BULLETIN

MADISON CHEMICAL INDUSTRIES INC.

InfoTech Bulletin #32

Coating Galvanized Metal Without Blasting:
GalvaGrip Surface Preparation Compound and Its Effect on the Surface of Hot Dipped Galvanized Metal

August 4, 2010

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1.1 Purpose

Duplex coating – the application of a protective barrier coating over the sacrificial zinc coating commonly known as hot dip galvanizing – is a widespread practice. Until recently, abrasive blasting was the only known way of achieving adequate long term adhesion of the barrier coating to the zinc surface. In 2008, Madison introduced a variety of what it calls "No-Blast" technologies, including GalvaGrip Surface Preparation Compound, which prepares galvanizing and other metals for the application of protective coatings without the need for abrasive blasting. This non-invasive approach is particularly important on hot dip galvanized (HDG) metal for many reasons, including the risk that blasting can remove a significant portion of the pure zinc top layer and can both expose and fracture the remaining intermetallic layers[1].

Under both commercial and laboratory conditions, it has been noted that the adhesion of appropriate barrier coatings is extremely high over HDG prepared using the novel No-Blast technology[2]. It has also been noted that very little of the zinc is removed by the surface preparation compound. This was determined by averaging the zinc thickness measurements before and after the use of GalvaGrip. The research study detailed in this report was conducted in order to develop methodology that would give us more precise data for two purposes. One is to determine in greater depth the mechanism by which GalvaGrip enables the achieving of these high coating adhesion values. The other was to measure, in a more exact way, the amount of zinc being removed and to confirm whether the pure zinc top layer was still intact, without the exposure of the corrosion-prone intermetallic layer. To achieve the above goals, laboratory experiments were designed to measure with precision the following parameters on HDG metal plates.

a) Surface Profile
- Average profile height
- Maximum peak-to-valley height
- Peak count

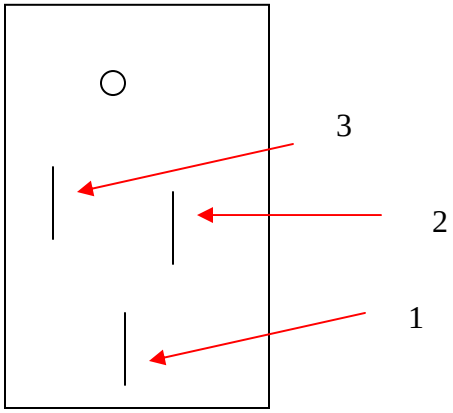
b) Galvanizing Coating Lost
Weight and thickness per standardized surface area

[1] There are several other factors as well, arising from the fact that abrasive blasting involves a number of difficult-to-control variables. A detailed discussion of these factors is beyond the scope of this report.
[2] GalvaGrip contains an ingredient called AP-50 Adhesion Promoter and is intended to work synergistically with coatings that also contain AP-50. A listing of appropriate coatings is available from Madison staff.

Method

1.2.1 - Surface Profile

Three standard- 4” x 6” x 3/16” HDG plates, galvanized by a commercial galvanizer in the traditional fashion, were used during the experiment. The profile of each plate was checked at three locations using a Mahr Perthometer with a PFM drive unit to gain an average plate profile (see diagram and photos below). Each plate was sprayed with GalvaGrip and left for three timed intervals of 10, 20 and 30 minutes. The plates were pressure washed with tap water after the allotted time, dried, and re-tested with the Mahr Perthometer.



Approximate locations of profile measurements

Mahr Perthometer test assembly with plate after GalvaGrip

1.2.2 - Amount of Galvanizing Coating Lost

Nine plates were used for this part of the experiment (the three used for the surface profile measurements, above) and six others. They were weighed with an analytical balance, sprayed with GalvaGrip and left for timed intervals of 10, 20 and 30 minutes (3 panels per interval). After rinsing and drying, the plates were reweighed.

1.3 Results and Observations

1.3.1 - Surface Profile

The following tables utilize the data collected from the Mahr Perthometer:

Table 1 - 10 minute application of GalvaGrip

3 readings	Rz Value (µi)	Rmax (µi)	RPc (/ i)	Rz % Difference	Rmax % Difference	RPc % Difference
1 Average	187	289	44	-22%	-34%	**941%**
A Average	146	190	461			

I –Represents initial results
A- Represents results after GalvaGrip
Rz – Means profile height (1000 µi = 1 mil)
Rmax- Maximum peak-to-valley height
RPc – Peak count per inch

Table 2 - 20 minute application of GalvaGrip

3 readings	Rz Value (µi)	Rmax (µi)	RPc (/ i)	Rz % Difference	Rmax % Difference	RPc % Difference
I Average	150	234	49	70%	53%	**653%**
A Average	254	359	366			

Table 3 - 30 minute application of GalvaGrip

3 readings	Rz Value (µi)	Rmax (µi)	RPc (/ i)	Rz % Difference	Rmax % Difference	RPc % Difference
I Average	120	204	34	136%	118%	**994%**
A Average	283	444	368			

1.3.2 - Amount of Galvanizing Coating Lost

Table 4 illustrates weight loss after GalvaGrip (Avg. of 3 plates per application time)

Appl'n Time	Difference in Weight (Oz) per sq. ft.	Thickness loss (mil)	Weight % Loss assuming 2 oz/sq.ft galvanizing
10 minutes	0.073	0.13	3.8%
20 minutes	0.095	0.17	5.0%
30 minutes	0.105	0.19	5.5%

Notes:

1. The thickness loss is based on the accepted conversion factor of 1.7 mil zinc coating = 1 oz. / sq. ft.

2. Weight % loss is based on the ASTM 123 specifications of minimum zinc coating for < ¼" thickness steel plate (2 oz/sq. ft.), which is equivalent to 3.4 mils. Typically the pure zinc layer represents half of this total and the intermetallic layers represent the balance.

1.4 Conclusions and Comments

1. The zinc coating weight loss is approximately 3.8 - 5.5% over a range representing the minimum, recommended and maximum practical exposure times. This translates into a maximum thickness loss of just below 0.2 mils. A typical HDG process, based on ASTM 123, applies a minimum thickness of 3.4 mils of zinc, therefore the removal of about 0.2 mils from the free zinc layer is a small percent and the vast majority of it is intact[3].

2. The effect of GalvaGrip on the surface profile is very evident with the Perthometer results. Even after 10 minutes, there is a dramatic increase in the peak counts (RPc), in the order of 650% to 1,000%. This is indicative of the 'etching' effect of GalvaGrip[4]. The results also show an increase in the average profile peak to valley depths (Rz), a process which becomes very evident within 20 minutes of initial exposure. By the 30 minute mark, the peak to valley depth more than doubles. Both of these phenomena are very significant, as they

[3]. The free zinc or eta layer is typically about 50% of the total galvanized matrix, so a loss of .2 mils would not expose the intermetallic layers or jeopardize the overall efficacy of the galvanizing system. Separate studies by independent 3rd party labs, Lambton Scientific and Exova, conducted on earlier dates, also conclude that the GalvaGrip process does not extend beyond the free zinc layer. These reports are available upon request.

[4] The Exova report reaches the same conclusion.

indicate a considerable increase of the surface area available to bonding, which naturally is desirable.

3. In summary, there is strong evidence to suggest that the GalvaGrip process, when applied as per Madison Chemical's application instructions, poses no risk of exposing the underlying alloy layers or of compromising the protective value of the galvanizing process. Furthermore, the etching effectiveness of GalvaGrip is confirmed by the significant increases in peak count and profile depth, both of which are universally associated with high adhesion values and long term coating performance.

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