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LABORATORY ACCREDITATION BUREAU
ACCREDITED ISO/IEC 17025
Certificate # L2267 Testing

Comparing the Corrosion Protection Provided by Zerust VCI Paper and Film to VpCI-146 and VpCI-126

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Project #:13-029-1125.bis

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Approved by: Margarita Kharshan
Vice President of R&D

Date: March 6, 2013

Background: PK Mathew submitted Zerust Paper and Zerust VCI Film that the customer is currently using, and requested that they be compared to Cortec VpCI-126 and VpCI-146.

Sample Received:

1) Zerust Excor Paper, received 02-21-13, good condition
2) Zerust VCI Film, good condition, received 02-21-13, with label : Item code FG000175, Lot 031203000009, manufactured 05-03-12
3) VpCI-126, batch 31957, sample taken from QA random testing
4) VpCI-146, batch 205519, sample taken from QA random testing

Method:

1) VIA Test, CC-027
2) Razor Blade Test, CC-004*
3) Nitrite Test*
4) FTIR, CC-006
5) GCMS*

*Cortec Laboratory is not accredited for the test marked

Materials:

1) Carbon Steel Panels
2) Copper Panels
3) VIA Test Kit
4) Razor Blade Test Kit
5) Methanol, lab grade
6) Methanol, GC grade
7) GCMS-GC 7820A, 5975 MSD

Procedure:

Corrosion Testing Procedures

1) The tests were performed according to standard test procedures.
2) Evaluation of the razor blade test results:
    i. At least 2/3 panels must pass
    ii. Pass = No visible sign of corrosion
    iii. Fail = Visible signs of corrosion
    iv. Only one panel may have corrosion

GCMS Procedure

1) The Zerust Excor paper was tested using the GCMS. An extraction of the paper coating was performed using GC grade methanol. The paper was cut into strips, and placed into methanol The methanol was heated to 42°C, and the paper was allowed to soak for 30 minutes. After 30 minutes, the paper was removed and the liquid was analyzed using the following GC conditions:
    a. Column: HP-5MS
    b. Carrier Gas: He
    c. Flow Rate: 1 mL/min
    d. Injection Port: 260°C
    e. Injection temperature: 40°C

f. Initial Hold: 2 minutes
g. Ramp: 10°C/min
h. Final Temperature: 320°C
i. Hold: 5 minutes

FTIR was tested according to standard procedure

Results:

Razor Blade Test – Carbon Steel

Sample	Panel 1	Panel 2	Panel 3
Zerust VCI Film	Pass	Pass	Pass
VpCI-126	Pass	Pass	Pass
Zerust Excor Paper	Pass	Pass	Pass
VpCI-146 Paper	Pass	Pass	Pass
Control	Fail	-	-

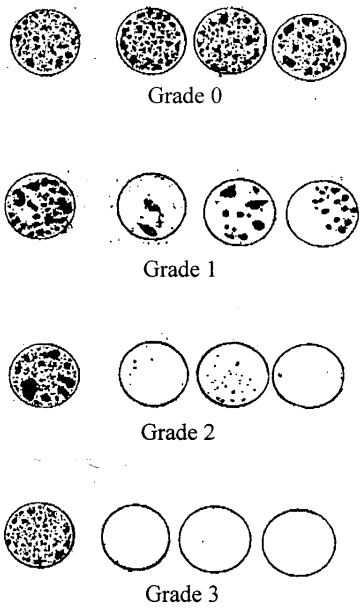
Razor Blade Test – Copper

Sample	Panel 1	Panel 2	Panel 3
Zerust VCI Film	Fail	Fail	Pass
VpCI-126	Pass	Pass	Pass
Zerust Excor Paper	Pass	Pass	Pass
VpCI-146 Paper	Pass	Pass	Pass
Control	Fail	-	-

VIA Test

Sample	Plug # 1	Plug # 2	Plug # 3	Pass / Fail
Zerust VCI Film	Grade 2	Grade 1	Grade 0	Fail
VpCI-126	Grade 3	Grade 2	Grade 3	Pass
Zerust Excor Paper	Grade 3	Grade 3	Grade 3	Pass
VpCI-146 Paper	Grade 3	Grade 3	Grade 3	Pass
Control	Grade 0	N/A	N/A	Fail

Note: Grades 0 and 1 are considered failing. See below for grading scale example.



Picture A.2

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

Figure 1. VIA Test Plug Grading Scheme

Results relate only to the items tested

Interpretations:

1) Based on the razor blade test results, the Zerust VCI film provides contact-phase protection for carbon steel, but does not provide multimetal protection. The VIA results determined that the film provides insufficient vapor-phase corrosion protection.
2) The results for the VpCI-126 film determined that it provides good vapor and multimetal contact-phase corrosion inhibition.
3) The VIA and razor blade test results for the Zerust Excor paper determined that it provides good vapor phase and contact phase corrosion protection.
4) Based on the GCMS results, it is possible that the major components of the Zerust Excor paper are benzotriazole combined with oxygen scavengers and carboxylates.
5) The Zerust VCI film contains nitrite, and based on the FTIR, carboxylates, most likely sodium benzoate.

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File        :D:\MS Data\2013\030613_ZERUST EXCOR PAPER.D
Operator    :
Acquired    :  6 Mar 2013    9:05      using AcqMethod AMINE_SPLIT_25TO1.M
Instrument :     GCMS
Sample Name: Zerus Excor Paper-Labeled Harsha Engineers
Misc Info   : Extraction: MeOH-42°C,30 min. 8.7g in 150mL
Vial Number: 1
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