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### *Evaluation of Conaplat Green VCI Film*

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**Project #:** 14-198-1125

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**Background:** It was requested that the Green VCI film manufactured by Conaplat be tested against VpCI-126 to compare the corrosion protection properties of the two films.

**Sample Received:** Green Film manufactured by Conaplat, no identifying markings, ok condition, received 08-29-14, labeled 14-198-1125

**Method:**

- 1) VIA Test Method, CC-027
- 2) Razor Blade Test Method, CC-004\*
- 3) Paragon 1000 FTIR, Method CC-006
- 4) Mechanical Properties (Performed at Cambridge):
  - a. Breaking Factor, ASTM D882-02\*
  - b. Tensile Strength at Break, Yield Strength, and Elongation at Break, ASTM D882-02\*
  - c. Puncture Resistance, MIL-STD-3010, TM 2065\*
  - d. Tear Strength, ASTM D1922-06a\*

\*Cortec Laboratory is not accredited for the test marked

**Materials:**

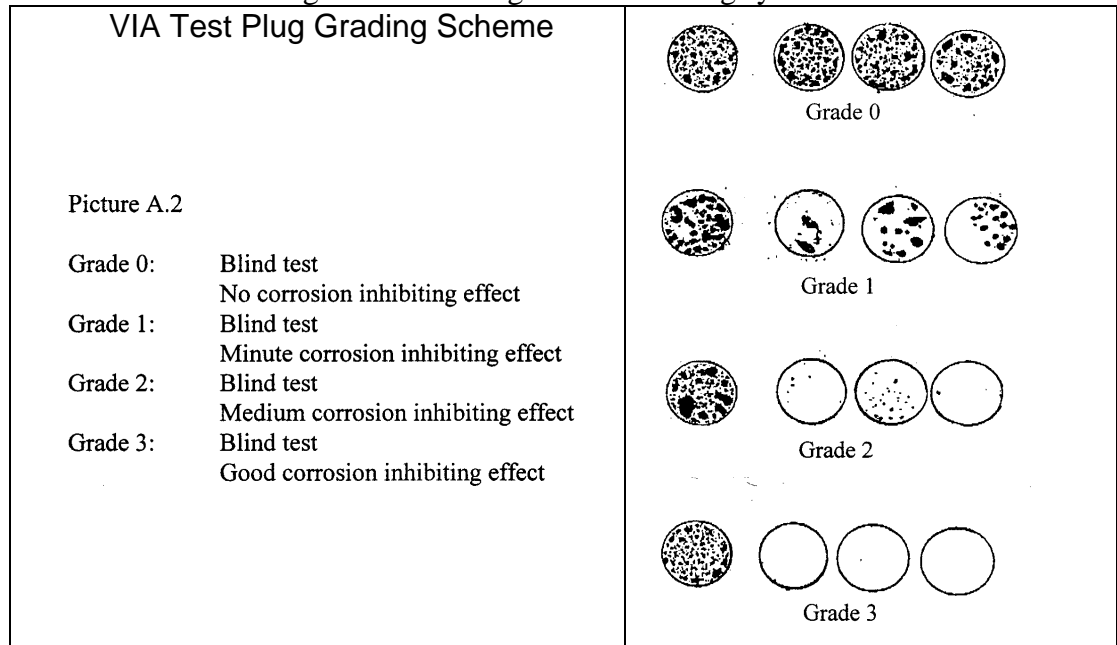
- 1) Cambridge Mechanical Property Testing Equipment
- 2) VIA test kit
- 3) Razor blade test kit
- 4) Polyethylene film (control), 3 mil
- 5) VpCI-126, batch #33569 and 35253
- 6) Paragon 1000 FTIR

**Procedure:**

Film Corrosion Testing

- 1) The razor blade, VIA and FTIR tests were performed according to standard procedure.
- 2) The razor blade results were graded according to visual evaluation. At least two out of three panels must pass. A pass is considered to have no visible sign of corrosion while a failing panel will have signs of corrosion.
- 3) Mechanical properties were tested at Cortec Advanced Film Division in Cambridge, MN.

