



FACT SHEET

Preventing Corrosion by Producing the Best Adhesion of NEPCOAT-Approved Topcoat Paints Over Metallized and Galvanized Steel Surfaces

RESEARCH PROJECT TITLE

Measurement of Adhesion Properties between Topcoat Paint and Metallized/Galvanized Steel with Surface Energy Measurement Equipment.

STUDY TIMELINE

April 2010 - September 2013

PRINCIPAL INVESTIGATOR

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MORE INFORMATION

http://www.uvm.edu/~transctr/pdf/netc/NETCR93_05-5_with_bookmarks.pdf

The New England Transportation Consortium, a cooperative effort of the transportation agencies of the six New England States, funded this research. Through the Consortium, the states pool professional, academic and financial resources for transportation research leading to the development of improved methods for dealing with common problems associated with the administration, planning, design, construction, rehabilitation, reconstruction, operation and maintenance of the region's transportation system.

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What was the Problem?

For many highway transportation steel structures, a zinc coating is applied to the surface of the steel for corrosion protection. Zinc is applied to steel in three ways: by zinc-primer paint, by metallizing (where hot zinc is sprayed onto the steel surface), or by hot-dip galvanizing (where the steel part is immersed in a molten zinc bath and a zinc layer metallurgically forms on the steel). Paints are often applied to the zinc-on-steel surfaces for additional corrosion protection and an aesthetic color finish (the duplex system). The frequent sight of peeled off paints on galvanized posts and other highway structures lead to a general impression that it is harder to achieve a good paint adhesion on metallic zinc-coated steel surface than that on the bare steel surface.



What was done?

This study tested adhesion properties of paints on different profiled zinc surfaces, and correlated adhesion with paint wetting. Researchers used the liquid paint contact angles as a measure for the wetting property and used the pull-off strength of the dried paint as a measure for the adhesive strength. The researchers also prepared metallic zinc coated metal substrates for painting by using three different methods for creating the rough surface: 1) galvanized steel surface roughened by sweep blasting, 2) galvanized steel surface roughened by mechanical grinding, and 3) naturally rough zinc surface produced by thermal spray of molten zinc droplets on steel plates (metallizing process). Test panels consisted of 17 different paint/metal pairs and a total of 84 painted test panels. Researchers performed at least 3 pull-off adhesion strength tests and 2 X-cut tape adhesion tests on each painted test panel. Thirty four profiled metal substrates were also used to test the paint wetting properties.

What are the next steps?

This report compares the adhesion properties and recommends practices that produce the best adhesion of NEPCOAT-approved topcoat paints over metallized and galvanized steel surfaces. Through an analysis of the correlation between the pull-off strengths and the contact angles, this report provides insight on the relative adhesive strengths of the different paint-substrate pairs. The researchers concluded that (1) the NEPCOAT paints could be used for galvanized and metallized steel to obtain comparable adhesion performance as that of the zinc-rich organic primer coated steel, (2) although the NEPCOAT intermediate paint on the metallized surface has adequate pull-off strength to pass the inspection, it is highly recommended that the state DOT specification of the use of sealant is strictly followed, (3) a time delay of two weeks between galvanizing and profiling/painting is permissible if the galvanized steel is stored in the normal indoor dry atmosphere, (4) a refined quantitative correlation between pull-off strength and contact angle could be useful for optimizing the paint-to-substrate match.

What are potential fiscal impacts?

Preventing corrosion on steel highway transportation structures in New England by improving the adhesion of NEPCOAT-approved topcoat paints will reduce the cost of replacing corroded steel parts. This report provides data on adhesion performance, as well as recommendations regarding which type of treatment is better for long term performance.