

# Eastman Tetrashield™ PC4000

Krahn Seminar April 2026

# Agenda

- **Tetrashield™ Technology background**
- **Portfolio overview**
- **Compatibility with solvents & binders**
- **Weathering performance results vs Industry benchmarks (sole & co-binder)**

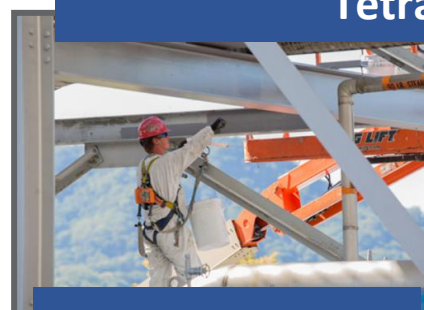
# From Tritan® to Tetrashield™

*Chemical structure drives properties. Eastman drives innovation.*



**Properties**

- Optical clarity*
- Mar/scratch resistance*
- Stain/chemical resistance*
- Hardness*
- High Tg*
- Temperature resistance*
- Hydrolytic stability*
- BPA free*



**Protective**

**Metal Packaging**

**EASTMAN**

# Solving industry needs with innovative solutions

PC4000, a TMCD-based resin, is the newest technology advancement from Eastman.



## Shielded secondary hydroxyls

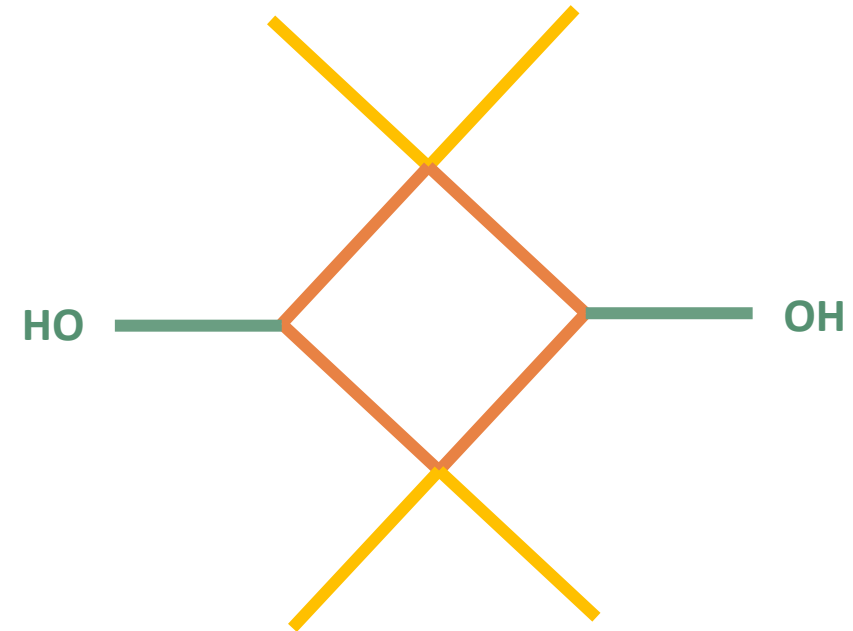
- Hydrolytic stability
- Stain and chemical resistance

## Cycloaliphatic structure

- High  $T_g$
- Hardness
- Rigid but not aromatic

## Tetramethyl structure

- Solubility
- Lower viscosity
- Compatibility
- Shield ester linkages



2,2,4,4-tetramethyl-1,3-cyclobutanediol (TMCD)

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# Eastman Tetrashield™ protective resin system

*A versatile, super durable resin for use in protective and industrial coatings*

Typical resin physical properties	PC4000	PC4050
<b>Solvents</b>	n-Butyl acetate	n-Butyl acetate
<b>Non-volatiles</b>	75%	70%
<b>Brookfield viscosity</b>	65 poise	25 poise
<b>Color</b>	<75 APHA	<75 APHA
<b>Hydroxyl number</b>	145-155 mg KOH/g	290-320 mg KOH/g
<b>Acid number</b>	<10 mg KOH/g	<5 mg KOH/g
<b>Glass transition temperature (T<sub>g</sub>)</b>	38°C	17°C

PC4000 is **versatile** and can be used at a **100% dosage or blended** with other major resins to achieve certain performance targets, improve performance and/or lower formulation costs.

PC4050 can be **blended with PC4000** to reduce drying time and accelerate hardness development.

## Available on request:

- Case studies
- Samples
- Starting point formulations
- Technical tips
- Technical data sheets
- Safety data sheets
- Laboratory and testing capabilities
- Technical know-how/collaboration partner

\*PC4050 is not TSCA registered but approved for EU, China, and India. We are currently evaluating obtaining TSCA approvals.

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# The modern protective coatings challenge

**Corrosion & long-term durability** — complex environments (marine, chemical, abrasion) shorten service life.

**Environmental & regulatory pressure** — VOC limits, REACH, low-VOC formulations.

**Performance vs sustainability trade-offs** — high-performance chemistries often contain (potentially) restricted components such as PFAS.

# Tetrashield™ PC4000 – Broad compatability

- Compatible with common solvents (no heating)
- Broad co-resin compatibility: FEVE, polyaspartic, acrylic, polyester

Resin	Compatible?
Polyaspartic	Compatible*
Acrylic	Compatible
Polyester	Compatible
FEVE	Compatible

\*Polyaspartics can be successfully blended with PC4000 and offer unique advantages, the crosslinking speed of the two resins tend to be drastically different, requiring careful formulation work

Solvent	Solubility Rating
Aromatic 100	Soluble
Acetone	Soluble
DE Acetate	Soluble
Dimethyl Carbonate	Soluble
DP Solvent	Soluble
EB Acetate	Soluble
EB Solvent	Soluble
EP Solvent	Soluble
Ethyl Acetate	Soluble
IBIB	Soluble
Isobutyl Acetate	Soluble
Isopropyl Acetate	Soluble
MAK	Soluble
MEK	Soluble
Methyl Acetate	Soluble
MIAK	Soluble
MIBK	Soluble
MPK	Soluble
n-Butyl Propionate	Soluble
PCBTF (Oxsol 100)	Soluble
Pentyl Propionate	Soluble
PM Acetate	Soluble
PM Solvent	Soluble
Propylene carbonate	Soluble
t-butyl acetate	Soluble
Toluene	Soluble
Xylene	Soluble

# Proven weathering performance vs industry benchmarks

*FEVE, Acrylic, Polyester*

# Formulation design for weathering study

## **White coatings:**

- 2K, NCO:OH ratio: 1.05  
Desmodur N 3390
- Pigment/Binder ratio: 0.58  
Ti-Pure™ R960
- UVA/HALS included

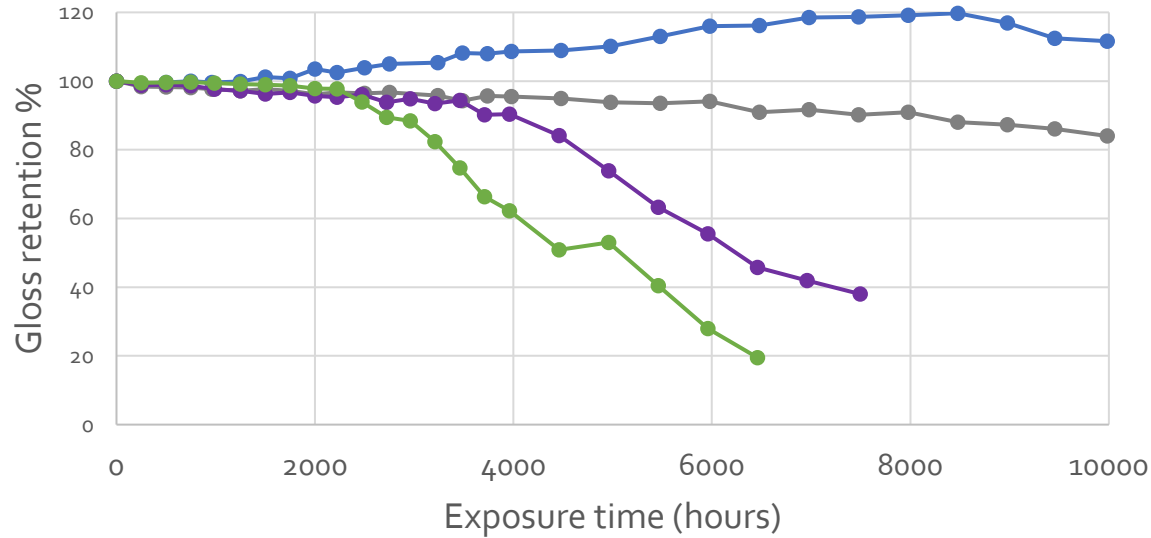
## **Black coatings:**

- 2K, NCO:OH ratio: 1.05  
Desmodur N 3390
- Pigment/Binder ratio: 0.02  
Monarch 1300
- UVA/HALS included

