

Waterborne for Concrete Coatings

NX-8100 Series

October 2015



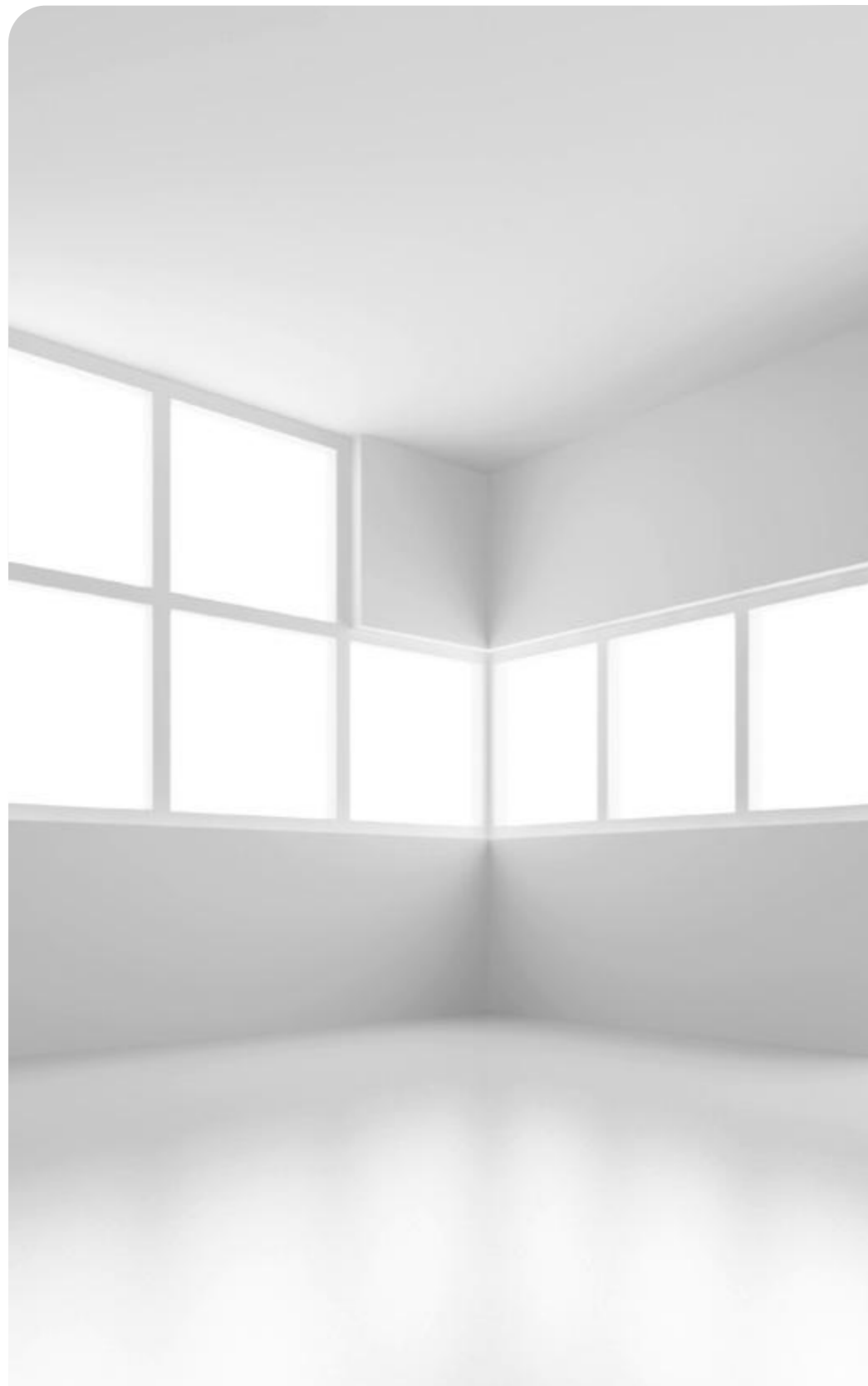
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Content

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- Example Formulations
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NX-8101

- Cardanol based waterborne curing agent for use in floor coatings
 - Low color with excellent film appearance
 - Fast cure
 - Balanced mechanical properties
 - Excellent adhesion over dry and damp concrete
 - Excellent self-leveling properties
 - Cost effective

