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STRUCTURAL SILICONE ADHESION TO DECEUNINCK ROVEX XTREME FIBERGLASS

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DOW RESTRICTED

OVERVIEW

- Projects submitted through COOL
- Planned testing and results
 - Peel adhesion
 - Accelerated aging of tensile adhesion joints
- Dow's thoughts
- Questions & dialogue

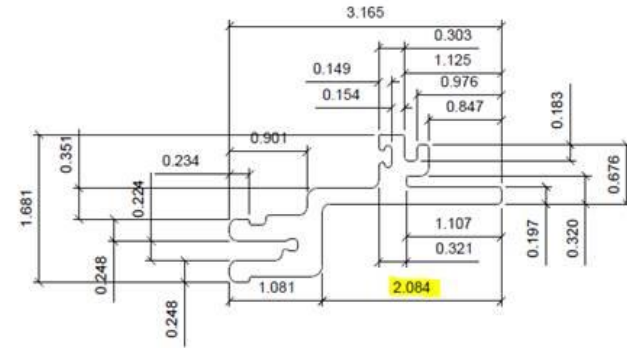
PROJECTS SUBMITTED THROUGH COOL

- Five projects submitted in COOL requesting structural adhesion testing to fiberglass since Oct 2018
 - UCSF Minnesota Housing, captured, Oct 2018
 - ✓ Fiberglass Extrusion PRP 1005 / 1002
 - 1100 Clay Street, captured, Dec 2018
 - ✓ “Fiberglass” ...?
 - Anaheim Radisson Hotel, four-sided SSG, Dec 2018
 - ✓ Fiberglass Extrusion
 - ✓ Kalcor P4324-01 - 2K Charcoal Gray Water Based Coating 18EA039
 - ✓ Fiberglass Extrusion Finished with PPG UC109852 Duranar Charcoal
 - Van Ness, captured, March 2019
 - ✓ Cream
 - ✓ Black
 - The Heights – Merrimack St, four-sided SSG & captured, June 2019
 - ✓ Painted fiberglass, *weatherseal only with 791
 - ✓ Raw fiberglass
- All passed structural adhesion testing requirements
 - 7 day room temp cure + 7 day water soak



TEST PLAN

- Peel adhesion, modified ASTM C794
 - Objective: build dataset to begin to understand adhesion variability on substrate
 - Substrate: Deceuninck Rovex Extreme
 - Sealants: 795, 995, 983, 121
 - Primers: None, Primer C, 1200 OS
 - Aging conditions: 1drt (983 and 121), 7 drt, 7drt + 1dw, 7drt + 7dw
- Tensile adhesion accelerated aging, ASTM C1184
 - Objective: understand impact of weathering on sealant adhesion to Deceuninck Rovex Extreme
 - Sealant: 983
 - No primer
 - Aging conditions
 - ✓ 21 drt
 - ✓ 21drt + 7dw
 - ✓ 21 drt + 1h 88 °C
 - ✓ 21drt + 1 h -29 °C
 - ✓ 21 drt + 5000 QUV (~229 total days)