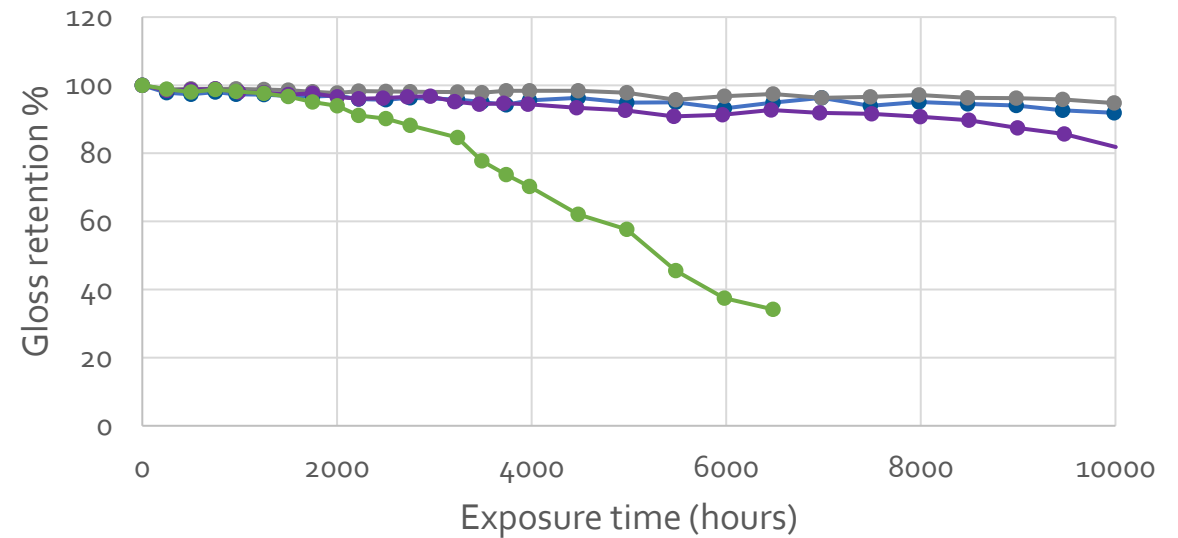
# Tetrashield™ PC4000 resin compared to other chemistries

QUVA | 60-degree gloss retention

### White formulation



### Black formulation



—●— FEVE    —●— PC4000    —●— Acrylic    —●— Polyester

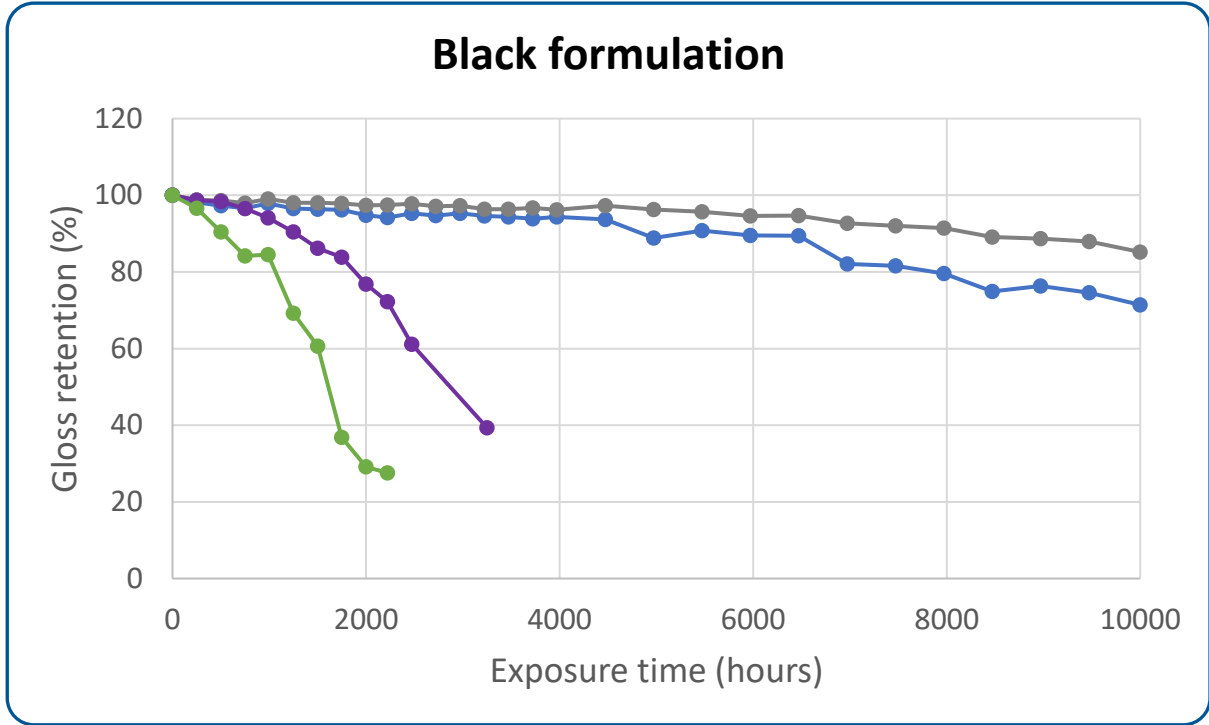
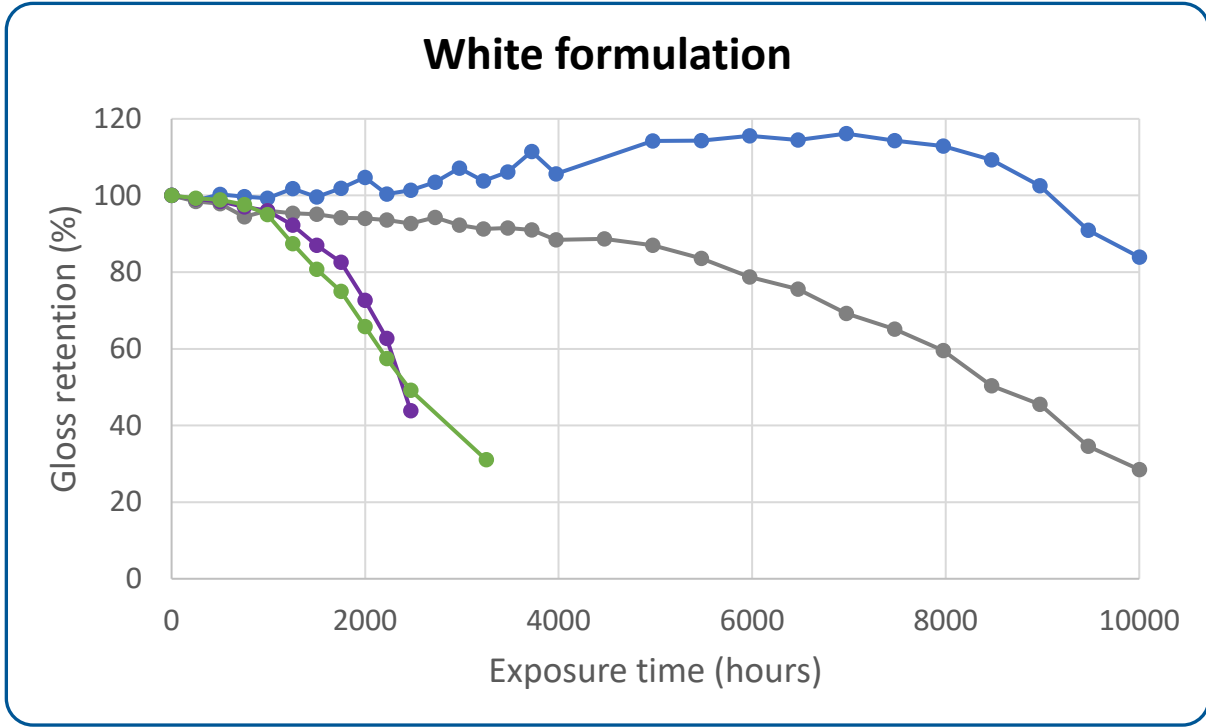
**Tetrashield™ maintains superior gloss retention across diverse colors under accelerated weathering conditions**

