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Evaluating VCI Packaging Products Used by Customer

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Background: The current packaging solution used by customer to ship axles from Northern Ireland to Illinois is not meeting their current needs. This corrosion protection system, using TechCorro products, involves wrapping the axles in VCI bags, securing the bags along with VCI emitter pads into place using VCI cling film material, and finally placing this into an outer bag along with desiccant. Cortec Laboratories has been asked to evaluate the corrosion inhibiting properties of some components of this process; specifically the VCI bags, the VCI cling film material, and the foam emitter, and compare them to Cortec's VpCI-126 HPUV film. VpCI-126 HPUV is a UV stable heat shrink film that can be used as a standalone corrosion protection product, eliminating the need for multiple products.

Sample Received: 3 TechCorro products, received in good condition:
-1 foam emitter, about 2x6"
-1 sheet of VCI film, approximately 75 micron
-1 sheet of VCI cling wrap film, approximately 25 micron

Method: VIA Test, CC-027
FTIR Analysis, CC-006
Razor Blade Test, CC-004*

*The test(s) marked are not covered under Cortec Laboratories, Inc. ISO 17025 Scope of Accreditation

Materials: VpCI-126 HPUV, lot 310210
Polyethylene film, control
VIA test kit
Paragon 1000 FTIR
Razor Blade test kit

Procedure: All tests were followed according to standard procedure. The TechCorro foam emitter was only tested using the VIA test, as there was only enough sample for one test and the use of the emitter is primarily for vapor phase corrosion protection.

Results:

VIA Results

Sample	Plug 1	Plug 2	Plug 3	Overall
TechCorro VCI Film	2	3	1	Fail
TechCorro VCI Cling Wrap Film	1	2	3	Fail
TechCorro Foam Emitter	2	2	3	Pass
VpCI-126 HPUV	3	3	2	Pass
Control	0	-	-	-

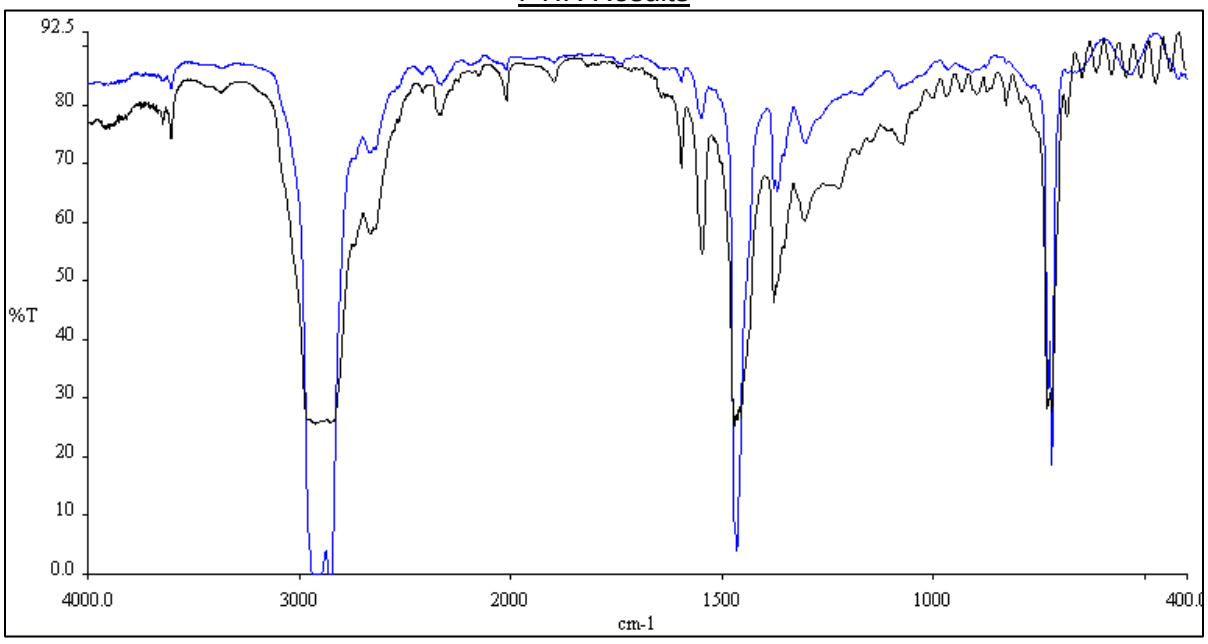
Carbon Steel Razor Blade Results

Sample	Panel 1	Panel 2	Panel 3	Overall
TechCorro VCI Film	Pass	Pass	Fail	Pass
TechCorro VCI Cling Wrap Film	Fail	Fail	Fail	Fail
VpCI-126 HPUV	Pass	Pass	Pass	Pass
Control	Fail	-	-	-

Copper Razor Blade Results

Sample	Panel 1	Panel 2	Panel 3	Overall
TechCorro VCI Film	Fail	Fail	Fail	Fail
TechCorro VCI Cling Wrap Film	Fail	Fail	Fail	Fail
VpCI-126 HPUV	Pass	Pass	Pass	Pass
Control	Fail	-	-	-