Substrates submitted for peel adhesion testing

SUMMARY OF TEST PLAN RESULTS

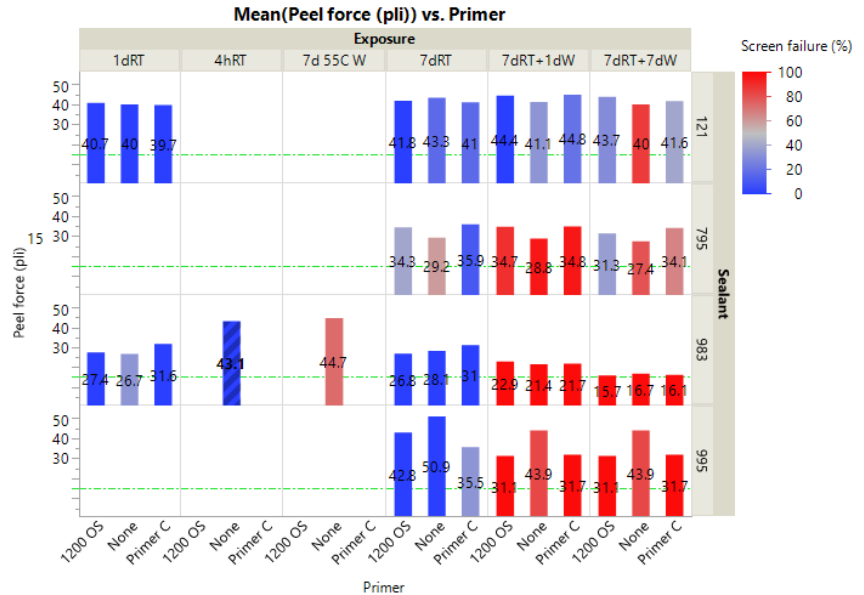
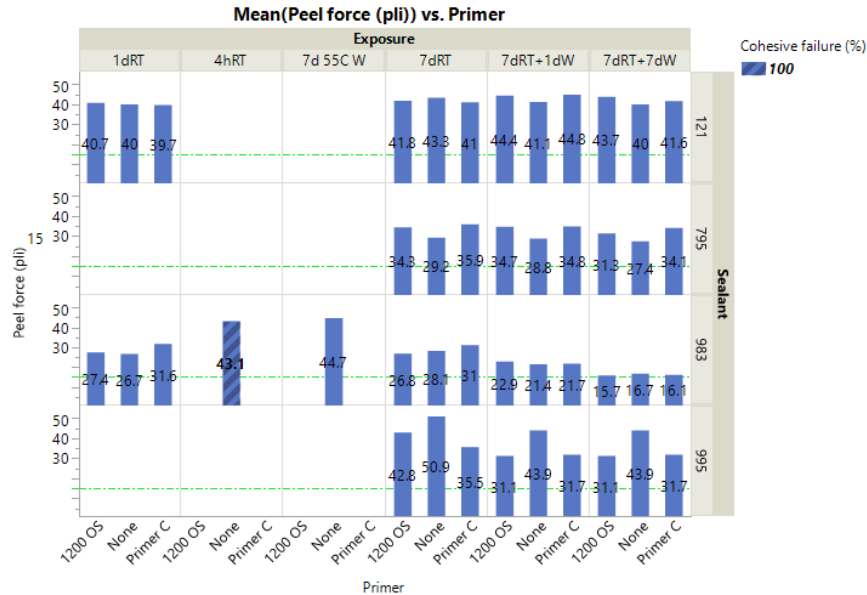
- Peel adhesion
 - No red flags – all samples passed structural testing requirements
 - Noticed a lot of dust from substrates being cut to length – important to adequately clean!
 - Neither primer had a significant impact on improving adhesion on this batch of samples
 - Continue with project specific testing
- Accelerated aging of tensile adhesion
 - 21 drt, 21 drt + 1h 88 °C, 21drt + 1 h -29 °C, 21drt + 7dw and 21 drt + 5000 QUV completed
 - ✓ All pass the 50 psi ASTM C1184 requirement and SSG sealant design criteria of 20 psi
 - ✓ Sealant performed as expected – fiberglass appearance changed after QUV weathering

Cure Condition	Peak Stress (psi)	Industry Standard (50 psi)	SSG Sealant Design Criteria (20 psi) *must be at least 2.5X
21drt	133 ± 5.7	Exceeds by 2.7x	Exceeds by 6.7x
21drt + 1h @ -29 °C	154 ± 2.4	Exceeds by 3.1x	Exceeds by 7.7x
21drt + 1h @ 88 °C	130 ± 7.0	Exceeds by 2.6x	Exceeds by 6.5x
21drt + 7dw	123 ± 11.8	Exceeds by 2.5x	Exceeds by 6.1x
21drt + 5,000 QUV	162 ± 7.7	Exceeds by 3.2x	Exceeds by 8.1x