Notes:  
UVA-340, G154 Cycle 1



# Tetrashield™ PC 4000 resin compared to other chemistries

QUVB | 60-degree gloss retention



—●— FEVE    —●— PC4000    —■— Acrylic    —■— Polyester

**Tetrashield™ in white continues to outperform acrylics and polyester under UVB with  $\geq 80\%$  GR until 6000 hrs. In black color, Tetrashield™ performs at the same level as FEVE, once again proving broad compatibility with colors.**

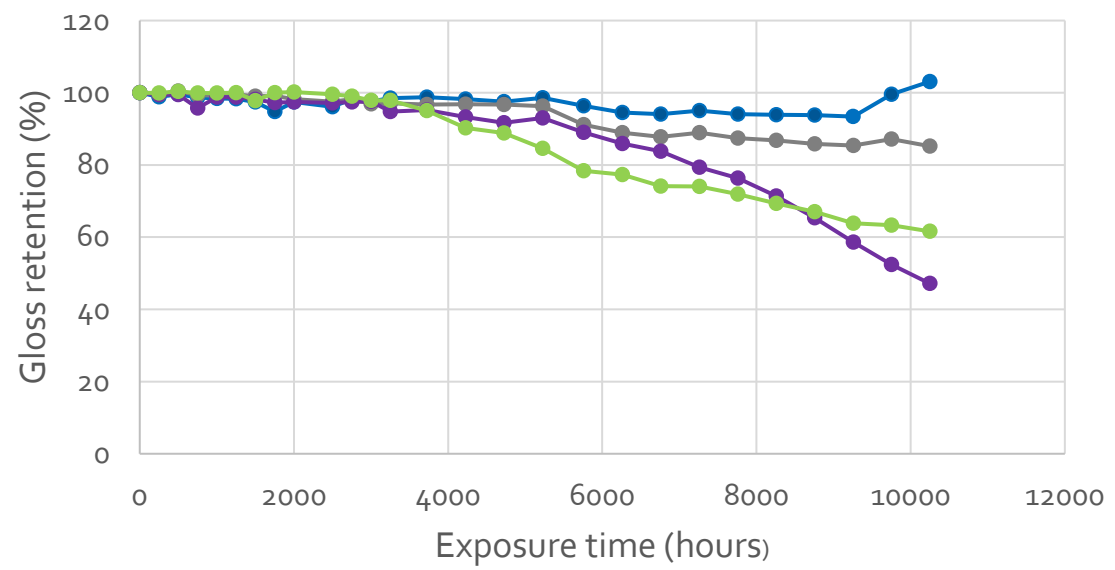
Notes:  
UVB-313, G154 Cycle 2



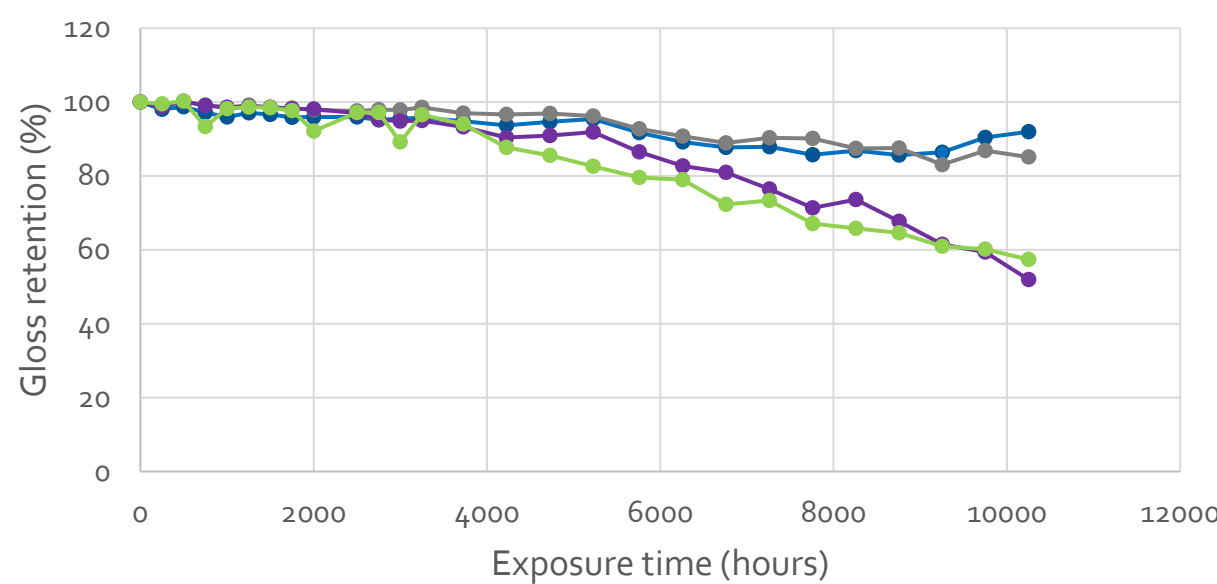
# Tetrashield™ PC 4000 resin compared to other chemistries

