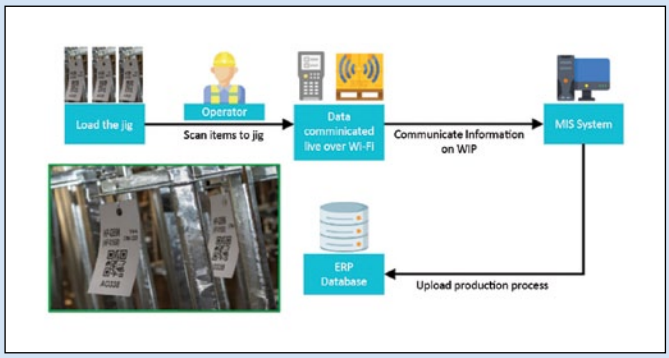

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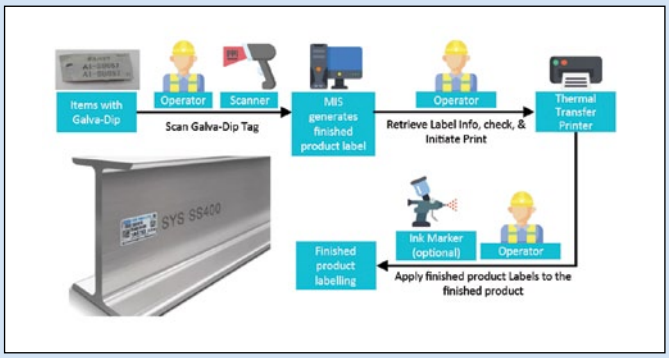

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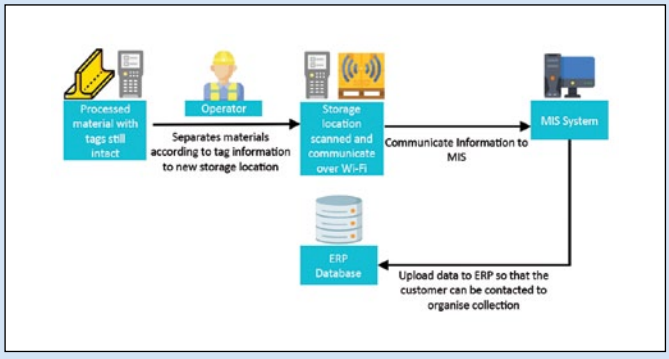

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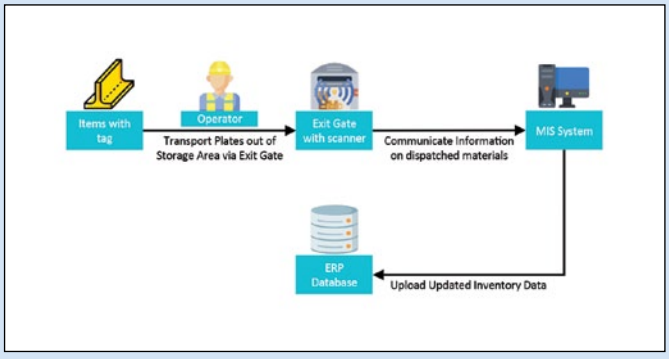

Receiving materials

On arrival all material can be logged and tagged. This ensures that any crucial information will remain with the product throughout the process. Eliminating human interaction and error.

Instead of any manual punching or writing GalvaDip tags are automatically printed and cut directly from your ERP system.

Once part of your database there will be no additional input from the users, only the manual hanging and unloading by operators.

Automated scheduling

During production, delays commonly occur during the miscalculation of jig space. Having to physically spot space increases processing time and can cause misallocation of material. During urgent jobs, some jigs may even be processed half-empty.

GalvaDip will solve this problem. By logging material on arrival the ERP system can automatically calculate demand and space. Operators can then easily identify jobs and when they need to be processed. Urgent customer requests are also automatically calculated ensuring no part is misplaced or lost.

