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ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Comparing Competitor Film to VpCI-126 Film

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ISO 9001 QUALITY SYSTEM REGISTERED

ENVIRONMENTAL ISO 14001 CERTIFIED SYSTEM REGISTERED

Background: Our customer makes metal lids and cans for various companies. They are not having any rust issues at the moment, but are interested in using VpCI-126 bags. They requested Cortec to test their current film they are using from a competitor.

Sample Received: Green competitor film, 2.5mils, received on 2-26-19 in good condition.

Method: FTIR Analysis, CC-006
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 w/lids, 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 #18F066507)
VpCI-126 film, 4mil (batch #510220)

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.

Results: The following results were found:

Razor Blade Test- Carbon Steel Panels

Sample	Panel #1	Panel #2	Panel #3	End Result
Competitor film	Fail	Fail	Pass	Fail
VpCI-126 film	Pass	Pass	Pass	Pass
Control	Fail	-	-	Fail

Razor Blade Test- Copper Panels

Sample	Panel #1	Panel #2	Panel #3	End Result
Competitor film	Fail	Fail	Fail	Fail
VpCI-126 film	Pass	Pass	Pass	Pass
Control	Fail	-	-	Fail

Nitrite/Nitrate Test Strips

Sample	Results
Competitor film	Contains nitrite/nitrate

Results: The following results were found:

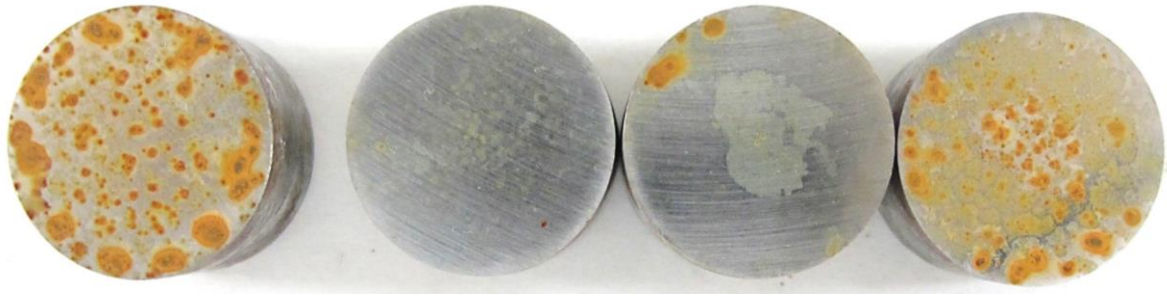
NACE VIA Test

Sample	Plug #1	Plug #2	Plug #3	End Result
Competitor film	Grade 2	Grade 1	Grade 0	Fail
VpCI-126 film*	Grade 3	Grade 3	Grade 2	Pass
Control	Grade 0	-	-	Fail

***Note- The results for VpCI-126 film used in this report was previously tested (from 16-083-1125)**

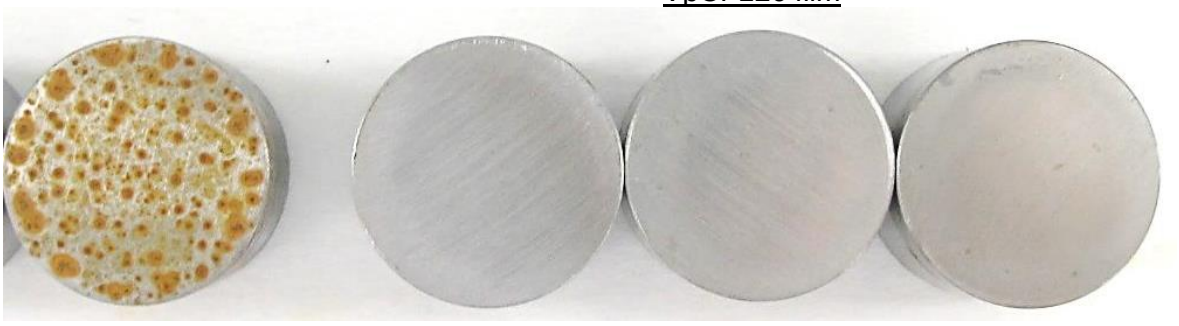
Photo from the NACE VIA test:

Competitor film



Control Plug#1 Plug #2 Plug #3

VpCI-126 film



Control Plug#1 Plug #2 Plug #3

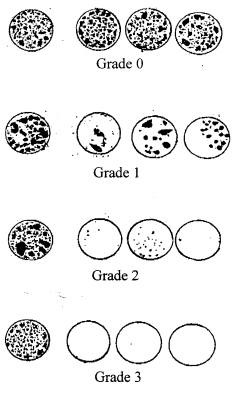
VIA Test Grades (Grade 2 or 3 are passing)
All three plugs must be grade 2 or better to pass the test