Xenon | 60-degree gloss retention

### White formulation



### Black formulation



—●— FEVE    —●— PC4000    —●— Acrylic    —●— Polyester

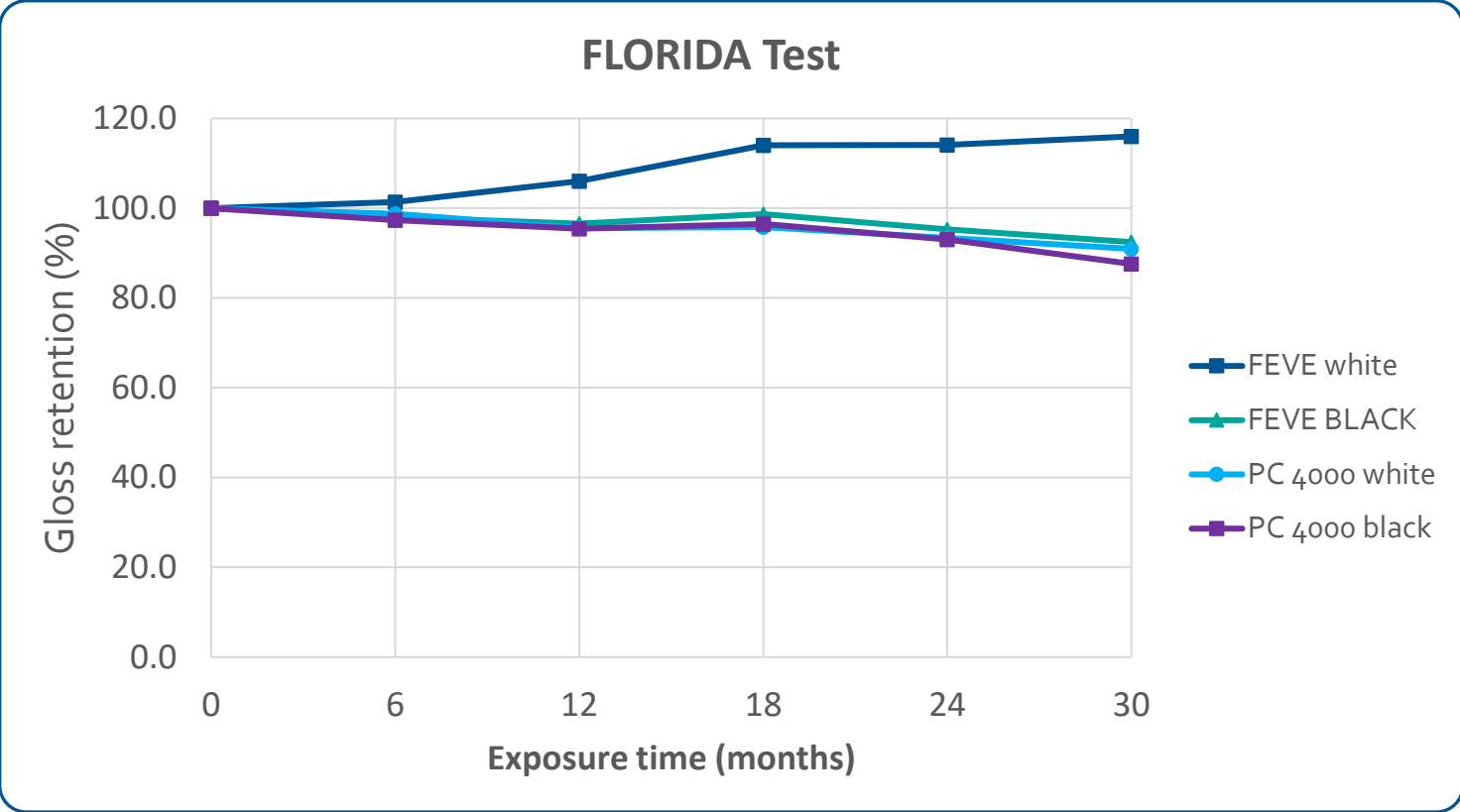
Tetrashield™ retains performance similar to FEVE across diverse colors under Xenon weathering

Notes:  
ISO 16474-2 C1



# Outdoor exposure FLORIDA Test (ongoing)

60-degree gloss retention



Tetrashield™ retains excellent weathering performance in REAL life conditions at same level as FEVE

# Creating coatings that protect

## *Outdoor case studies*



- <https://www.eastman.com/en/media-center/news-stories/2021/bristol-motor-speedway-protects-bleachers>
- <https://www.youtube.com/watch?v=bqCPWiAiaQE>
- [Newly Coated Tank Protection at Eastman Chemical Complex \(materialsperformance.com\)](https://www.materialsperformance.com)

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**Weathering performance**

**Tetrashield™ PC4000 – Blend study**

*FEVE, Polyaspartic, Acrylic, Polyester*

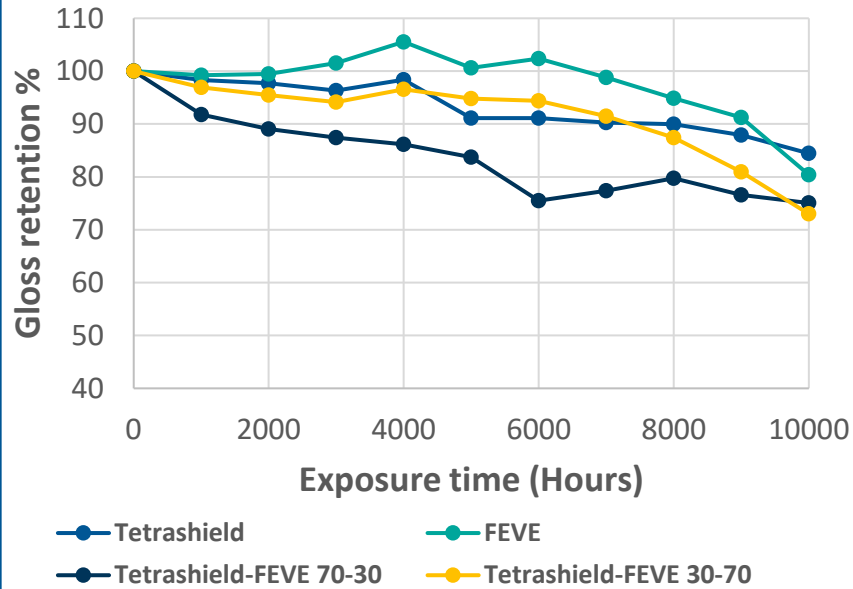
# Formulation design blends for weathering study

- PC4000 neat and blended (70:30 & 30:70 resin solids) with different representative co-resins in white and black coatings
- For each co-resin: neat + PC4000 blends at 70:30 and 30:70; PC4000 control (neat) included for both colors.
- Exposure: QUVA (UVA-340, ASTM G154 Cycle 1) to 10,000 h;
- Co-binders tested:
  - FEVE
  - Polyaspartic
  - Acrylic
  - Polyester

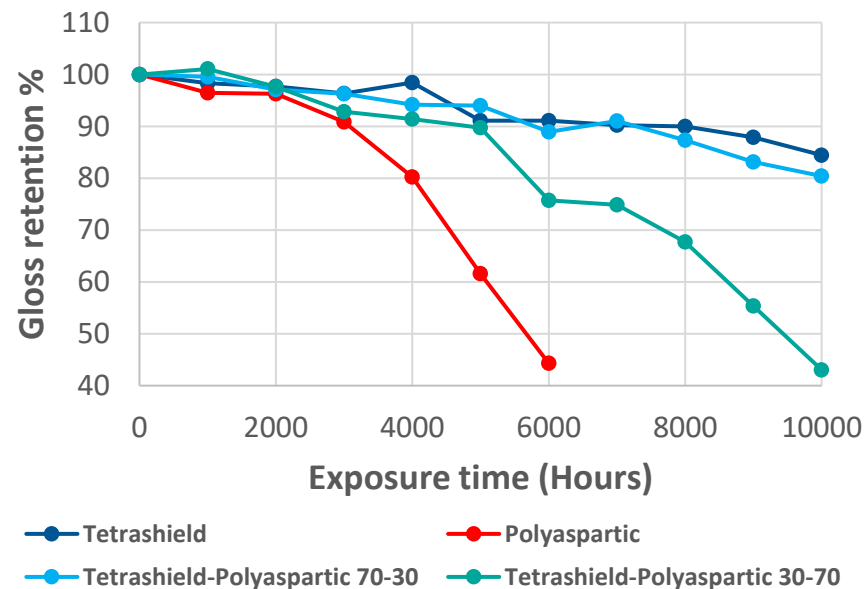
# Tetrashield™ PC 4000-blends (white coating)

