PCI Vueguard® 932 Anti-Fog Coating for Tritan™

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Introduction

- Vueguard® 932 coatings from PCI Labs were selected as candidates to impart anti-fogging properties to Tritan™.
- Links to Vueguard® coatings product specs:
  - Vueguard® 932
- Contact Info:

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Dip-coating Application Details

- Tritan™ TX1001 and TX2001 1/8” thick 4”x4” plaques were dip-coated on both sides with Vueguard® 932 AF Coating with the following procedure:
  - The Tritan samples for anti-fog were first dip-primed with UV curable primer PST 1200.
  - The cured primed Tritan™ was then over-coated with the dip-coating.
  - Standard thickness for anti-fog Vueguard® 932 was 8-10 μm
- Coated plaques passed breath fogging[1] and hot water fogging[2] tests.
- Coated plaques were tested for:
  - Instrumented drop impact resistance
  - Taber abrasion resistance
  - Pencil hardness

[1] No fog formation after direct breathing on the coated surface

[2] A glass beaker (300 ml) is filled with 250 ml of water. The beaker is placed on a hot plate and the water heated to 60°C. The water temperature should be maintained 60±3 °C during the entire test. Place a chip coated with anti-fog coating on top of the beaker, with coated side facing the water bath, covering completely the beaker opening. Sample should not fog for at least one minute.

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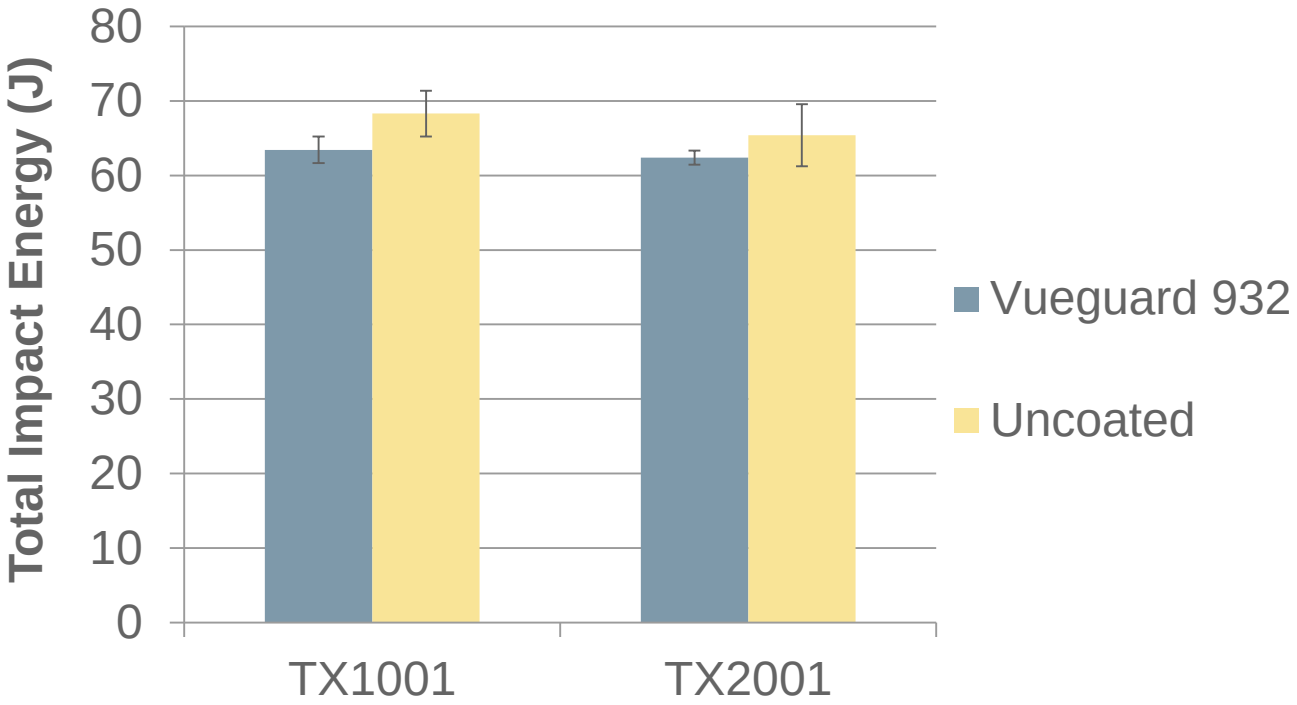
Instrumented Drop Impact Resistance



A 28 kg load was dropped from 0.5 m at a temperature of 23°C.

- No significant reduction in impact energy was recorded for Tritan™ plaques coated with Vueguard® 932, and the mode of impact failure of all tested Tritan plaques coated with Vueguard® 932 was ductile.