Live tracking

If your site has additional treatment stages or you would like to galvanize the product multiple times, GalvaDip tags can be scanned to log the processing.

Operators scan QR codes and input any additional changes/information. This will then be registered in your ERP system generating live updates and calculating the flow at your site.

Post-galv stick

Once material has been processed an identical customer-facing tag can be duplicated. This GalvaStick adhesive tag will survive any transportation and weather conditions.

Customer notification

On completion the unique QR code is scanned and registered automatically in your ERP system. Using a simple command, customers can be automatically notified that their product is complete and ready for pickup.

This will ensure that no excess material is waiting in the yard for pickup.

Automated collection

Similar to job completion, items can be strategically sorted by your ERP system and placed in the yard. During customer pick-up items can be easily located and scanned out. The system will then register the action and confirm the job as complete.

No one application is the same. That's why we have the experience and people in place to ensure that GalvaDip can increase profit for your company and ensure satisfaction.

GALVADIP CASE STUDY
Entegra – Australia

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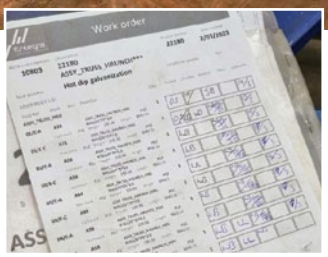

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1 The harsh Australian rural environment requires the sheds to receive full hot dip galvanizing.

2 Job number welded for traceability pre-galv.

3 Job number welded for traceability post-galv.

4 Work order generated directly from ERP system.

5 Initial tag design replacing existing job number and adding key assembly information.

6 Improved tag with additional website linking QR code.

Overview

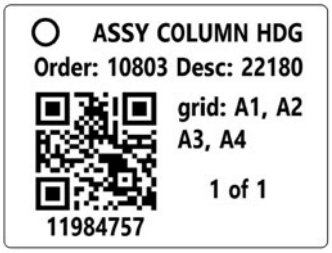
Entegra is a major regional designer and producer of metal sheds, silos, and other outdoor structures. Their primary market is in agriculture and mining.

Their process

After the design is finalised, each piece must be assembled and galvanized. To trace each section a crude job number is slowly welded to the steel – that's all that's used to track the material.

GalvaDip upgrade

Both welding and identifying job numbers are a timely and often inaccurate process.



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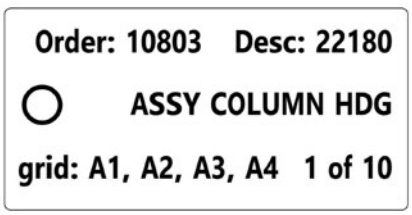

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Crucial information such as weight, centre of gravity and size is also missing.

Going forward GalvaDip will be used to instantly print comprehensive information. The tags will be delivered alongside work orders to the fabricators. As each part is assembled, a tag will be hung.

Going forward Entegra will add website linking QR codes to each tag. This will allow any fabricator or assembler along the production line to scan and identify all associated information.

GalvaDip will allow for full start-to-finish traceability. Once a job is created or material arrives, every worker along the production chain can instantly log and read all critical information.

On-site both the delivery and construction workers can move parts to their required location before assembly. No longer will workers be required to guess the correct parts.

HOT DIP GALVANIZING... THE **BEST PROTECTION!**

CONSISTENTLY DELIVERING SUPERIOR QUALITY GALVANIZED PRODUCTS TO ALL OUR CUSTOMERS

Armco Galvanizers Isando has been operating since 1989. Geared up to accommodate heavy structural steel up and till 13m in length. Isando has an average output of plus minus 2000 tons per month.

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

Armco Superlite is listed in accordance with the BSI ISO 9001:2015 quality scheme which ensures the quality of all products and services produced by **Armco Superlite**. Specific customer quality plans are drawn up where required for any of our operations.

Armco holds the SATAS mark for Hot Dipped Galvanized steel and all products galvanized at our premises are according to the SANS 121 / ISO 1461 specification. Galvanizing certificates are supplied on request.

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