Grade 0: Blind test
No corrosion inhibiting effect

Grade 1: Blind test
Minute corrosion inhibiting effect

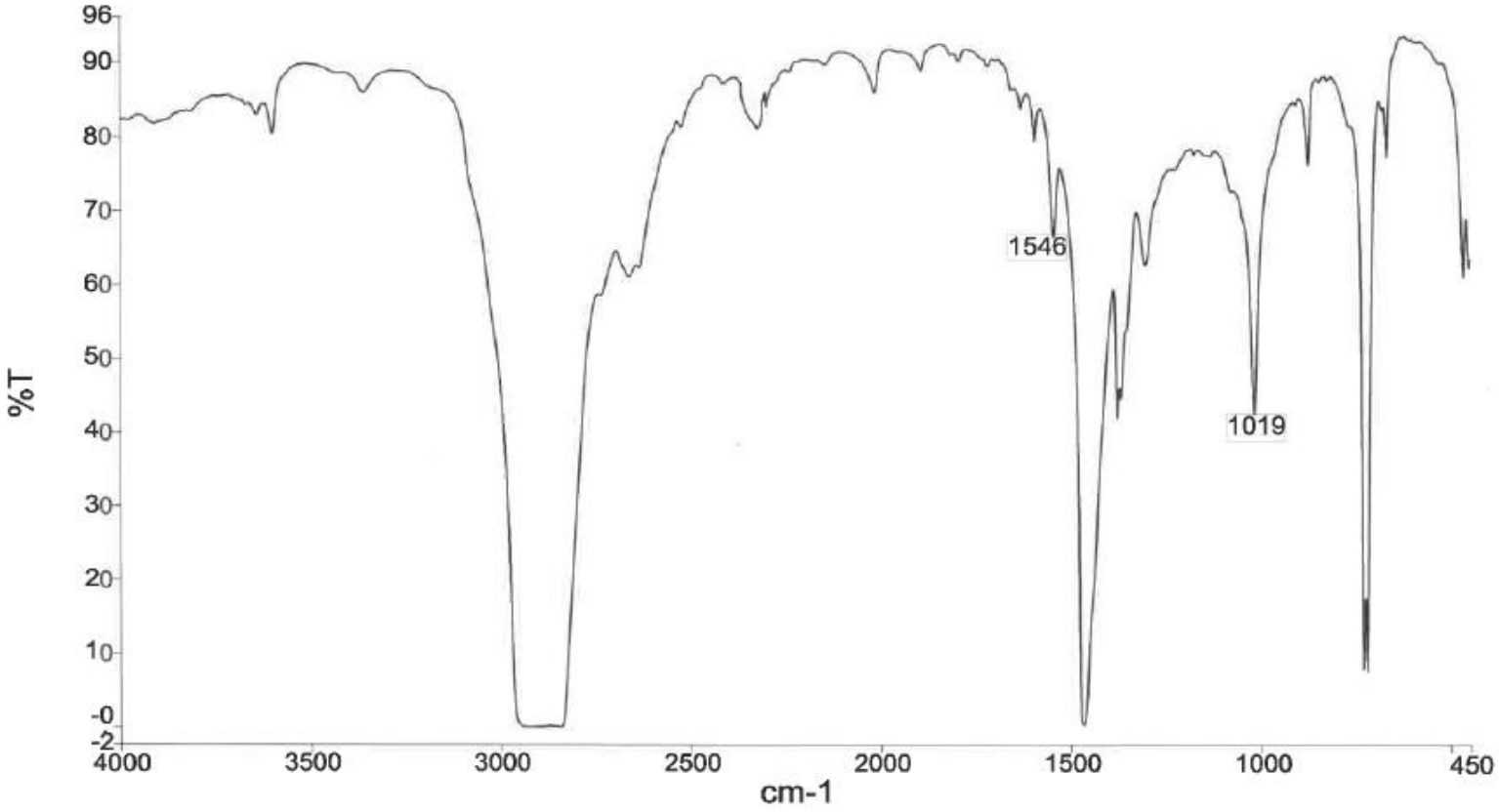
Grade 2: Blind test
Medium corrosion inhibiting effect

Grade 3: Blind test
Good corrosion inhibiting effect



FTIR Analysis:

Competitor Film



Interpretations: Based on the FTIR analysis, the competitor film appears to contain carboxylate type corrosion inhibitors based on the peaks observed in the 1500-1850 cm^{-1} region of the spectrum. This film also appears to contain desiccant, based on peaks observed in the 1000-1200 cm^{-1} region of the spectrum. The film also tested positive for nitrite. However, based on the results of the corrosion testing, this film does not contain sufficient amounts of corrosion inhibitor to pass the VIA and razor blade tests.