PEEL ADHESION – MODIFIED ASTM C719

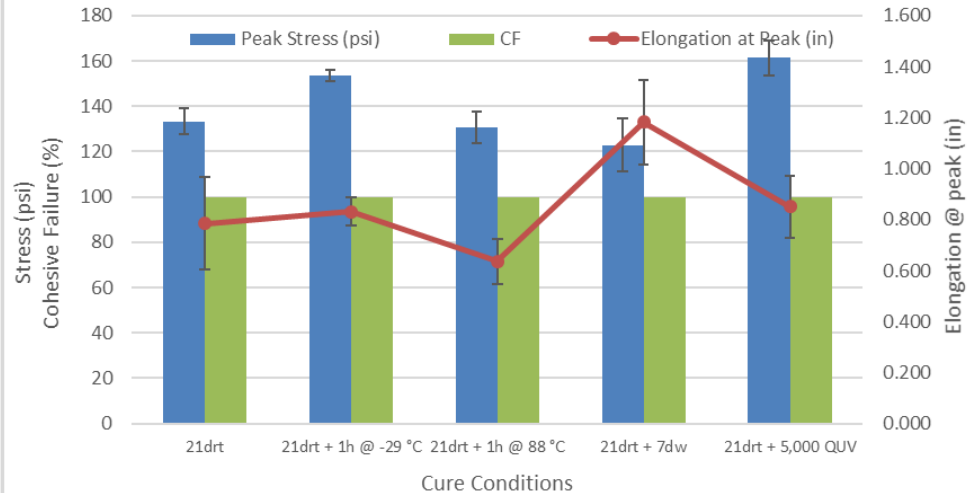
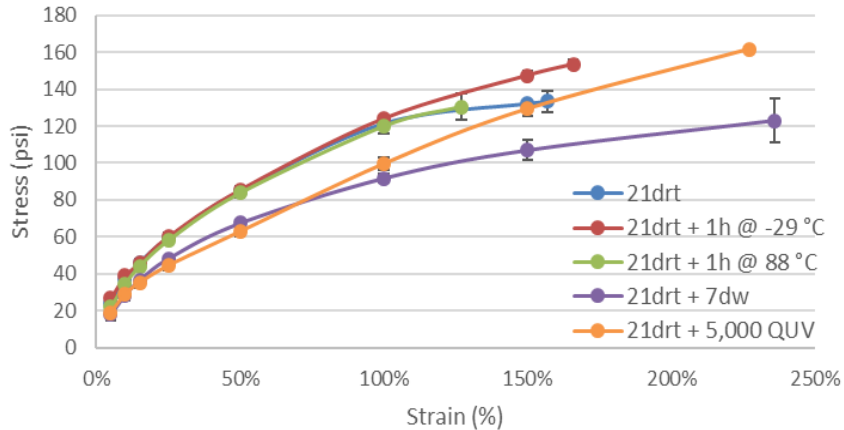
- Scenarios tested in triplicate
- A lot of screen failures after 1 and 7 day water soak, 86% and 92% respectively
- Surprised to see 983 values lower than other structural sealants and project specific testing
 - 16 pli vs. 20-30 pli after 7 day water
- All scenarios pass even when considering variability



ASTM C1184 ACCELERATED AGING OF ASTM C1135 TENSILE ADHESION JOINTS

- Cure conditions tested in triplicate
- Modulus as expected
 - Stable across room temp cure and hot and cold extremes
 - Water soak and QUV weathering show some impact
- Failure modes as expected
 - Elongation: some softening from water soak, all else unaffected
 - Peak stresses a bit stiffer when cold and weathered

ASTM C1135: unprimed 983 SGS to Rovex fiberglass



DOW'S THOUGHTS

- Long term sealant adhesion is only as robust as the substrate that it has to stick
- Dow cannot “approve” another suppliers material
- Deceuninck has to approve the use of the Rovex in structural glazing applications
- Paint finishes adds layer of complexity
 - Adhesion of the paint finish to the substrate
 - Adhesion of the sealant to the different finishes
- Continue project specific testing while understanding we are not approving the substrate
- Concerns about fiberglass’s long term durability when exposed to UV

QUESTIONS & DIALOGUE

- Follow-up from April meeting
 - Mock-up results available – structural, thermal or both?
 - Is there a better understanding around Kynar Aquatec® PVDF based finishes?
 - ✓ Noticed different colors on Van Ness and Anaheim projects
 - ✓ Common failure modes for the Aquatec® finish? If so, can we test something “bad” to understand worst case?
 - ✓ Potential for different thicknesses of finish based on color choice?
 - ✓ Is overspray a concern?
 - Has there been any discussion on how to handle field repairs and deglazes?
 - ✓ What if the surface of the fiberglass/PVDF based finish is compromised? Is there a repair process from Deceuninck?
 - Collaboration output – consider publishing a paper to co-present at an industry event/conference
- New concerns
 - Sealant adhesion behaves as expected after conditioning and weathering, but weathering impact very apparent of the fiberglass
 - What testing has Deceuninck done around long term aging/weathering of the substrate?
 - Will this fiberglass ever see UV in the designs?



THANK YOU



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