## The importance of the correct specification of metallic coatings for steel – An EGGA White Paper



Vasile Rus



## **Continuously coated "ZM steels"** *Extensive use of misleading information for comparisons with batch galvanizing*



"10x better corrosion resistance" ??
"2-3x better corrosion performance" ??
"3.8x improvement in soil corrosion" ??
"estimated longevity of 90 years..." ??
"replacement for batch galvanizing" ??

## **Actions Taken...just some examples**

- Internal education and analysis
- Standardisation for steel products cable trays (salt spray classes..); highway guard rails; ....
- Corrosion testing standards ISO 8407 revision
- Sector-specific actions solar



NOTE: these data are probably created using non-recommended methods of removal of corrosion products for ZM steels CEGGA

Table 1: Comparison of HDG/ZM performance ratio from Thierry et al (2019) and calculated performance ratios for the most relevant last 2 years

10x better? 2-3x better? Not even in short-term tests

Mass loss (g/m²) Thierry et al (2019)						<b>Performance ratio HDG/ZM</b> EGGA calculations					
Exposure sites	HDG 1 <sup>st</sup> year	ZM 1 <sup>st</sup> year	HDG 2 <sup>nd</sup> year	ZM 2 <sup>nd</sup> year	HDG 4 <sup>th</sup> year	ZM 4 <sup>th</sup> year	1 <sup>st</sup> year	2 <sup>nd</sup> year	4 <sup>th</sup> year	Last 3 years	Last 2 years
Bangkok	3.6	0.6	7.1	1.3	19	6	6.0	5.5	3.2	2.9	2.5
Brest	9.2	2	15.4	7.5	32.8	15.3	4.6	2.1	2.1	1.8	2.2
Cadiz	4.3	1.8	6.5	2.8	12.8	7.8	2.4	2.3	1.6	1.4	1.3
Daytona Beach	11.5	2.5	28.6	6.7	31	31	4.6	4.3	2.2	1.7	0.3
Dubai	15.1	3.4	24.5	10.3	47.3	21.8	4.4	2.4	2.2	1.8	2.0
ljmuiden	7.3	2.2	11.8	6.8	24.4	12.3	3.3	1.7	2.0	1.7	2.3
Jiangjin	8.9	4.2	16	9.7	28.3	16.3	2.1	1.6	1.7	1.6	1.9
Kattesans	11.6	4	18.3	5.9	38.7	14	2.9	3.1	2.8	2.7	2.5
Kvarnvik	18.2	7.2	36.6	8.6	55.4	26.1	2.5	4.3	2.1	2.0	1.1
Qingdao	9.5	4.6	25.2	11.3	41.3	18.8	2.1	2.2	2.2	2.2	2.1
Singapore	14.4	5.3	25.5	10.4	43.3	22	2.7	2.5	2.0	1.7	1.5
Wanning	19.9	7.1	33.3	10.3	51.4	27	2.8	3.2	1.9	1.6	1.1
						Average	3.4	2.9	2.2	1.9	1.7

Method of removal of corrosion products for majority of exposure tests comparing galvanized coatings with ZM coatings has not followed the most accurate procedures : **under-estimating the corrosion of ZM coatings** 



### Corrosion loss for ZM coatings increases with time



Based on: Thierry D, LeBozec N, Le Gac A, Persson D. Long-term atmospheric corrosion rates of hot dip galvanised steel and zinc-aluminium-magnesium coated steel. Materials and Corrosion. 2019;1–8. https://doi.org/10.1002/maco.201911010

Results from 9 out of 12 sites presented in this study clearly show the corrosion loss of ZM coatings is increasing/accelerating with time

### JGA tests showed that the **CUT edges** have significant effect on overall corrosion on test panels – so also in real applications?