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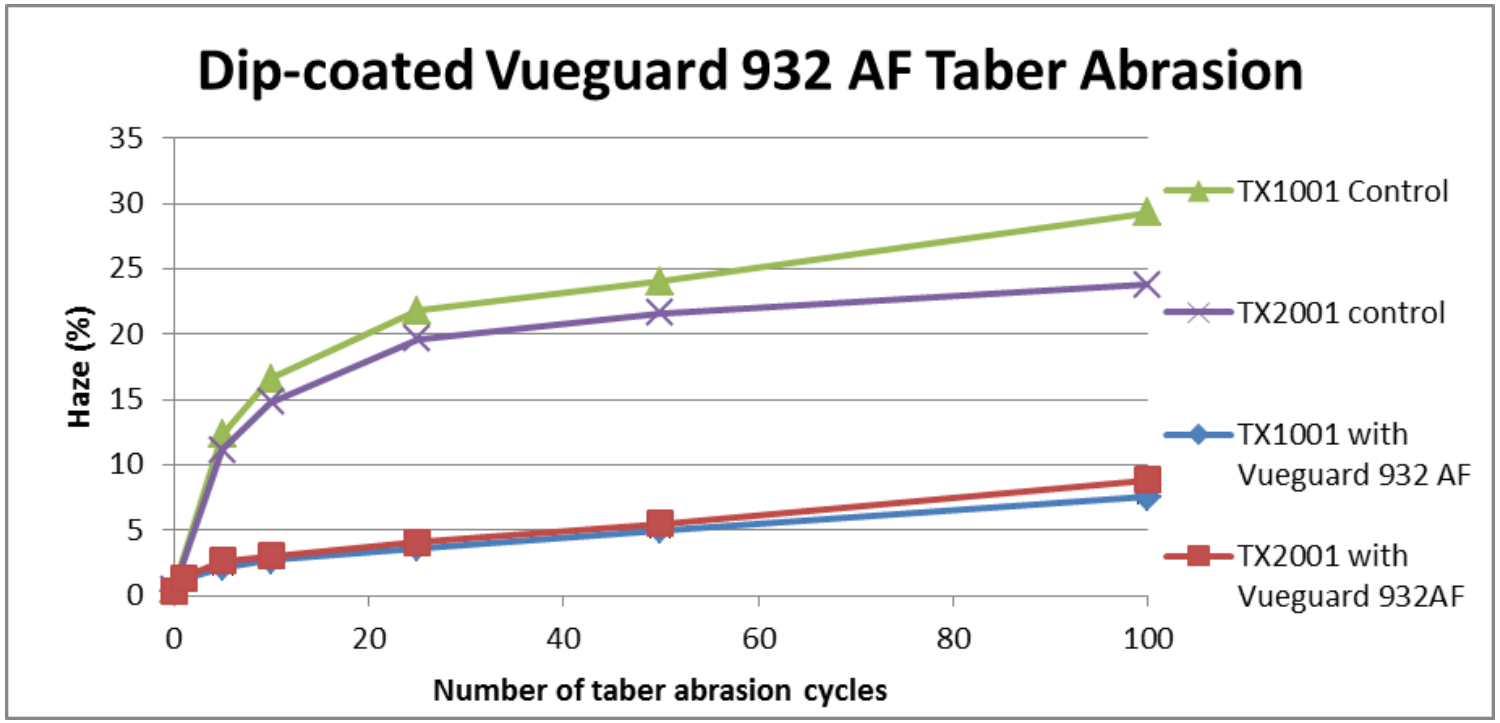
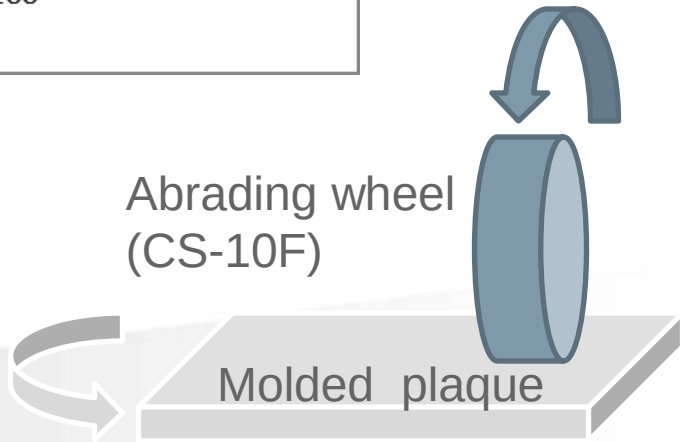
Taber Abrasion Resistance



- The Vueguard® 932AF coating significantly improved the abrasion resistance of Tritan™.



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Pencil Hardness

- Pencil hardness of coated plaques was tested according to ASTM D-3363. Molded plaques were tested with Mitsubishi Hi-Uni graphite pencils at 750 g load and 45 degree angle. Hardness of the lead that just fails to scratch the surface was reported.