QUVA | 60-degree gloss retention

### Tetrashield™-FEVE blends



### Tetrashield™-Polyaspartic blends

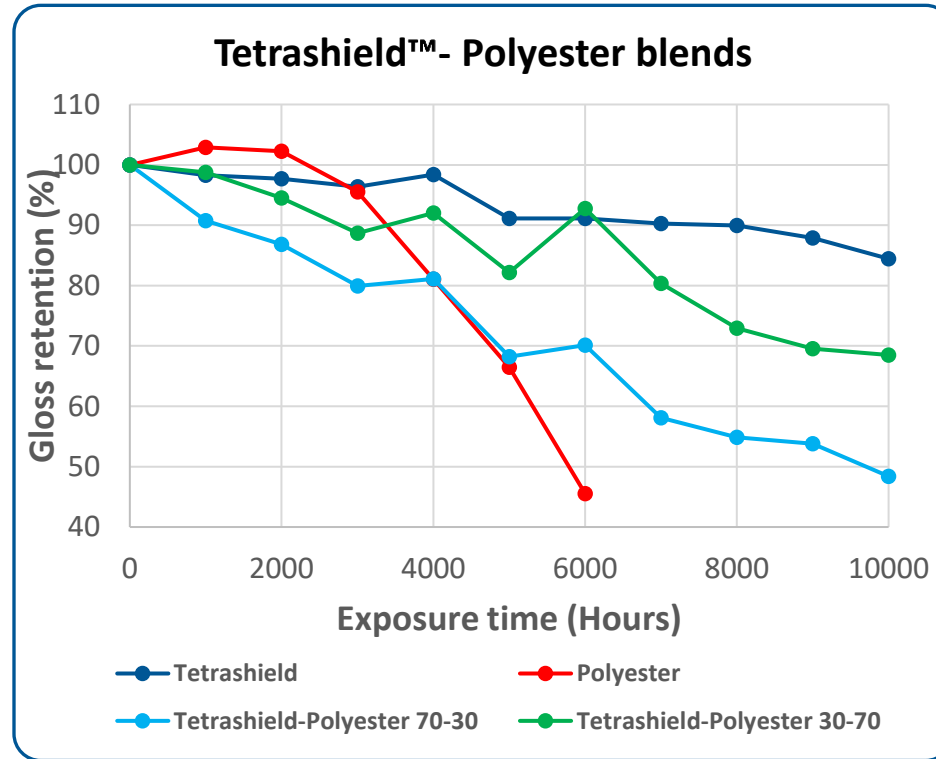
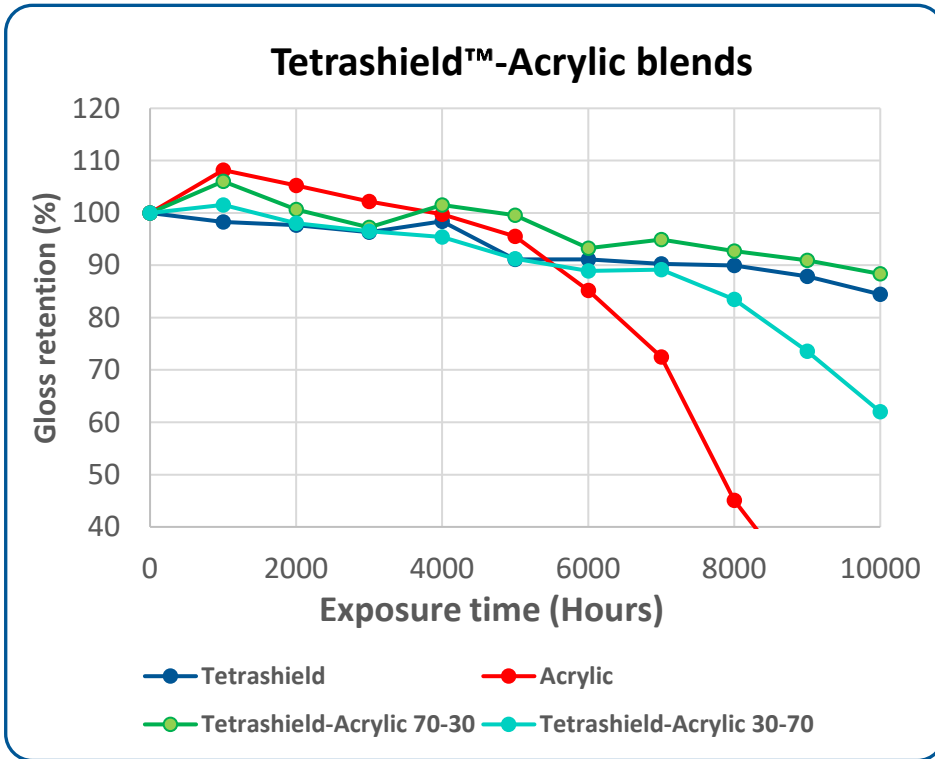


Gloss 60°	0 hrs	10K hrs
Tetrashield™	92	78
FEVE	57	45
Polyaspartic	93	41
Tetrashield™-FEVE 70-30	84	63
Tetrashield™-FEVE 30-70	79	58
Tetrashield™-Polyaspartic 70-30	95	77
Tetrashield™-Polyaspartic 30-70	91	39

Tetrashield™ maintains superior gloss retention across diverse blends under accelerated weathering conditions

# Tetrashield™ PC 4000-blends (white coating)

QUVA | 60-degree gloss retention

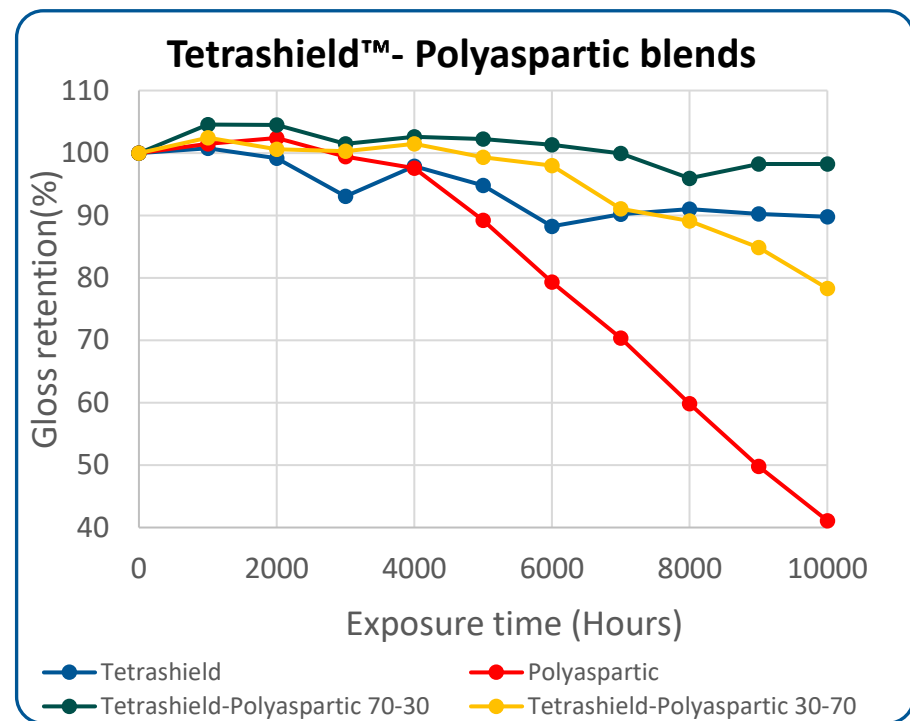
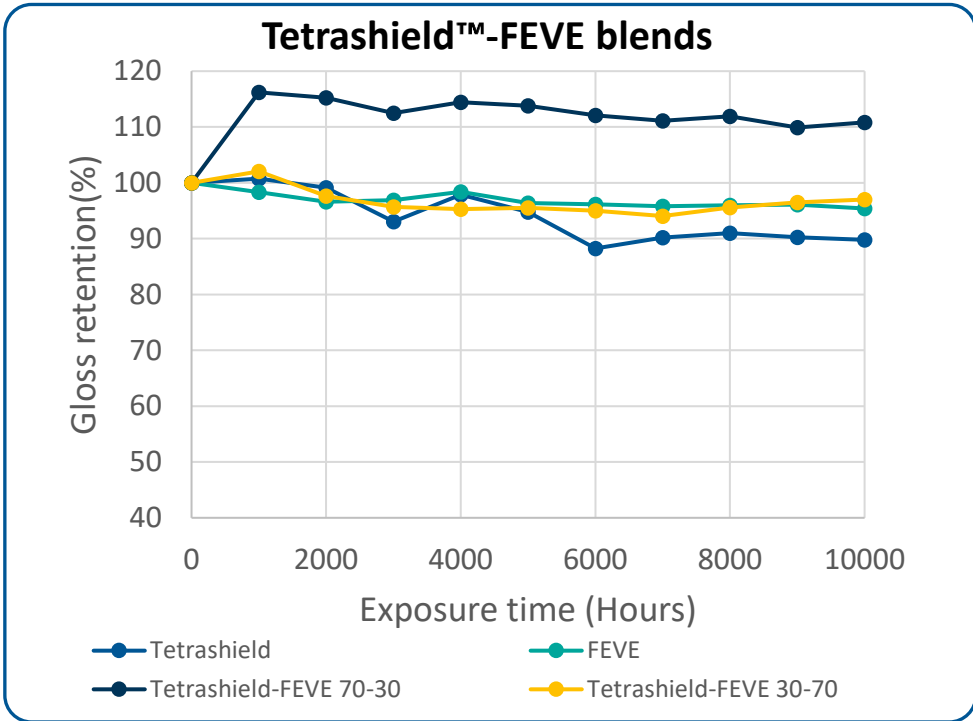