Mexico





Zn-Ai-Mg coating at formed area of typical highway guard rail



Source: CENIM, Spain

#### Zn-Al-Mg coating after bending through 2 x section thickness



Source: Nisshin Steel, Galvatech 2011

There are good reasons why batch galvanizing is applied <u>after manufacture of</u> steel components

#### MAGIZINC® PROTECTION THAT LASTS

MagiZinc\* is an innovative replacement for conventional galvanised steels. It provides superior corrosion protection even in harsh environments. Its unique formulation means that MagiZinc\* outperforms the protection of conventional galvanised steel. Suitable for a wide range of indoor and outdoor applications, it can be used to reduce coating weight or extend product life. This means less use of valuable resources and reduced environmental impact.

#### A product that performs

MagiZinc<sup>®</sup> was developed to deliver outstanding corrosion protection compared to conventional galvanised zinc coating. Its unique formula, incorporating carefullycontrolled levels of magnesium and aluminium, provides a stable barrier to reduce the corrosion rate. MagiZinc has been extensively tested by Tata Steel.

Comprehensive outdoor performance testing demonstrates the long-lasting product life even in humid climates and harsh environments. MagiZinc is successfully used in demanding environments for a wide range of interior and exterior applications.

MagiZinc (140gr/m<sup>2</sup>) and Zinc (275gr/m<sup>2</sup>) after 5 weeks in salt spray test



# ISO/TR 16335: "*Corrosion of metals and alloys* — *Corrosion tests in artificial atmospheres* — *Guidelines for selection of accelerated corrosion test for product qualification*"

#### 3 Categories and characteristics of accelerated corrosion tests

The oldest and most wildly used method for laboratory accelerated corrosion testing is maybe the continuous neutral salt spray test (category A in <u>Table 1</u>). The continuous salt spray test is particularly useful for detecting discontinuities such as pores and other defects in certain metallic, anodic oxide and conversion coatings as well as in organic coatings. However, although used extensively for the purposes of qualification testing, results from continuous salt spray testing seldom correlate well with in-service performance.

# ISO/TR 16335: '*Corrosion of metals and alloys* — *Corrosion tests in artificial atmospheres* — *Guidelines for selection of accelerated corrosion test for product qualification*'

Table 3 — Suitability of the different tests for assessing corrosion resistance of specific metallicmaterials with or without corrosion protection

			rosion tests				
	Metallic material	A (constant salt spray)	<b>B</b> (alternate immersion)	C (humidity cycling with salt spraying)	<b>D</b> (air pollutant exposure)	<b>E</b> (air pollut- ant exposure, drying and salt spray)	<b>F</b> (condensation)
	Metals and alloys	Ν	U	Р	4)	P <sup>5</sup> )	7)
	Metals protected by cathodic coatings	U	U	Р	4)	P <sup>5</sup> )	7)
Zinc and zinc alloy coatings on steel	Metals protected by anodic coatings	N	Ν	P1)	4)	P <sup>5</sup> )	7)
	Metals protected by conversion coatings on an anodic coating	Ν	U	Р	4)	P5)	7)
	Metals protected by organic coatings	Ν	U	P2), 3)	4)	P <sup>5</sup> )	<b>P</b> 6), 7)
	Metals with temporary corrosion protection	-	-	-	-	-	P8)

P = Preferred kind of method

!!!! Why is constant salt spray used to compare ZM with zinc coatings?

U = Useful for comparative testing of similar products

## No substitute for coating thickness

Accelerated (salt spray) tests with high chlorides are highly unreliable for predicting performance of ZM steels compared to ISO 1461 (...remove the chlorides and results are reversed...)





ZM Coated Steel

Results of accelerated corrosion testing (**in the absence of chlorides**) of batch galvanized sample (left) and ZM coated steel (right) **after 10 cycles** 

## Use of thinner zinc coatings has its risks





Let's communicate accurate and reliable information on use of batch galvanizing and comparisons to ZM steels



The Importance of the correct Specification of metallic Coatings for Steel





www.galvanizingeurope.org

www.intergalva.com