4) VIA test results were graded according to the following system:



**Results:**

**Razor Blade Test- Carbon Steel Panels**

Film Sample	Panel #1	Panel #2	Panel #3	Pass / Fail
Green Conaplat Film	Fail	Fail	Fail	Fail
VpCI-126	Pass	Pass	Pass	Pass
Control	Fail	-	-	-

**Razor Blade Test- Copper Panels**

Film Sample	Panel #1	Panel #2	Panel #3	Pass / Fail
Green Conaplat Film	Fail	Fail	Fail	Fail
VpCI-126	Pass	Pass	Pass	Pass
Control	Fail	-	-	-

**VIA Test**

Film Sample	Plug #1	Plug #2	Plug #3	End Result
Green Conaplat Film	Grade 0	Grade 0	Grade 0	Fail
VpCI-126	Grade 3	Grade 3	Grade 3	Pass
Control	Grade 0	-	-	-

## Mechanical Properties

Property		Test Method	Units	Conaplat Green Film	Plain PE Film	VpCI 126 35253
Caliper		ASTM D6988	mil	4.19	3.22	3.30
Breaking Factor	MD	ASTM D882-02	lbs/in	9.01	15.78	12.30
	TD			7.29	11.68	11.50
Tensile Strength at Break	MD	ASTM D882-02	psi	1028.00	2390.00	3803.98
	TD			984.00	1839.00	3917.06
Elongation at Break	MD	ASTM D882-02	%	582.50	930.26	682.71
	TD			640.63	755.05	803.65
Yield Strength	MD	ASTM D882-02	psi	772.88	866.85	1297.02
	TD			613.84	577.58	1577.24
Dart Drop Impact Resistance		ASTM D1709-04, Test Method A	grams	65.10	580.24	614.53
Puncture Resistance	Outside Layer	MIL-STD-3010, TM 2065	lbf	4.94	4.26	5.55
Puncture Resistance	Inside Layer	MIL-STD-3010, TM 2065	lbf	5.01	4.74	5.60
Tear Strength	MD	ASTM D1922-06A	gram force	241.60	624.00	368.00
	TD			1209.60	1548.80	1184.00
Coefficient of Friction		ASTM D1894	static	0.11	0.10	0.39
			kinetic	0.43	0.22	0.41

**Results relate only to the items tested**

**Photos:**



Figure 1. VIA test results for the Green Conaplat Film

## **Interpretations:**

1. Corrosion Test Results:
  - a. The test results (razor blade and VIA) determined that tested VpCI-126 provides good contact and vapor-phase corrosion protection.
  - b. The corrosion test results for the Conaplat Green film determined it did not provide contact or vapor-phase corrosion protection. The test results determined that it failed both tests.
2. Film Properties:
  - a. FTIR results all determined that the Green Conaplat film contains salt of organic acid, probably sodium benzoate which is not considered VCI.
3. Mechanical Property Test Results:
  - a. The ASTM D 882 results determined that when VpCI-126 is stretched, the force at which the film will become irreversibly deformed is higher than the other films. The force required to break VpCI-126 when it is being stretched is also higher than the other films.
  - b. The ASTM D 882 results for the Conaplat Green film determined that it required less force to break it when being stretched, the percent it elongated was also the lowest of the three films when stretched, and the force required to break the film is the lowest of the films tested.
  - c. The dart drop test results (ASTM D 1709) determined the Conaplat Green film was much more brittle than the control or VpCI-126 films. The test result showed that VpCI-126 is tough as the control film.
  - d. The puncture resistance (MIL-STD-3010) was similar for the three tested films.
  - e. The tear strength test results determined that VpCI-126 and the Conaplat Green Film had similar results, with VpCI-126 having slightly better results for the machine direction.
  - f. VpCI-126 has a higher coefficient of friction (static) than the two other films. The Coefficient of friction (kinetic) between the Green Conaplat film and VpCI-126 is pretty similar. The control film had the lowest coefficient of friction (kinetic and static) of all the films.