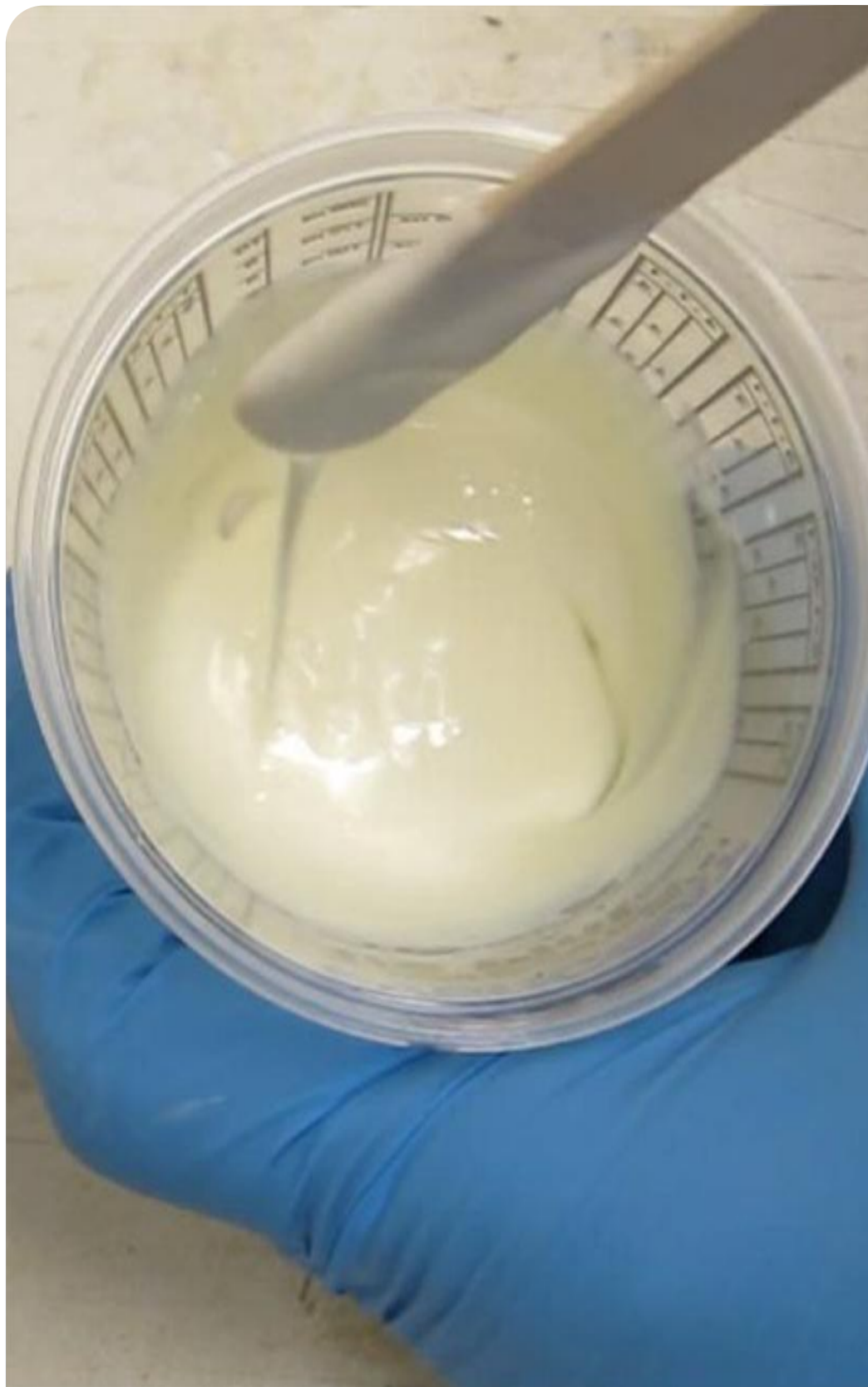


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Typical Properties

Properties	NX-8101	Competitive WBCA
Viscosity @ 25°C (cPs)	20000-50000	40000
Amine value (mg KOH/g)	120-140	150-190
Solids	50	50
AHEW	270	275
Color (Gardner)	7	4
Recommended, (phr, EEW 190)	125-160	140-180

Admix Reduction With Water



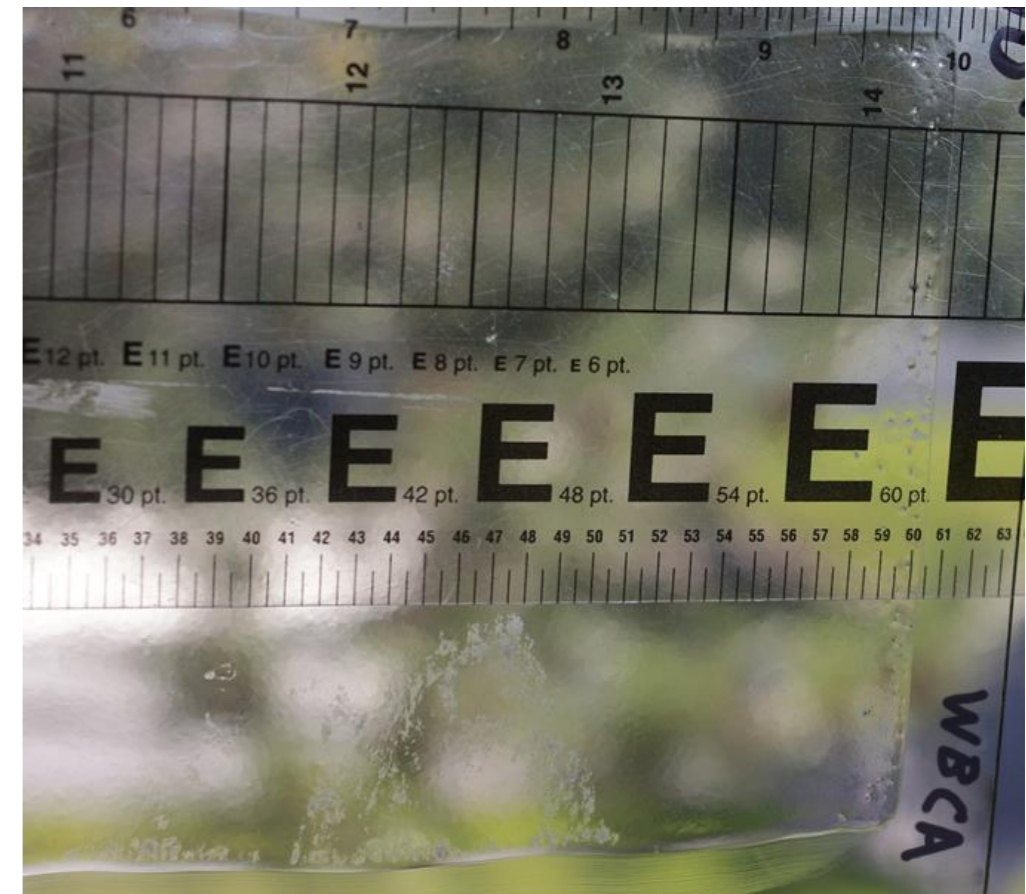
Curing Agent	Effort Required to Reduce Admix Viscosity With Water
NX-8101	Very easy to reduce with water
Competitive WBCA	Initial resistance for water acceptance

When admixed with standard liquid epoxy, NX-8101 reduces easily with water

High Humidity Film Appearance with Liquid Epoxy



NX-8101



Competitive WBCA

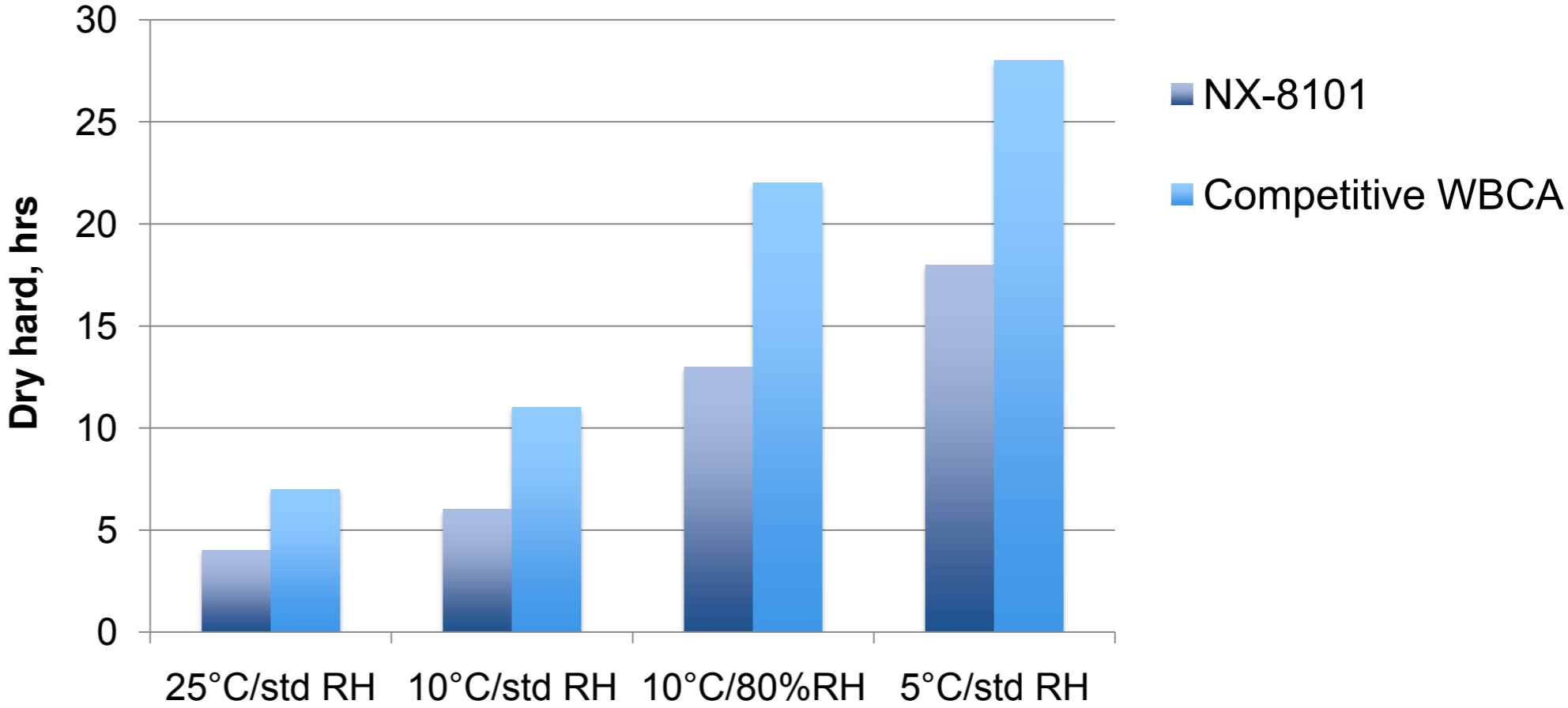
Good flow and film formation under LTC and high humidity (10°C / 80% R.H.)



