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**MADISON CHEMICAL  
INDUSTRIES INC.**

**InfoTech Bulletin #24**

**Performance Properties of No-Blast  
Waterborne Protective Coating Systems**  
Mild to Moderate Atmospheric Service

**February 2010**



**Madison Chemical Industries Inc.**  
**“The Technology Leader For Infrastructural Coatings”**  
490 McGeachie Drive Milton, Ontario, Canada L9T 3Y5  
Phone (905) 878 - 8863 Fax (905) 878-1449  
Email: [sales@madisonchemical.com](mailto:sales@madisonchemical.com) Web Site: [www.madisonchemical.com](http://www.madisonchemical.com)

## **Performance Properties of No-Blast Waterborne Protective Coating Systems For Mild to Moderate Atmospheric Service**

Much research has been invested in developing waterborne industrial maintenance coatings in roughly the past twenty-five years. This has accelerated more recently for a number of reasons, including increasing costs of petroleum-derived raw materials e.g. solvents and resins, more stringent VOC and HAPS regulations and pressure from lower cost off-shore manufacturers of more traditional coating technologies.

However, in Chemical and Engineering News, Sept. 2007, commentators pointed out that while improvements are significant, the toughest corrosion situations still call for solvent based and high or 100% solids products. Specifically, waterbornes don't have the tight cross-linking of epoxies or polyurethanes which allows them to exhibit outstanding corrosion protection. In addition, waterbornes require meticulous surface preparation, particularly on metal substrates in order to achieve adhesion sufficient for an adequate service life. At best, the leading waterbornes may serve the medium duty markets (water towers, interior steel, factories, etc.). Innovation will be a key to any sustained success in this market.

Madison Chemical recognized the need to be at the forefront of these developments and a few years ago formulated its first high performance waterborne polyurethane coating. While seeing duty in areas such as floors and interior walls, it remained somewhat of an underutilized product. This was soon to change, however. With two seemingly unrelated discoveries during 2007, our researchers opened the door to a number of new applications for this technology. They discovered both a novel adhesion promoter and an easy-to-use metal surface preparation compound that provided adhesion results comparable to that of a commercial abrasive blast (NACE 3 or SSPC-SP6). Taking these discoveries and applying them to our ongoing work with waterbornes led to the FusionClad system for light to moderate industrial service.

The lynchpin of the system is FerroGrip Surface Conditioner. FerroGrip, a soap-like non-hazardous compound, is sprayed on the substrate surface at full strength. Over a period of 30-40 minutes, it dissolves mill scale, lifts oxidation, removes contaminants and lays down a layer of Madison AP-50 Adhesion Promoter. The prepared steel is ready to accept the FusionClad products.

Three water-dispersible coatings comprise the FusionClad System:

FusionClad Primer - advanced polymer-based steel primer

FusionClad TC (short for Top Coat) - advanced acrylic topcoat

FusionClad TC Ultra - advanced waterborne polyurethane topcoat

While each performs a unique function, they are designed to work synergistically with FerroGrip and each other. It's important to note that this system is designed for light to moderate service excluding immersion, ponding water, embedment and other highly corrosive environments. If these conditions are present, Madison recommends our more robust systems, including Alumizinc 'S', AcrylaThane and a variety of plural component, fast set polyurethanes.

The attached table compares the important application and performance properties of this system to some competitive products. A number of these are particularly significant:

1. The competitive products require a commercial blast surface preparation according to the manufacturers, whereas FusionClad utilizes FerroGrip. FerroGrip is a considerably more cost effective approach than abrasive blasting.

2. FusionClad products have considerably lower VOC content than its competitors, an increasingly important consideration.

3. The mode of destructive test failure for FusionClad adhesion pulls is cohesive (within primer layer) as opposed to being adhesive (between the primer and steel). Although competitor 4 has a higher numerical result than FusionClad TC Ultra, it fails adhesively, which is less desirable than cohesive failure<sup>(1)</sup>. The adhesion between substrate and coating is paramount to corrosion protection, thus FusionClad is arguably superior.

4. FusionClad TC and TC Ultra have a very hard, mar and scuff resistant surface, as indicated by 2H-4H pencil hardness. This is much harder than the competitive products, which range between 2B-HB. While competitor 4 does have significantly higher impact strength, this comes at the expense of a softer and more easily stained and marred film. FusionClad provides a better balance between these two competing properties, a more desirable condition<sup>(2)</sup>.

In conclusion, the combination of FerroGrip and FusionClad provides a unique approach to coating metal for light to moderate service. Surface preparation cost is reduced, while key performance properties are enhanced compared to more traditional approaches. Suggested end uses include a variety of interior and exterior applications, such as:

- fabricated steel or iron structures, e.g. trusses, girders, beams and other shapes
- sheet metal of all kinds and products manufactured from same
- metal cladding or paneling
- furniture, shelving, racking
- exterior of storage tanks, piping, silos

For detailed product specifications and application instructions, refer to Madison's Technical Data Sheets and Application Instructions for the aforementioned products.

(1) From *Corrosion Prevention by Protective Coatings*, Charles G. Munger, NACE International, 1999, p. 199-200

(2) From *Paint Technology Handbook*, Roger Talbert, CRC Press, 2007, p. 172

NOTE: The following are trademarks and/or registered trademarks of Madison Chemical Industries Inc.:  
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Version 2, February 2010  
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PROPERTY	REFERENCE	UNITS OR BASIS	FusionClad Primer	Fusion Clad Primer + FusionClad TC	FusionClad Primer + TC Ultra	Competitor 1 1 coat DTM Acrylic Primer/Finish 1 coat DTM Acrylic Coating	Competitor 2 2 coats DTM Acrylic Coating	Competitor 3 1 coat Universal Metal Primer (Alkyd) 1 coat DTM Acrylic Coating	Competitor 4 2 coats DTM Acrylic Enamel
Surface Preparation	SSPC		FerroGrip	FerroGrip	FerroGrip	Abrasive Blast, Commercial, Using Angular Blast Medium SSPC SP6			
VOC		g/L	30 per coat	30 primer <100 (topcoat)	30 (primer) 36 (topcoat)	<250 (top coat) <150 (primer)	<250 per coat	<420 (primer)	192
Adhesion	ASTM D-4541	PSI and Failure mode GF-glue AF-adhesive CF - cohesive	1050 100% CF  No intercoat failure	1200 100%CF  No intercoat failure	1520 100%CF  No intercoat failure	470 100%CF  No intercoat failure	900 60%CF 40%AF No intercoat failure	500 100%AF  No intercoat failure	2100 75%AF 25%CF No intercoat failure
Adhesion	ASTM D-3359	Pull by Tape	5B	5B	5B	5B	5B	2B	5B
Gloss	@ 60°		7	15.4	28.2	11	11	11	44
Abrasion	ASTM D4060, CS-17, 1 kg, 1000 rev	mg	172	144	79	78	52	95	87
Impact	ASTM D-2794	in-lbs	30	50	50	15	25	25	>200
Film Hardness	ASTM D-3363	Pencil (9H is hardest, 6B is softest),	HB	2H	4H	2B	2B	2B	HB
Flexibility	ASTM D-522 (180°, 5 mm mandrel)	Pass/Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Weathering - Gloss	QUV -	2000 hrs.	6.1	15.0	28.0	10.1	10.1	10.1	40.8
Weathering - DE	QUV -	2000 hrs.	0.85	0.61	0.55	1.25	1.25	1.25	0.48