Gloss 60°	0K hrs	10K hrs
Tetrashield™	92	78
Acrylic	86	23
Polyester	56	26
Tetrashield™-Acrylic 70-30	87	77
Tetrashield™-Acrylic 30-70	94	58
Tetrashield™-Polyester 70-30	87	42
Tetrashield™-Polyester 30-70	54	37

**Tetrashield™ maintains superior gloss retention across diverse blends under accelerated weathering conditions**

# Tetrashield™ PC 4000-blends (Black coating)

QUVA | 60-degree gloss retention

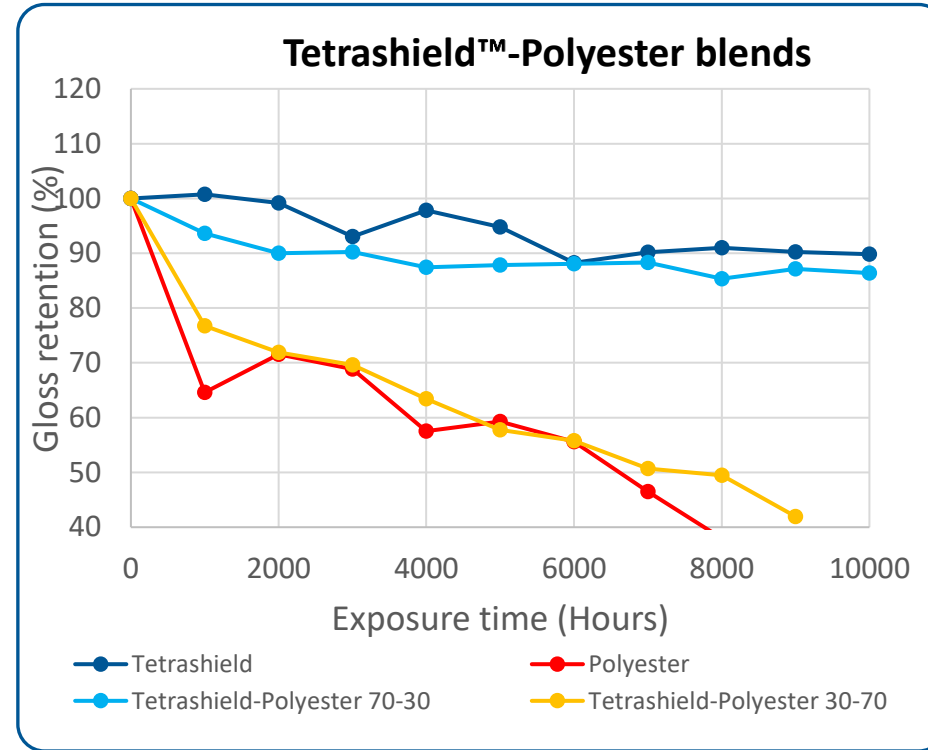
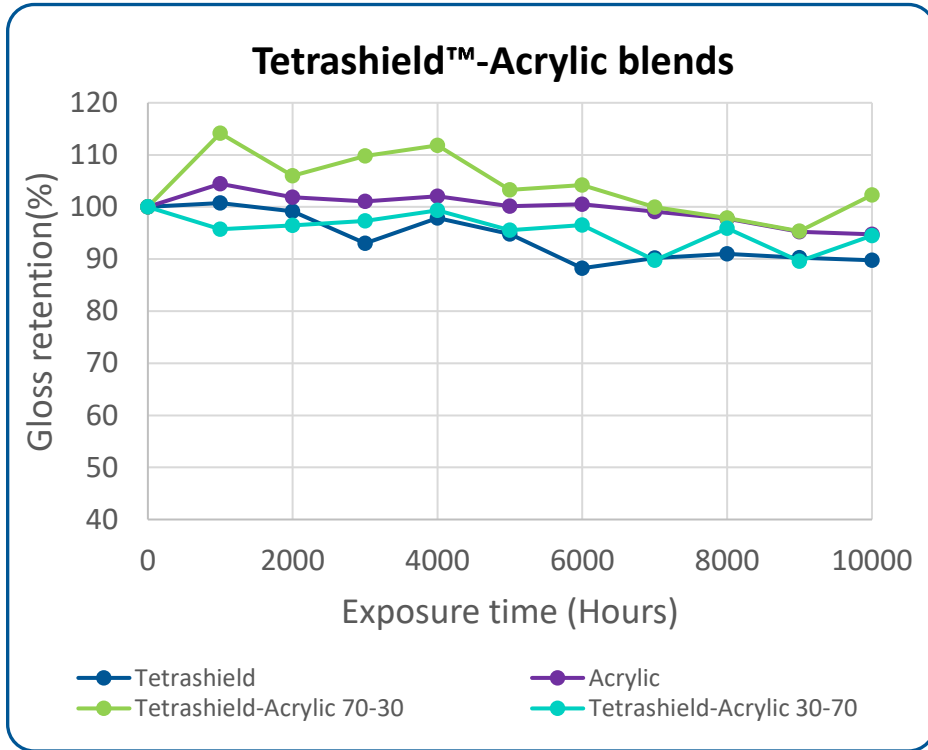


Gloss 60°	0K hrs	10K hrs
Tetrashield™	90	81
FEVE	77	74
Polyaspartic	87	34
Tetrashield™-FEVE 70-30	76	84
Tetrashield™-FEVE 30-70	82	79
Tetrashield™-Polyaspartic 70-30	81	79
Tetrashield™-Polyaspartic 30-70	82	65