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Cure Properties

Cure with liquid epoxy



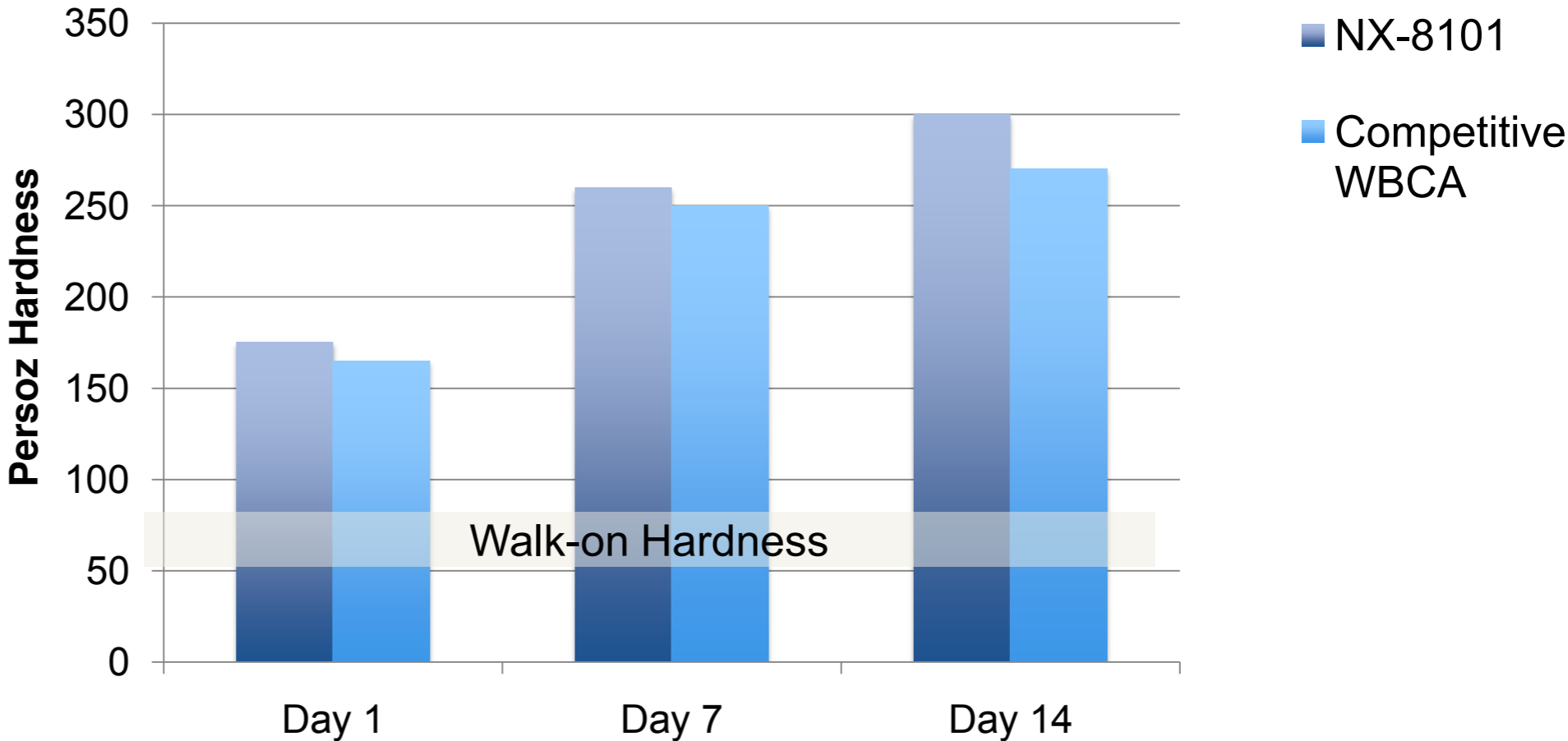
NX-8001 shows faster cure than competitive WBCA at room and low temperatures, and low and high humidity.