Pencil Hardness Scale

6B 5B 4B 3B 2B B HB F H 2H 3H 4h 5H 6H 7H 8H 9H

Softer ← → Harder

Material	Dip - Coated	Pencil Hardness
Tritan® TX1001	Uncoated	B
Tritan® TX1001	Vueguard® 932 AF	B
Tritan® TX2001	Uncoated	B
Tritan® TX2001	Vueguard® 932 AF	B

Wolf Wilburn Pencil Hardness Tester

- No changes in pencil hardness of Tritan™ were recorded with the application of Vueguard® 932 AF coating

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Conclusions

- Vueguard® 932 AF coating, when applied over PST 1200 primer, was effective in imparting anti-fogging properties to both Tritan™ TX1001 and TX2001 molded parts.
- All tested Tritan™ plaques coated with Vueguard® 932 AF retained their ductility, and did not exhibit any significant reduction in impact energy
- Vueguard® 932 AF improved the taber abrasion resistance of neat Tritan™ molded plaques, while it did not influence their pencil hardness.

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Appendix:
Solution Properties of Primer Pst 1200

The following solution properties are typical values for PST 1200, as supplied:

Solids:	11.9%
Viscosity @ 25ºC:	8 cP
Appearance:	Clear liquid
Density @ 25ºC:	7.6 lb/gal
% Solvents:	88.1%

The solids content of PST 1200 needs to be controlled in the operating range of 11-13 %, by weight. A mixture of DAA, Butyl Acetate, MIAK and n-Propanol (1 : 2.4 : 0.9 : 2.4) can be used to maintain the solids content. 15 min of mixing is recommended prior to use (Cowls blade, or equivalent, high shear blade – moderate agitation), followed by filtration of the coating with 1.0 µm double open end cartridge, bag (or equivalent) filtering systems.

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Appendix: Recommended Operating Ranges for Primer Pst 1200 as supplied by PCI

The following operating ranges were provided by PCI as recommendations for consistent processing of this primer.

% Solids	11-13%
Viscosity @ 25ºC	8 cP
% Solvents	87-89%
Addition Solvents	DAA, Butyl Acetate, MIAK and n-Propanol (1 : 2.4 : 0.9 : 2.4)
Process % Relative Humidity	~ 50% RH
Process Air Temperature	20 - 26ºC
Process Air Flow	HEPA Filtered Laminar Air
Spray Gun	HVLP or Air-Assist
Oven Flush-off (with Air movement)	1-2 min @ 40ºC
UV - Cure Conditions	Dosage energy: 450-650 mJ/cm^2 with medium pressure, Hg lamps @ 300 Watts/in
Dry Coating Film Thickness	2-3 micrometers
Quality Control	Run min. three coated plaques and measure: Coating Thickness; 2-3 um Adhesion: 100% (ASTM 3002 / 3359)

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Appendix: Solution Properties of Vueguard 931 AF as supplied by PCI

The following solution properties are typical values for PST 1200, as supplied:

Solids:	24.1 %
Viscosity @ 25ºC:	8 cP
Appearance:	Clear liquid
Density @ 25ºC:	7.9 lb/gal
% Solvents:	75.9 %

The solids content of Vueguard 931 AF needs to be controlled in the operating range of 23-26%, by weight. A mixture of PM Solvent and n-Propanol (15.5 : 1) can be used to maintain the solids content. 15 min of mixing is recommended prior to use (Cowls blade, or equivalent, high shear blade – moderate agitation), followed by filtration of the coating with 1.0 µm double open end cartridge, bag (or equivalent) filtering systems.

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Appendix: Recommended Operating Ranges for Vueguard 931 AF as supplied by PCI

The following operating ranges were provided by PCI as recommendations for consistent processing of this coating.

% Solids	23-26%
Viscosity @ 25ºC	8 cP
% Solvents	74-77%
Addition Solvents	PM solvent: n-Propanol (15.5 : 1)
Process % Relative Humidity	~ 50% RH
Process Air Temperature	20 - 26ºC
Process Air Flow	HEPA Filtered Laminar Air
Spray Gun	HVLP or Air-Assist
Oven Flush-off (with Air movement)	5-6 min @ 50ºC
UV - Cure Conditions	Dosage energy: 1200 mJ/cm^2 with H+ lamp@ 480 Watts/in
Dry Coating Film Thickness	8-10 micrometers
Quality Control	Run min. three coated plaques and measure: [1]Breath Fogging Test: No fogging [2]Hot Water Fogging Test: No fogging for 1 min Adhesion: 100% (ASTM 3002 / 3359) Scratch Resistance: No scratches, 2 psi @ 5 rev with 0000 steel wool.

[1] No fog formation after direct breathing on the coated surface

[2] A glass beaker (300 ml) is filled with 250 ml of water. The beaker is placed on a hot plate and the water heated to 60°C. The water temperature should be maintained 60±3 °C during the entire test. Place a chip coated with anti-fog coating on top of the beaker, with coated side facing the water bath, covering completely the beaker opening. Sample should not fog for at least one minute.

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