FTIR Results



Above: Cling film (blue line, higher %T) and VCI film (black line, lower %T)

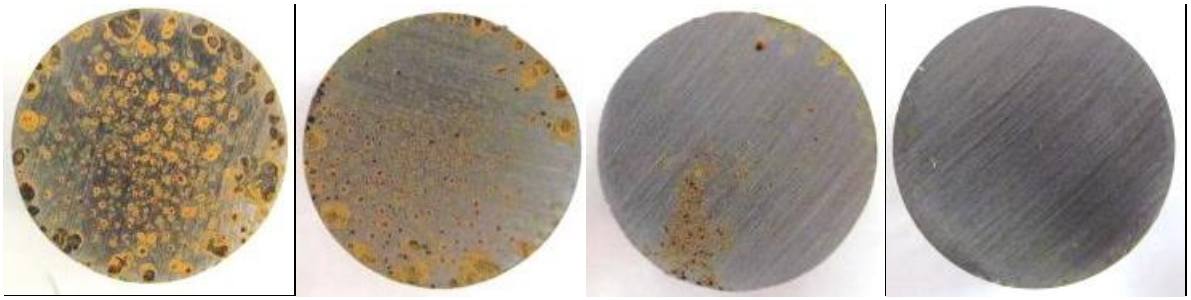
Results relate only to the items tested

Photos:

TechCorro VCI Film VIA Results

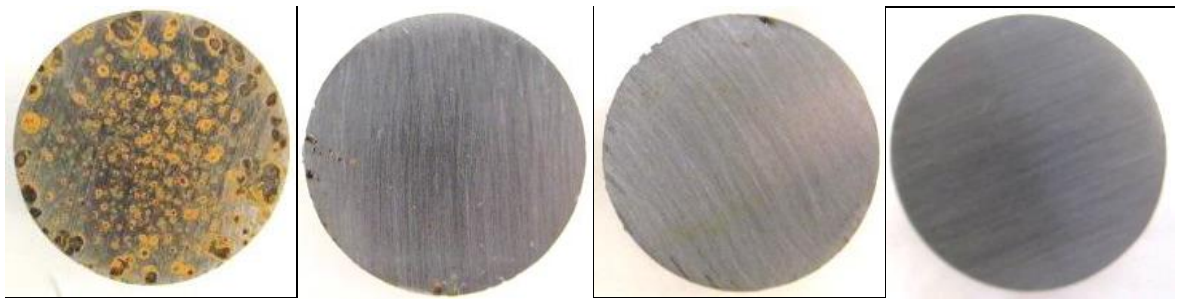
Control Plug 1 Plug 2 Plug 3

TechCorro Cling Film VIA Results



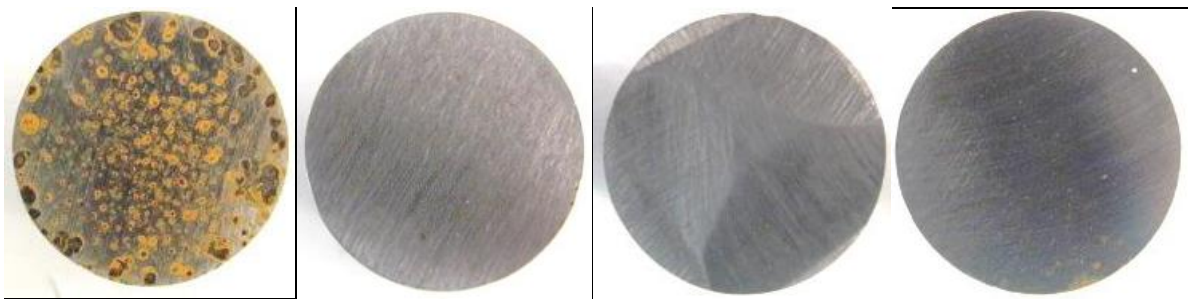
Control Plug 1 Plug 2 Plug 3

TechCorro Foam Emitter VIA Results



Control Plug 1 Plug 2 Plug 3

Cortec VpCI-126 HPUV VIA Results

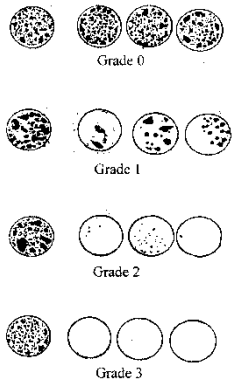


Control Plug 1 Plug 2 Plug 3

VIA Test Grading

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



Interpretations: The TechCorro VCI film provides sufficient contact phase protection for steel, according to the Razor Blade test, but it does not protect steel in the vapor phase nor does it protect copper. The TechCorro foam emitter provides sufficient vapor phase protection, according to the VIA test. The TechCorro cling film does not provide sufficient corrosion protection, according to VIA and Razor Blade testing.

FTIR Analysis shows that both of the TechCorro films have the same or very similar additives. They both contain some corrosion inhibitor and nitrate.

In comparison, Cortec VpCI-126 HPUV film provides effective multi-metal corrosion protection, according to both VIA and Razor Blade test results.