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Hardness Development @ 25°C

Cured with liquid epoxy



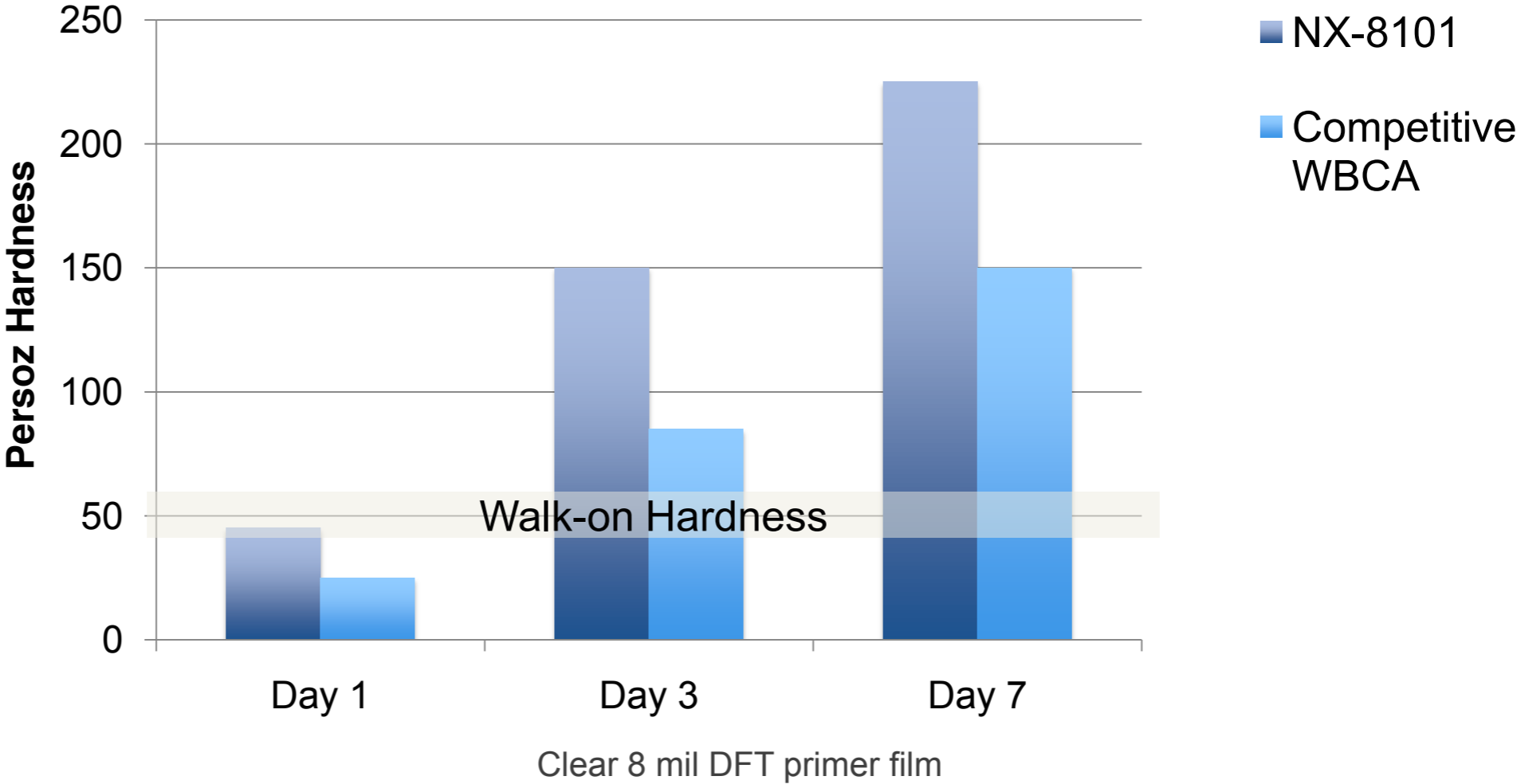
Both systems show fast walk-on hardness in clear non-pigmented formulation



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Hardness Development @ 10°C/80% R.H.

Cured with liquid epoxy*



Even under high humidity LTC conditions, NX-8101 allows quick walk-on times

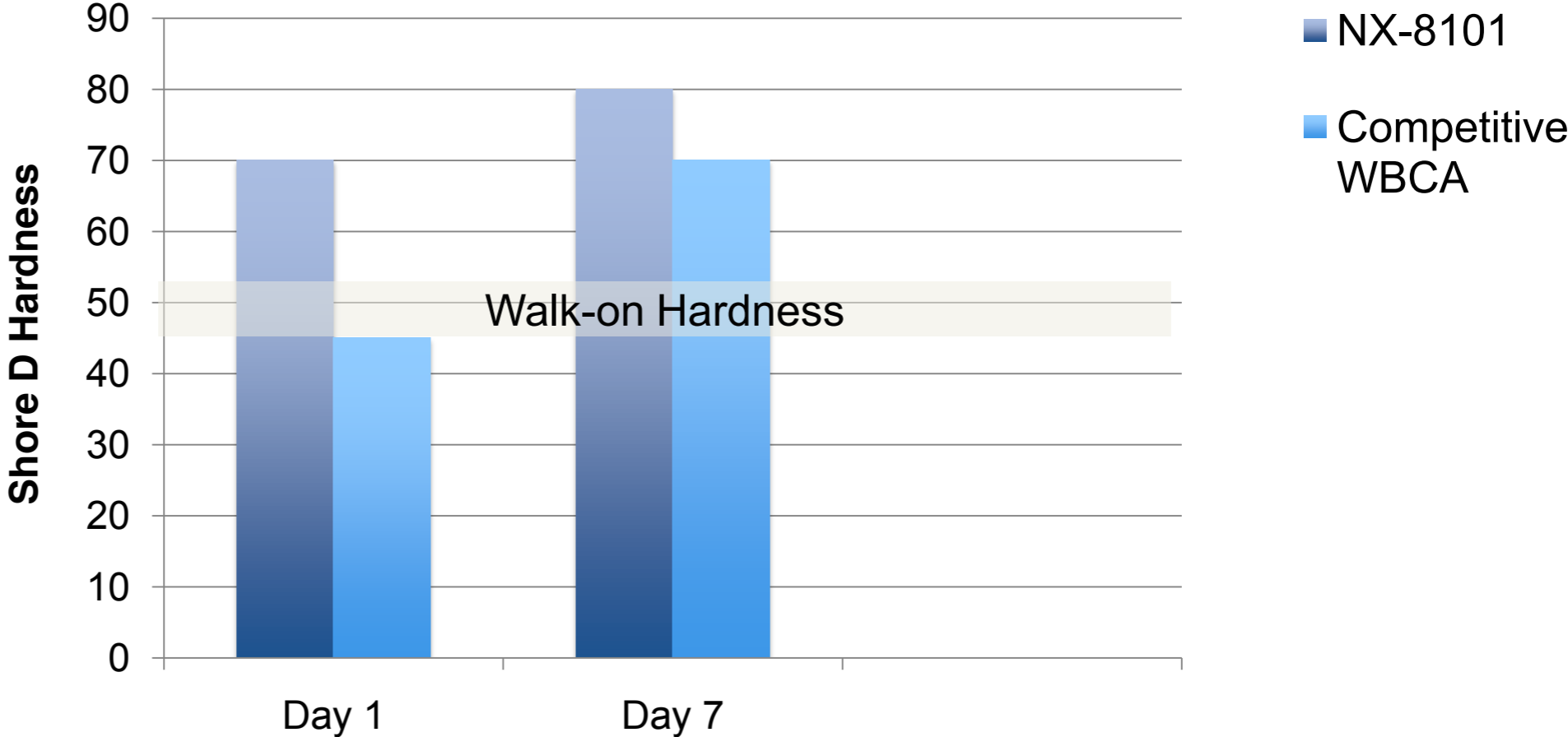
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Hardness Development @ 25°C