**Tetrashield™ maintains superior gloss retention across diverse blends under accelerated weathering conditions**

# Tetrashield™ PC 4000-blends (Black coating)

QUVA | 60-degree gloss retention



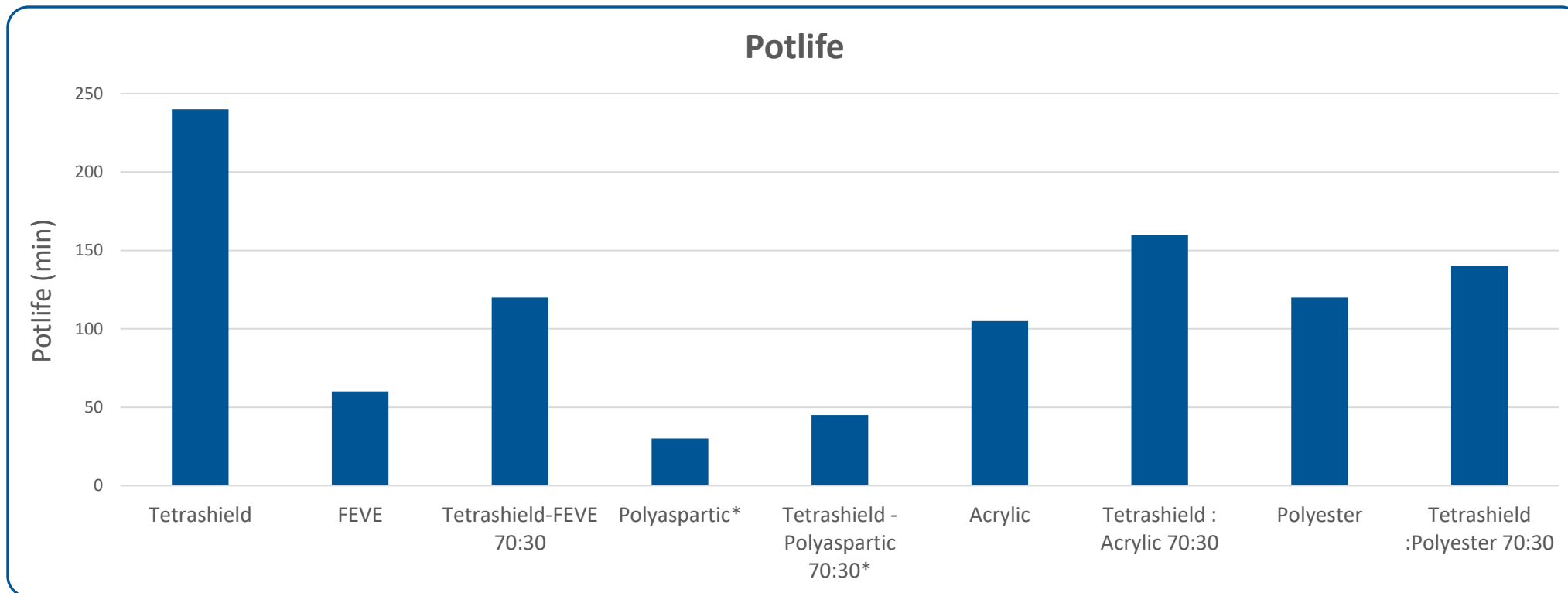
Gloss 60°	0K hrs	10K hrs
Tetrashield™	90	81
Acrylic	89	84
Polyester	62	22
Tetrashield™-Acrylic 70-30	78	80
Tetrashield™-Acrylic 30-70	89	84
Tetrashield™-Polyester 70-30	90	77
Tetrashield™-Polyester 30-70	81	34

**Tetrashield™ maintains superior gloss retention across diverse blends under accelerated weathering conditions**



# Pot life Tetrashield™ blends white 2K coatings

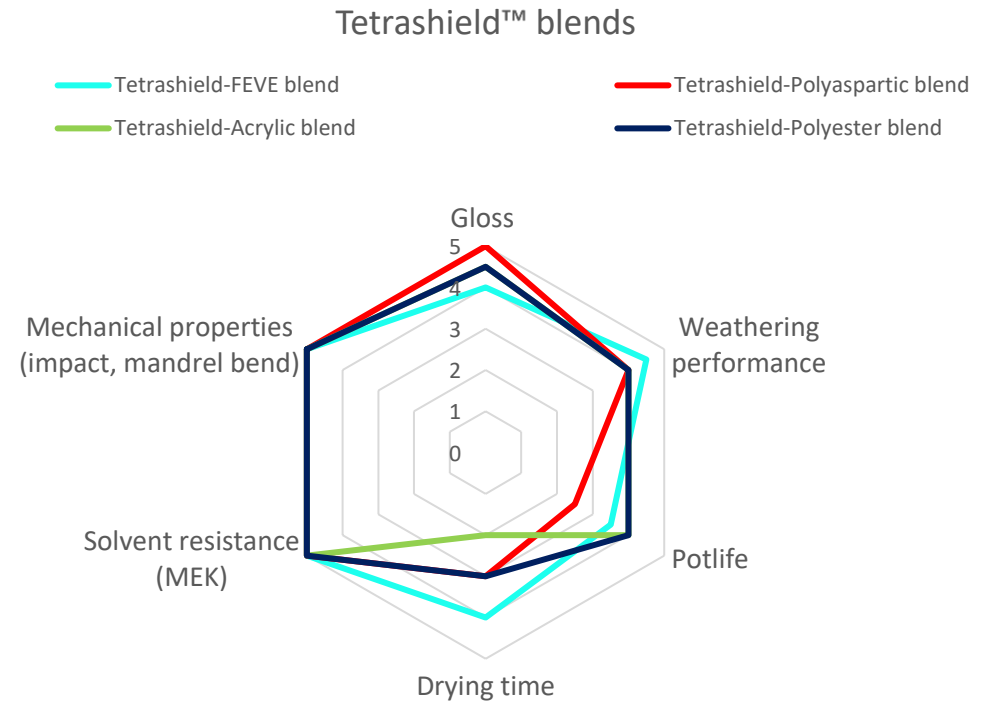
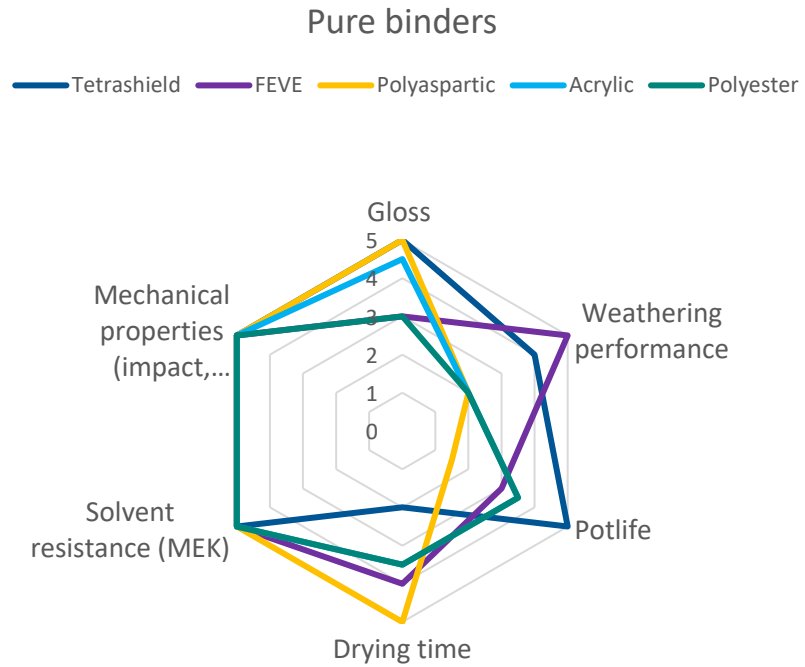
Pot life extension



\*Viscosity of polyaspartics coatings increased exponentially. It was not possible to estimate the time it was doubling. The data shows the time it took to reach roughly 800 mPas.

**Tetrashield™ increases the potlife, improving handling and ease of use in 2K coatings.**

# Summary property comparison



0=worst, 5=best

**Tetrashield™ improves gloss, weathering performance and increases potlife of other 2K binders**

# Summary & conclusions

## **Broad Compatibility**

Compatible with a wide range of solvents and binders used in exterior coatings, enabling easy formulation adaptability.

## **Long-Term Weathering Durability**

Offers durability comparable to premium FEVE fluoropolymer coatings, ensuring extended gloss and color retention in harsh environments

## **Flexible Formulation Use**

Functions both as a standalone binder and as a blending resin in 2K systems without sacrificing weathering resistance

## **Extended 2K Pot Life**

Enhances pot life and handling time of two-component coatings, improving processing and application efficiency.

