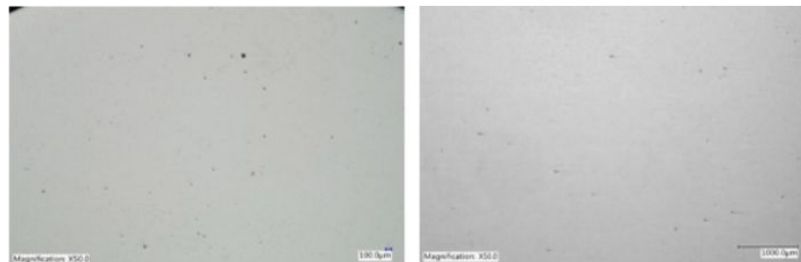


## Improving the Durability of Packaging Materials



VCI E post exhaustion; grade 3.

+ Superhydrophobic coating, grade 4.

FIGURE 2 VIA tests comparison of VCI E corrosion behaviors using superhydrophobic coating.

tion VIA tests, creating concerns about the exhaustion test criteria. One possible explanation for the failure is the exhaustion test conditions; 60 °C for 12 days while circulating air at 50% RH and a flow rate of 100 cm<sup>3</sup>/min can result in the loss of the VCI component on the wrap paper. Therefore, following exhaustion tests, the VCI quantity is not sufficient to protect the steel sample during the VIA tests. The other issue is the mechanism of VCI surface adsorption. When the VCI adsorbed onto the steel surface, its hydrophobic nature does not allow wetting of the surface that results in better corrosion protection. The exhaustion test on the wrapping materials removes (depletes) the protective VCI compounds and results in unacceptable VIA grading.

It is a more realistic approach to conduct the exhaustion tests on the wrapped steel samples with VCI packaging materials and subject those samples to the VIA tests. These tests demonstrate whether the VCI-adsorbed compound can maintain its attachment to the metal surface during the exhaustion tests, protecting steel samples against corrosion. By modifying the exhaustion tests to include the steel samples in the test chamber (wrapping steel samples with the VCI impregnated papers during the exhaustion cycle), VIA tests showed a very satisfactory performance for VCI A, VCI B, VCI C, VCI D, and VCI E, with a grading of 3 to 4. This modification in the exhaustion cycle allowed the VCI molecule to be absorbed on the steel surfaces; improved corrosion performance was seen for these VIA tests.

## Conclusions

In summary, VCI-impregnated papers showed satisfactory corrosion protection in the VIA test method after exhaustion

tests and steel samples achieved grade 4. Applying superhydrophobic coating showed a satisfactory performance for all impregnated papers. Two commercially available papers failed the post exhaustion VIA tests. This created concern over the feasibility of the exhaustion test criteria. Conducting the exhaustion tests on the wrapped steel samples with VCI packaging materials and subjecting those samples to the VIA tests demonstrated satisfactory results of grade 3 to 4. Therefore, the MIL-STD 3010C VIA and exhaustion test method might need to be re-evaluated and the exhaustion cycle procedure modified.

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