Self leveling Formulation

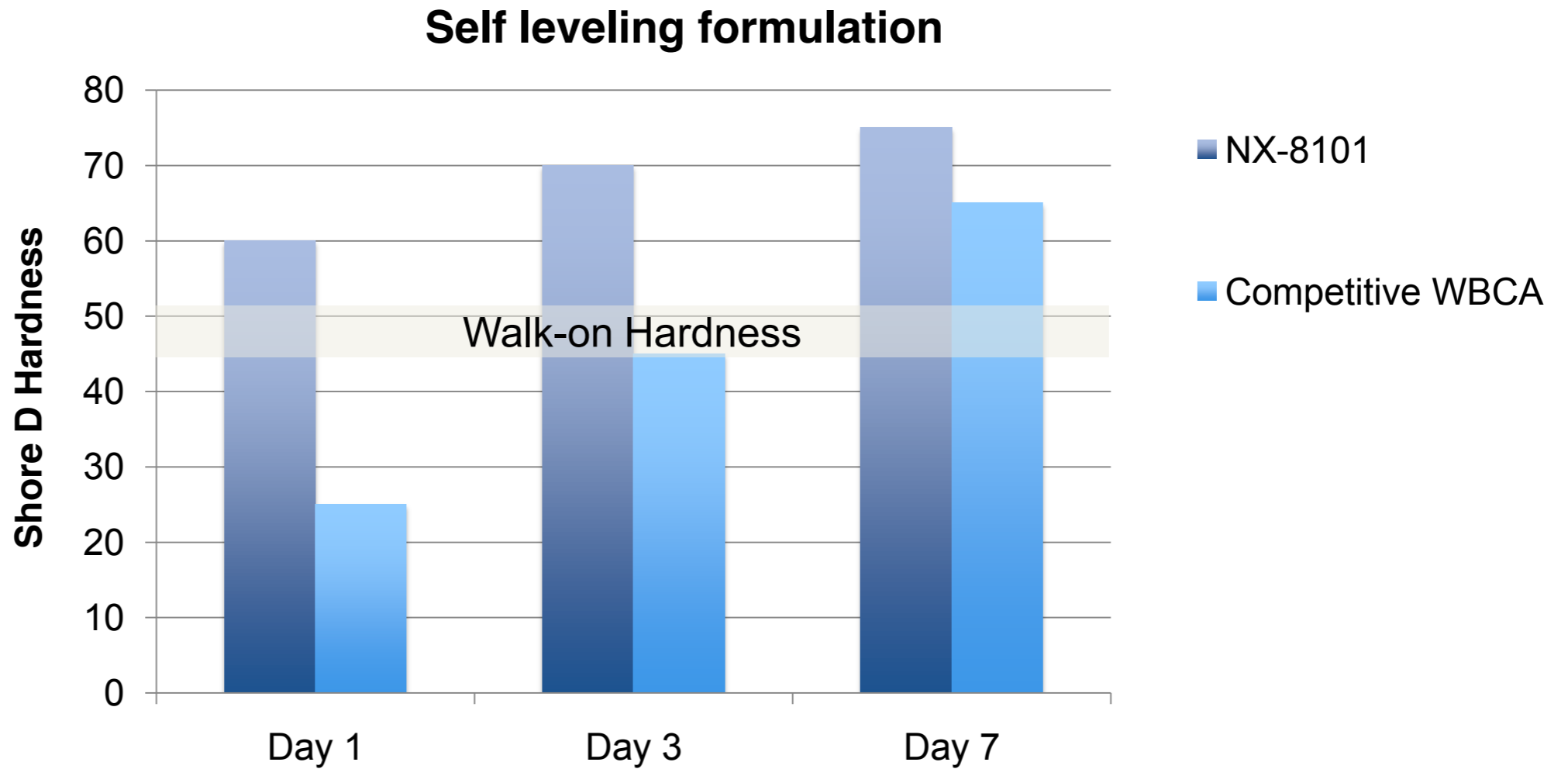


In a self-leveling formulation, NX-8101 achieves walk-on hardness on the first day. (3 mm film thickness)



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Hardness Development @ 10°C / 80% R.H.



NX-8101 self-leveling formulation permits early walk-on hardness at low temperatures and high humidity (3 mm film thickness)



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Flexibility

Pigmented Formulation #1

	NX-8101	Competitive WBCA
Direct Impact	20 in-lbs	15 in-lbs
Reverse Impact	4 in-lbs	< 4 in-lbs

*25°C cure for 7 days before impact testing

NX-8101 shows slightly better impact resistance than competitive WBCA.
DFT of 100μ (over CRS)



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Adhesion to Concrete

Adhesion to **Dry Concrete**:

- Used 25 mil drawdown applicator to apply primer on concrete paver and cured for 7 days before adhesion test.

Adhesion to **Damp Concrete**:

- Concrete pavers fully immersed in water. After 72 hrs freestanding water on the top removed by blotting with paper towels.
- Pavers were ½ immersed in water and primer was applied with a 25 mil drawdown applicator
- Coated pavers were cured for 7 days before adhesion test.



Adhesion to Concrete

Curing Agent	Dry Concrete (psi/MPa)*	Wet Concrete (psi/MPa)*
	Direct to concrete	Direct to concrete
NX-8101	650 / 4.48	620 / 4.27
Competitive WBCA	625 / 4.30	523 / 3.56

*Mode of failure: in the concrete

NX-8101 shows excellent adhesion to dry and wet concrete. (failure mode = concrete)



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Chemical / Stain Resistance

MEK Resistance 7 day cure @ 25°C (200 double rubs)

	Marring	Break-through	Softening
NX-8101	Yes	No	Slight
Competitive WBCA	Yes	No	More

