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ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Evaluation of Propak VCI Film

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Project #: 17-227-1916 Part 2

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Approved by:

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Background: Two samples of Propak VCI film were submitted by Interface for WVTR testing under project 17-227-1916. Part 2 of this report will evaluate one of the Propak VCI films for corrosion inhibiting properties. There was insufficient quantity of the other film for the additional testing.

Sample Received: Blue Propak VCI Film, 3mils, received in 2017 in good condition

Method: FTIR Analysis, CC-006, using ATR accessory
Razor Blade Test, CC-004*
NACE Standard VIA Test, TM0208-2008, item No. 21253*
Nitrite/Nitrate Test*
*The tests marked are not covered under Cortec Laboratories, Inc. ISO 17025 Scope of Accreditation

Materials: VIA test kit (testing jars/apparatus, steel plugs, 400grit sandpaper)
Carbon Steel panels, SAE 1010 (for razor blade testing)
Copper panels (for razor blade testing)
Glycerol (lot #Q10A018)
Nitrite/Nitrate Test Strips (lot #HC719626)
Methanol, ACS grade (lot #071417B)

Procedure: For VIA testing, the procedure was followed according to NACE VIA Test, TM0208-2008 option 2 (option 2 uses machine-aided grinding and polishing for the steel plugs).

Note- the VIA tests were conducted using two strips of sample per jar (1" X 6" per strip)

The FTIR analysis and razor blade testing was followed according to standard procedure. The ATR accessory (FTIR) effectively measures chemical composition at the film surface. Therefore, by obtaining spectra from both sides of the film, it can be a useful tool to determine if both sides of the film have a similar composition (monolayer or symmetric coextruded) or different compositions (asymmetrically layered Coex). For Coex VCI films, it is common to concentrate the VCI in one side of the film.

Results: The following results were found:

Razor Blade Test- Carbon Steel Panels

Sample	Panel #1	Panel #2	Panel #3	End Result
Propak VCI Film (front side)	Fail	Fail	Fail	Fail
Propak VCI Film (back side)	Fail	Fail	Pass	Fail
Control	Fail	-	-	Fail

Razor Blade Test- Copper Panels

Sample	Panel #1	Panel #2	Panel #3	End Result
Propak VCI Film (front side)	Fail	Fail	Fail	Fail
Propak VCI Film (back side)	Fail	Fail	Fail	Fail
Control	Fail	-	-	Fail

NACE VIA Test

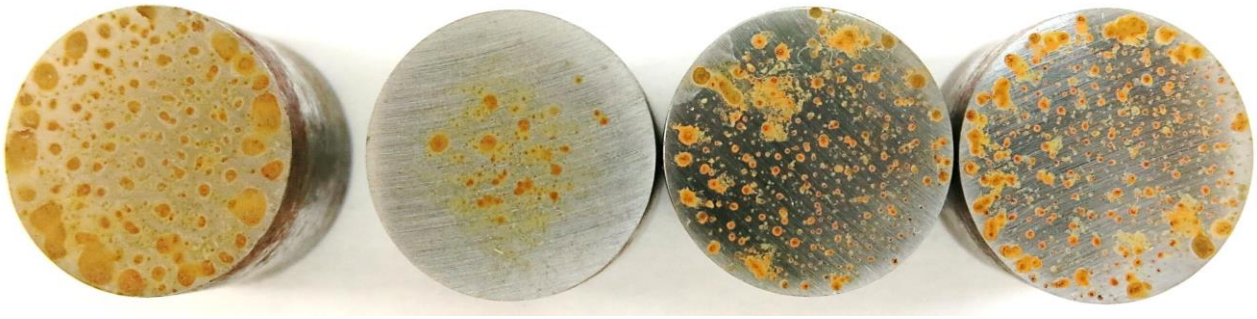
Sample	Plug #1	Plug #2	Plug #3	End Result
Propak VCI Film	Grade 1	Grade 0	Grade 0	Fail
Control	Grade 0	-	-	Fail

Nitrite/Nitrate Test Strips

Sample	Results
Propak VCI Film	Tested positive for nitrite/nitrate on both sides of the film

Photo from the NACE VIA test:

Propak VCI Film



Control Plug#1 Plug #2 Plug #3

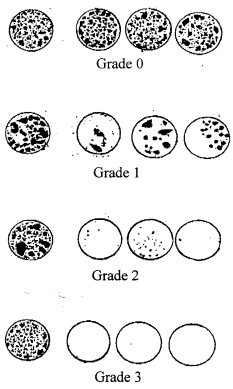
VIA Test Grades (Grade 2 or 3 are passing)
All three plugs must be grade 2 or better to pass the test

Grade 0: Blind test
No corrosion inhibiting effect

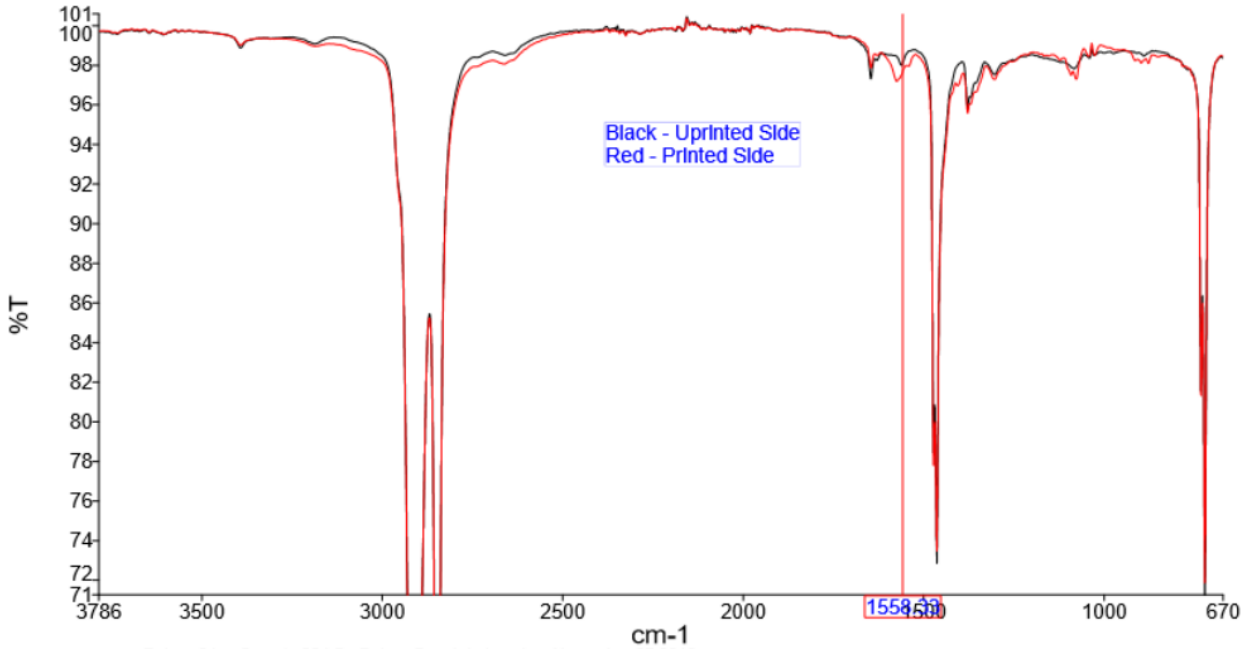
Grade 1: Blind test
Minute corrosion inhibiting effect

Grade 2: Blind test
Medium corrosion inhibiting effect

Grade 3: Blind test
Good corrosion inhibiting effect



FTIR (ATR) Spectra



Interpretations: The Propak VCI film does not provide sufficient corrosion protection to pass the VIA test or razor blade tests.

The FTIR spectra primarily show peaks due to polyethylene. Note that when the data is presented in units of "%T", peaks on the plot are downward pointing. Carboxylate based corrosion inhibitors often show a distinct peak at approximately 1558 cm^{-1} (vertical line on spectra) and/or peaks generally in the region of about 1500-1850 cm^{-1}. The spectra from both sides of the film show only very small peaks in the region suggesting only low levels of such corrosion inhibitors if any at all. There are slight differences in the two spectra (2 sides of the film), suggesting a possible difference in composition, but the differences are small. If the film was asymmetric, it would be expected to see more evidence of VCI chemicals in the unprinted side, which is not supported in the spectra. When viewing the FTIR data in combination with the other test data, this film does not appear to be asymmetric in construction. Also, the film does not appear to contain desiccant, based on an absence of large peaks in the 1000-1200 cm^{-1} region of the spectrum.