Corrosion Office's Technical Corrosion Collaboration Announces Research Success

Experts Discuss Discrepancy Between Exposure Results in the Lab and Field

By Bill Abbott

There is increasing evidence that many lab corrosion exposures produce results in significant disagreement with field experience. This is proving to be true in the case of the evaluation of new and, in particular, non-chrome paint systems. In some cases lab testing may produce results in contradiction with field exposures. In spite of this, salt fog testing often remains a requirement for the qualification of paint systems. Data from such tests may have a large impact on decisions regarding the use of new paint systems on military assets.

The Problem

A good example of one consequence of these effects involved a particular non-chrome primer being considered as a prime candidate for part of a non-chrome paint system. This is a commercially produced magnesium-rich primer.

Early lab testing according to the test standard ASTM (American Society of Testing and Materials) B117 for early generation products produced severe blistering on coatings using the magnesium-rich primer. At the same time, field exposures, even in severe environments, failed to show such effects, and actually showed a high corrosion resistance. In spite of the latter results, the lab data could cause a potentially good system to be disqualified from use.

Technical Corrosion Collaboration's Approach to Resolving The Discrepancy

This existence of a significant field versus lab discrepancy provided a good opportunity for the Technical Corrosion Collaboration (TCC) pilot program to study a subject of immediate interest to the services. The TCC program is sponsored by the Office of the Secretary of Defense (OSD) Corrosion Policy and Oversight Office. Three universities participating in the TCC program, including The University of Virginia, the University of Southern Mississippi, and The...
Ohio State University, undertook tasks as part of this study.

The questions to be resolved included the following: What is the source of this discrepancy? Should any ASTM B117 test method and results be applied to coatings evaluations such as those involving the magnesium-rich primer? The products of the university work that were key to answering these questions included (1) a fundamental understanding of the actual protection mechanisms afforded by the magnesium-rich primer and (2) a working explanation of the cause of the blisters observed on early-generation coating formulations. This information should allow the DoD and coating manufacturers to make improvements to the coating formulation and to produce a more realistic accelerated test environment for the qualification of the magnesium-rich primer technology.

The Results

In short order, similar observations of field versus lab discrepancies were made by the universities involved. The major sources of magnesium-rich primer blistering were shown to involve a high time of wetness, and high chloride concentration. The ASTM B-117 exposure environment makes no effort to realistically reproduce field exposure environments with respect to many factors commonly accepted to be relevant to environmental severity, such as those mentioned above. It was also found that the blistering could be prevented by including high concentrations of acidifying atmospheric gases into the B117 environment such as carbon dioxide (CO$_2$). While multiple mechanisms by which these factors may inhibit blister formation may exist, there is strong experimental evidence that making simple modifications to the B117 exposure environment may totally eliminate blistering on at least the magnesium-rich primer. Even if such changes were made, this would not necessarily mean that B117 could be used for realistic corrosion testing.

The “problem” or the perception of a problem using magnesium-rich primer has been resolved. Adverse conclusions regarding the merits of the magnesium-rich primer based on earlier blister formation in lab testing should be disregarded as not applicable to field use. More specifically, ASTM B117 should not be used for corrosion testing of this, and probably other, new coating systems.

Conclusions

At the moment, empirical evidence shows that the best available data related to non-chrome coatings are those based on actual field use/exposures. These results represent one small but relevant example of the field versus lab discrepancies surrounding corrosion exposures. Unfortunately, at the present time there is no laboratory test that can reproduce results from the field with certainty. This is one area in which TCC research is currently involved.

Disclaimer

These findings do not necessarily represent an endorsement by OSD of this particular non-chrome technology. This information is presented to aid potential users in the decision-making process and to bring attention to critical new data.

Editor’s Note: TCC researchers from The University of Virginia, The University of Southern Mississippi, and The Ohio State University collaborated with OSD in the production of this report.

References