24 hour Spot Test @ 25°C

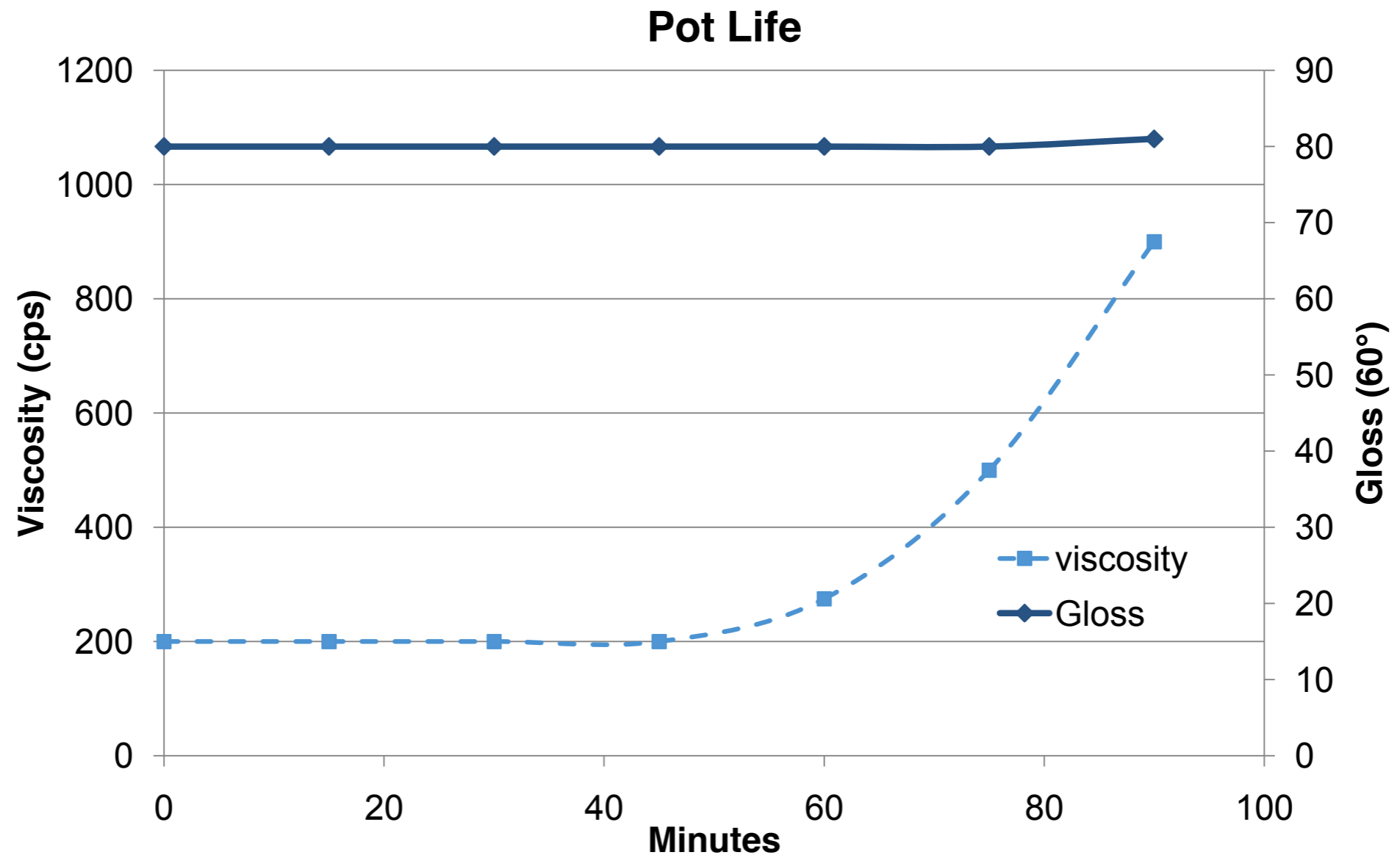
	NX-8101	Competitive WBCA
Mustard	Slight stain	Slight stain
Ketchup	No Effect	Slight stain
3% Acetic Acid	No Effect	No Effect
Bleach	No Effect	No Effect
Coffee	No Effect	No Effect
Ethanol	No Effect	No Effect
Xylene	No Effect	No Effect

NX-8101 shows good chemical resistance.



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NX-8101 Pot Life @ 25°C



Admixed with standard liquid epoxy reduced with water –
total weight solids 52%

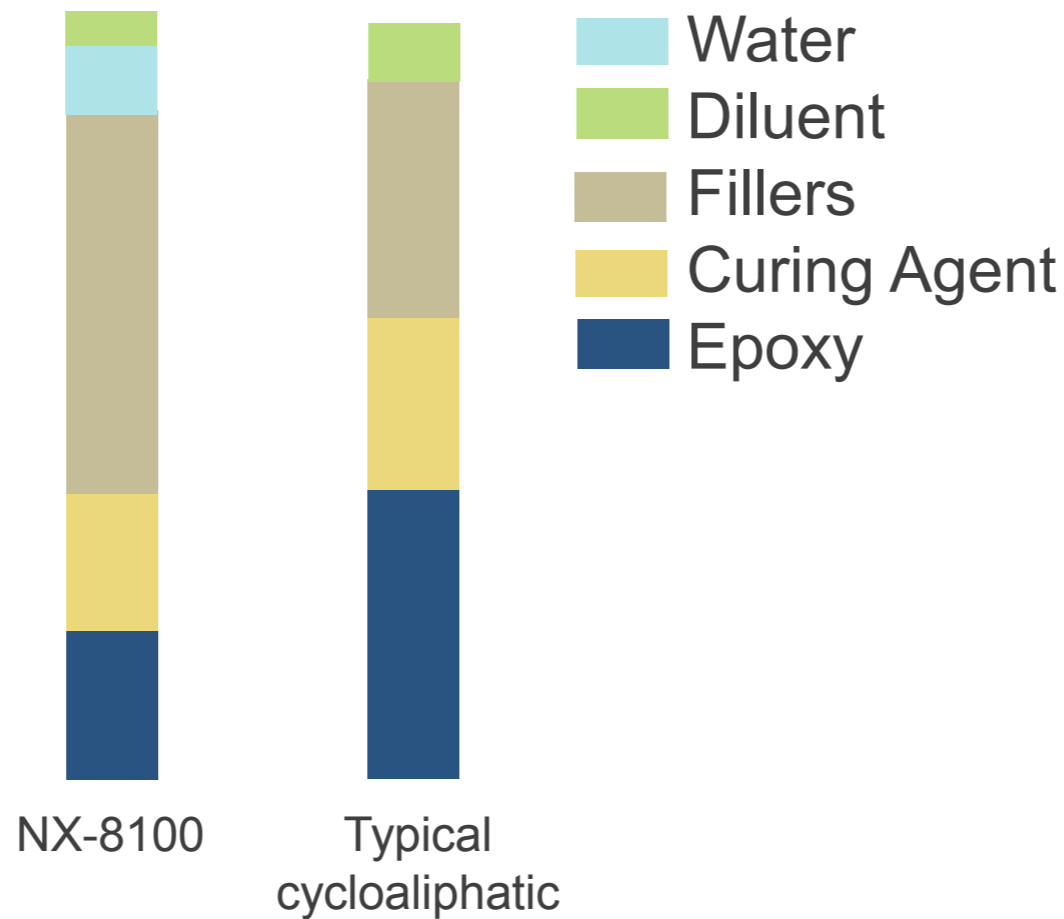


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Formulation Relative Costs

Self-leveling formulation:

- Diluent demand is less
- Relative filler loading is more than 2 times greater
- Water content used for viscosity reduction is a minimal cost
- Results in lower relative applied cost



The NX-8100 Series system can use a greater filler loading due to viscosity adjustment from water



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Formulation Guidelines

- Standard liquid epoxies can be used (based on Bisphenol A or F)
- No additional emulsifiers are required
- Reactive diluents (mono or di-functional) can be used without additional emulsifiers
- Preliminary evaluations show enhanced flexibility and higher filler loadings with **Ultra LITE 513** versus standard C12-C14 reactive diluents
- Dispersants like Disperbyk 192 help with pigment wetting
 - *(The dispersant can be used in either the epoxy (PART A) or the curing agent (PART B) to aid in pigment dispersion)*
- Defoamers like BYK 045 and BYK 054 help with air release and surface appearance
- Temperature of NX-8101 should remain below 40°C during the pigment dispersion phase



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Clear Floor Primer #1

PART A	Wt.
EPON 828	86.93
Heloxy 8	11.84
BYK 348	0.62
BYK 054	0.62
subtotal	100.00

