

BONDING THERMOPLASTICS TO FRP - AN UPDATE

Presented at the:

NACE 1996 FRP SYMPOSIUM

Buffalo, NY

by

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ABSTRACT

Bonding FRP to PVC and CPVC with different resins has been tested for peel strength. Another testing has been performed to check the effect of using a carbon veil in the back of PVC and PVDF, on the bond to the FRP substrate. Results will be discussed.

BONDING FRP TO PVC AND CPVC

In June 1990, at the request of Troy Mfg Ltd and Dow Chemical, five resin systems were tested for their bond between FRP and PVC, as well as CPVC.

Testing was performed at the Concordia University, in Montreal, by L.Li and S.V.Hoa. The five types of bonding systems were:

1. Crystic 392 isophthalic resin (Ashland Chemicals).
2. Crystic 392 / C veil.
3. Derakane 510A-40 vinyl ester resin (Dow Chemicals).
4. Derakane 510 A-40 / C Veil.
5. Derakane 510C-300 vinyl ester resin (Equivalent to Derakane 510C-350, in the USA).

Eight samples were supplied, by the fabricator, using Boltaron PVC and CPVC, bonded to FRP. All systems using the vinyl ester resins were first washed with a 50/50 mixture of Styrene and MEK solvents, to follow the resin manufacturer's recommendations.

PVC and CPVC were bonded to FRP using: Crystic 392 - Crystic 392 / C Veil - Derakane 510A-40 .

PVC was also bonded to FRP, using: C Veil, with Derakane 510A-40, and C-300.

Testing

This was done at 24 ° C.,per the British Standard for Peel Strength Testing which was modified: in the Standard, the top half of samples is clamped, here they were clamped as a cantilever. Using a band saw, the samples were slit at one end of the interface of the laminate and the liner, across the width of the specimen, to create a crack, 20 mm along its length. Subsequently, a razor blade was used to create a sharp crack. The specimens were gripped on a special jig which was fixed on an MTS testing machine. During the test the load was applied to the laminate / liner interface and the peel load was measured. The

MTS testing machine was set up with stroke control at a displacement rate of 2 mm / min.

Results

The peel strength is calculated by dividing the maximum force by the width of the specimen. Testing results were as follows:

<u>Sample</u>	<u>Average N/mm</u>
CPVC / Crystic 392 / C Veil	20.62
CPVC / Crystic 392	19.87
PVC / Crystic 392 / C Veil	19.56
PVC / Crystic 392	16.13
PVC / Derakane 510C-300	12.71
CPVC / Derakane 510 A - 40	6.70

Conclusion

For PVC & CPVC, the best results were obtained, using Crystic 392 / C Veil. Another isophthalic resin: Vestopal 400, has been reported, by Troplast AG, in Germany, to have given values of 12 - 15 N/mm, with the Trovidur PVC & CPVC.

THE EFFECT OF CARBON VEIL

In the early 90's, a couple of failures occurred, on PVDF/FRP vessels, at two chemical plants, within the same corporate: one in Canada, and one in the USA. In both cases, the PVDF liner delaminated from the FRP, with blisters. Samples were sent to the PVDF manufacturer, who suspected that the carbon veil, which was used, at the US plant, throughout the back of the liner, for spark testing, to be responsible of the failure. In the case of the Canadian plant, carbon veil was used only in the back of the welds. In 1993-94, the effect of carbon veil on the bond was tested, for both PVC & PVDF, at the above corporate lab.

Testing PVC

PVC / FRP samples were prepared, in the lab & tested, using Ashland Chemical's isophthalic resins: Aropol 7130 & Crystic 392, with & without carbon veil, to check the tensile bond strength, using a Tinius-Olsen testing machine. Results were as follows:

<u>Sample</u>	<u>Carbon veil</u>	<u>Temp</u>	<u>Stress at failure</u>	<u>Type of failure</u>
Crystic 392	No	Room	626 psi	Broke off PVC, bond intact
Crystic 392	Yes	Room	743 psi	Broke off PVC, bond intact
Aropol 7130	No	Room	595 psi	Broke off PVC, some bond failure
Aropol 7130	Yes	Room	586 psi	Broke off PVC, bond intact
Crystic 392	No	150° F	772 psi	Broke off PVC, bond intact
Crystic 392 /)		Room	535 psi	Cohesive failure, bond intact
Chopped strand Mat	No	150° F	493 psi	Cohesive failure, bond intact

Testing PVDF

Samples of 90 Mils thick Symalit PVDF/FRP: 12"x12"x_" were prepared by Troy Mfg. One layer of 1 oz/yd² carbon veil, followed by 2 Nexus veils & two 1 _ oz/ft² mats were applied , before the structural FRP layers, using a Novolac based vinyl ester.

The bond was tested according to the ASTM D1781 climbing drum test, using a Tinius-Olsen tensile testing machine. The test failures all happened at the fabric backing of the PVDF, at 60-76 in.lb/in. This confirmed previous tests, in the same lab, which had shown the same results, with and without the carbon veil.

Conclusion

Carbon veil used in the back of PVC, CPVC & PVDF had no effect on the bond.

A cheaper alternative, can also be used today, for spark testing: Nexus veil is available as a graphite impregnated veil, and has started to be used, with success.

Acknowledgements

Dr. S.V. Hoa, at the University of Concordia for the PVC/CPVC testing.

Mr. Juan Huerta, at Dow Chemical, for the PVC/PVDF testing.