PART B	Wt.
NX-8101	130.00
subtotal	130.00

PART C	Wt.
D.I. Water	42.00
subtotal	42.00

- Mix Part A + B together first
- Then reduce with half the Part C water
- Adjust final mix with remaining water

Total Wt. A + B + C 272.00



Self-Leveling Formula #1

PART A	Wt.
EPON 828	19.27
Heloxy 8	2.13
DISPERBYK 111	0.51
Rhodopol 23 (xanthan gum)	0.05
Cimbar 325 (barium sulfate)	20.50
TIPURE R-706	6.30
BYK 054	1.23
subtotal	50.00

PART B	Wt.
NX-8101	27.00
subtotal	27.00

PART C	Wt.
D.I. Water	24.00
subtotal	24.00

PART D	Wt.
Sil-Co-Sil 106 (quartz powder)	81.29
US Silica NJ #70 (quartz sand)	98.71
subtotal	180.00

Total A + B + C + D 281.00

- Mix Part A + B together first
- Then reduce with half the Part C water
- Next stir in the Part D silica sand mixture
- Adjust final mix with remaining water



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Self-Leveling Formula #2

PART A	Wt.
EPON 828	18.95
Ultra LITE 513	2.46
Disperbyk-192	0.47
Rhodopol 23 (xanthan gum)	0.06
Cimbar 325 (barium sulfate)	23.00
TIPURE R-706	5.00
Surfynol DF-62	0.03
BYK 054	0.03
subtotal	50.00

PART B	Wt.
NX-8101	27.00
subtotal	27.00

PART C	Wt.
D.I. Water	24.00
subtotal	24.00

PART D	Wt.
Sil-Co-Sil 106 (quartz powder)	90.32
US Silica NJ #70 (quartz sand)	109.68
subtotal	200.0

- Mix Part A + B together first
- Then reduce with half the Part C water
- Next stir in the Part D silica sand mixture
- Adjust final mix with remaining water

Total A + B + C + D 301.00



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Pigmented Formulation #1

PART A	wt.
EPON 828	52.16
Heloxy 8	3.13
Disperbyk 192	1.59
Cimbar EX barium sulfate	11.70
TIPURE R-706	31.30
BYK 054	0.13
subtotal	100.00

PART B	wt.
NX-8101	74.00
subtotal	74.00

Total Wt. A & B 174.00

PART C	wt.
D.I. Water	25.00
subtotal	25.00

Total Wt. A + B + C 199.00

- Mix Part A + B together first
- Then reduce with half the Part C water
- Adjust final mix with remaining water

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Pigmented Formulation #2

Part A

EPON 828	30.00
Ultra LITE 513	3.00
sub total	33.00

Part B

NX-8101	43.59
D.I. Water	18.54
Disperbyk 192	2.32
Imsil A25 silica	8.05
Cimbar EX barium sulfate	8.41
TIPURE R-706	12.50
Surfynol DF-62	0.54
BYK 054	0.62
D.I. Water	5.43
sub total	100.00

Mix Part A + B together well before application

Total Wt. A + B 133.00



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Pigmented Formulation #3

PART A	wt.
EPON 828	53.00
Ultra LITE 513	5.5
Disperbyk 192	1.59
Cimbar EX barium sulfate	23.00
TIPURE R-706	16.78
Surfynol DF-62	0.07
BYK 054	0.07
subtotal	100.00

PART B	wt.
NX-8101	77.50
subtotal	77.50

Total Wt. A & B 177.50

- Mix Part A + B together first
- Then reduce with half the Part C water
- Adjust final mix with remaining water

PART C	wt.
D.I. Water	22.50
subtotal	22.50

Total Wt. A + B + C 200.00



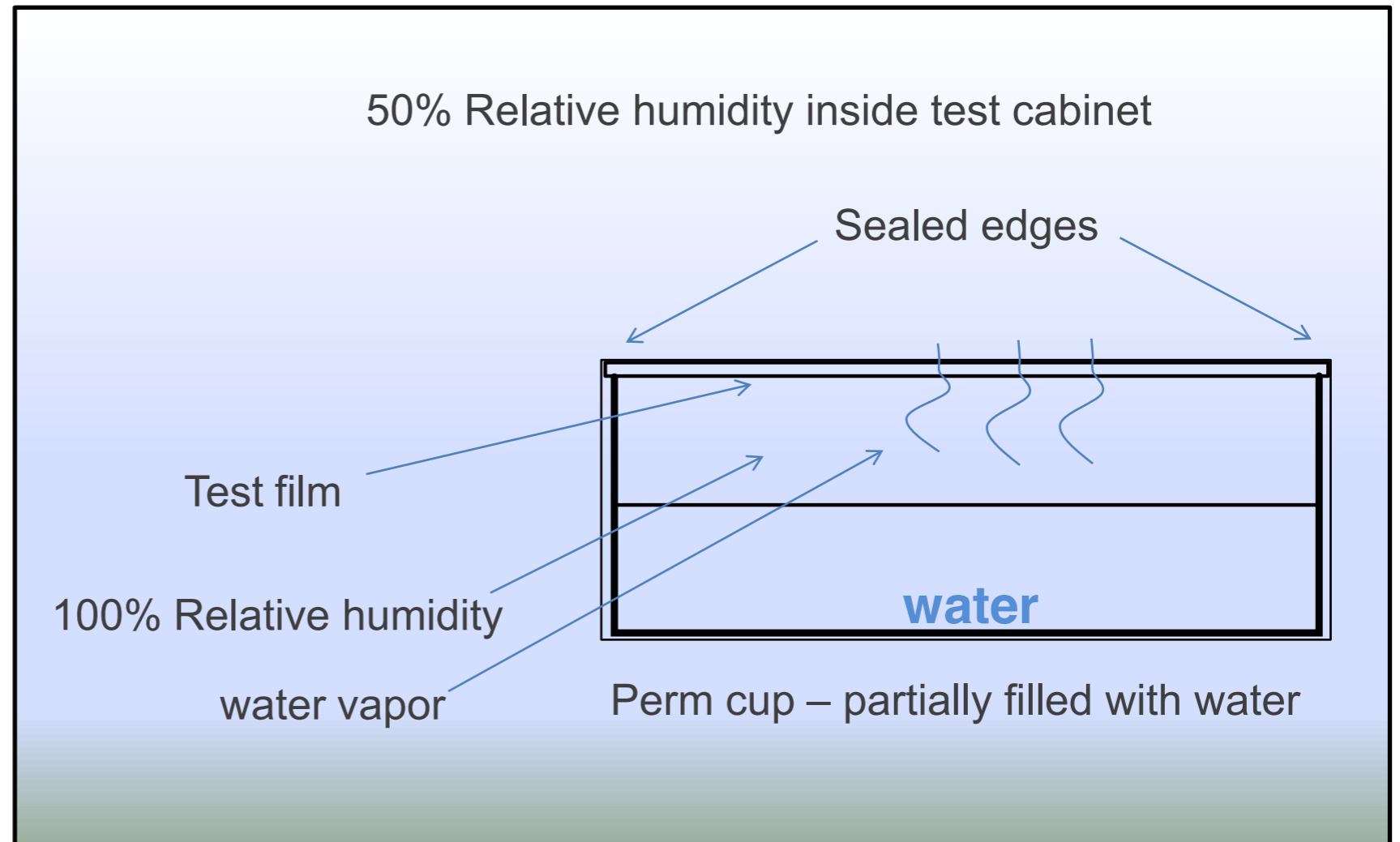
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WVT is not a constant, it is temperature and humidity dependent

✓ Vapor pressure difference inside and outside the perm cup help drive the water vapor through the test film

✓ After a steady state is observed, the weight loss of water over time is used to calculate the WVT

✓ The exposed surface area and film thickness are used in WVT calculations



Initial test conditions may use different temperature and relative humidity settings – however they must remain constant for the duration of the specific test

Water Vapor Transmission

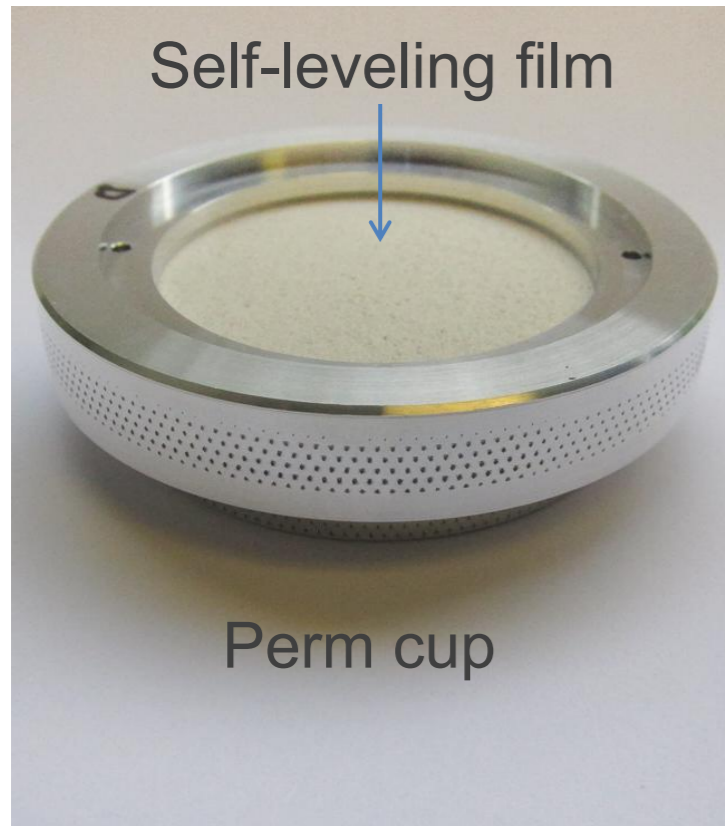
Pigmented Formula #1

US (dry film thickness = 6 mils)	Metric (dry film thickness = 150 μ)
WVT = 1.434 [grains/h. ft ²]	WVT = 1.001 [g/h·m ²]
Permeance perms = 3.26 [inch-pound]	metric perms = 1.86x10 ⁻⁷ [g/Pa·s·m ²]

Self-Leveling Formula #2

US (dry film thickness = 40 mils)	Metric (dry film thickness = 1000 μ)
WVT = 1.99 [grains/h. ft ²]	WVT = 1.306 [g/h·m ²]
Permeance perms = 4.53 [inch-pound]	metric perms = 2.43 x10 ⁻⁷ [g/Pa·s·m ²]

* WVT test condition: @ 24°C / 50% R.H.)



- NX-8101 Formulations were tested for WVT, their perm rating is greater than 3, indicating the coatings are breathable for moisture.
- Breathable coatings based on NX-8101 can maintain integrity of coatings (no blistering or delamination) by allowing moisture vapor to pass through therefore release vapor pressure.

Water Vapor Transmission

NX-8101 For Use Over Steel

- NX-8101 is compatible with solid epoxy dispersions
- No additional emulsifiers are required
- Current results with BECKOPOX® EP 2384w/57W :
 - Excellent film formation
 - Great spray characteristics
 - Excellent adhesion and blister resistance in salt spray testing with minimal corrosion inhibiting pigments



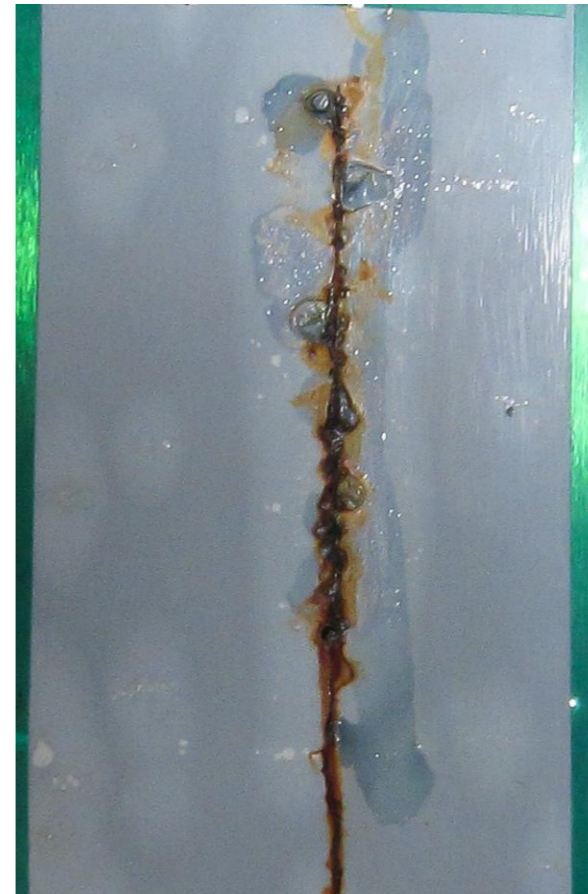
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Non-pigmented over CRS
500 hours Salt Spray (50 micron DFT)
Q-Panel S surface

*NX-8101
no field blisters*



NX-8101



**WBCA* for
Metal**

*Control
with field
blisters*

* commercial water borne curing agent designed for corrosion protection of steel substrates

NX-8101 exhibited no blisters away from the scribe line while the commercial waterborne curing agent showed blisters in and near to the scribe along with field blisters

NX-8101 For Use Over Steel

Conclusion

Properties	NX-8101	Competitive WBCA
Easy Mixing with liquid epoxy	Excellent	Fair
Fast cure at low temperatures and high humidity	Excellent	Poor
Excellent adhesion to damp concrete	Excellent	Excellent
Cured films are resistant to stains	Excellent	Good
Suitable for concrete primer formulations	Excellent	Excellent
Suitable for self-leveling formulations	Excellent	Fair