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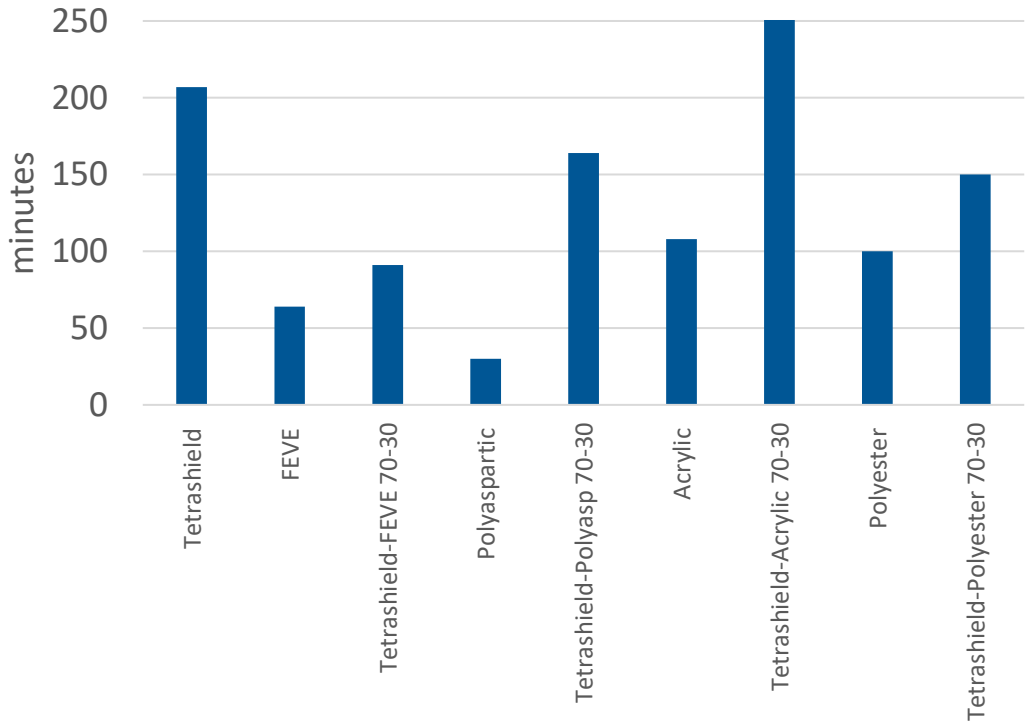
**Thank you!**



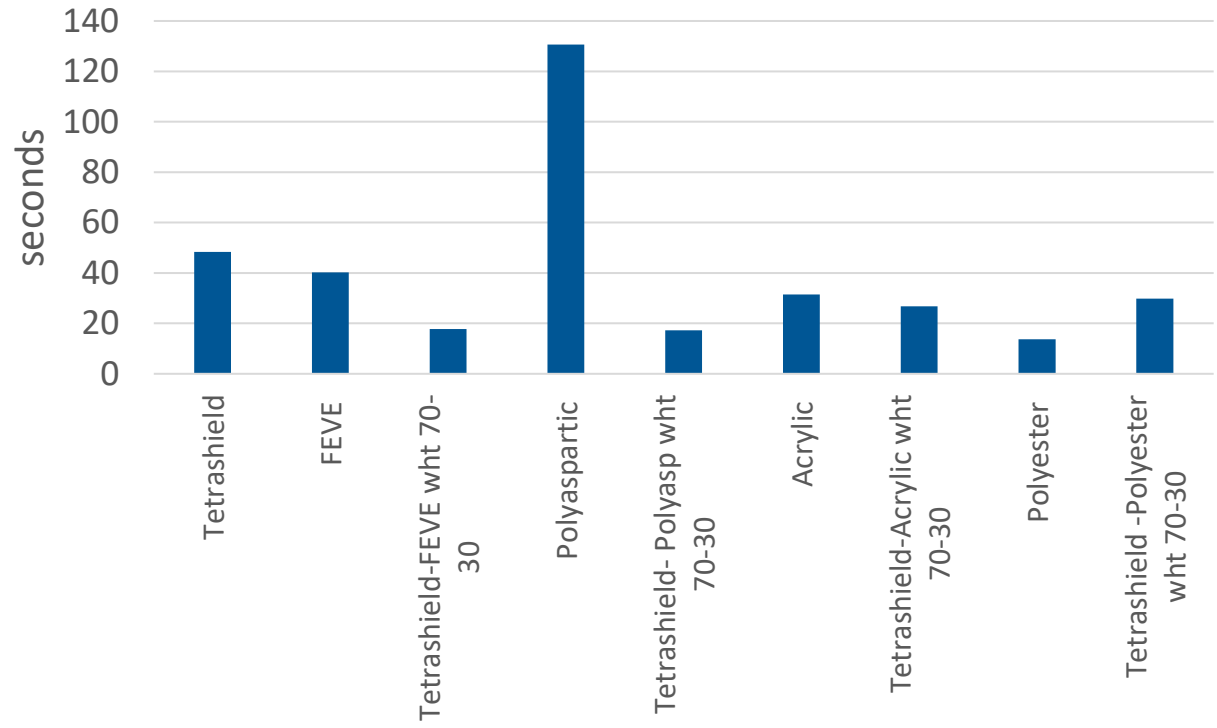
# Appendix

# Drying time & hardness development white coatings

### Dry-to-touch (Cottonfree) time



### Pendulum Hardness (7 days)



**TetraShield™ increases drying and hardness development time**

# Starting point formulation

Our technical service team can provide further formulation guidance to meet certain specifications.

Compound	Solids%	Wt%	Description	Supplier
<b>Mill base—Part A</b>				
Tetrashield™ PC 4000	75	10.74	Polyester resin	Eastman
Aromatic 100	0	4.88	Solvent	
Disperbyk 180	100	0.55	Wetting and dispersing agent	BYK
Ti-Pure™ R960	100	24.13	Pigment	Chemours
Crayvallac® Ultra	100	0.77	Rheology modifier	Arkema
<b>Letdown—Part A</b>				
Tetrashield™ PC 4000	75	24.96	Polyester resin	Eastman
Resiflow LH-240	100	0.99		
Solvent blend*1	0	4.24	Solvent	
10% BYK 331 in nBuAc	10	3.22	Surface additive	BYK
2,4-Pentanedione	100	0.24	Potlife extender	Wacker
DBTDL 1% in nBuAc	1	1.18	Catalyst solution	
Tinuvin 292	100	0.90	HALS	BASF
Tinuvin 400	100	1.2	UV absorber	BASF
<b>Cross-linker—Part B</b>				
Desmodur® N3390 BA/SN	90	16.14	Cross-linker	Covestro
Solvent blend*1	0	6.1	Solvent	
<b>Total</b>		<b>100</b>		

\*1: Solvent blend = Butyl acetate / Aromatic 100 / EB acetate = 40/40/20

\*2: Depending on environment conditions, catalyst level may need to be adjusted. If non-tin catalyst is desired, K-KAT XK-661 at 0.4 wt% of total resin solids is recommended to be used as a starting point.

\*3: Benzoic acid (~0.5% total resin solids) may also be used to extend pot life if needed

\*4: Zoldine® MS Plus/Incozol 2 (1.8wt% total resin solids) as moisture scavenger may be used in hot, humid environment

Total resin solids= solids of binder+ solids of crosslinker

Parameter	Value
NCO:OH	1.05
Wt% solids	70.3
P/B	0.58
VOC	369 g/L

Properties of the ready for spray formula (Part A+B)

<b>Potlife (hours)</b>		<b>Koenig Hardness Pendulam (sec.)</b>	
	3,5	24 hours	43,4
<b>Viscosity Brookfield DV-II (cP)</b>		48 hours	88,2
Spindle #5 - 50 RPM - 25°C	176	72 hours	107,1
<b>Non-Volatile Content (%)</b>		7 days	128,8
1 h. / 1 gr. / 110°C	75,3	<b>Drying time ASTM 5895 (hours)</b>	
<b>Density (g/l)</b>		stage I (Set to touch)	1
	1,2432	stage II (Tack free)	8,8
<b>VOC (g/L)</b>		stage III (Dry-Hard)	11,6
	369	stage IIII (Dry-Through)	23,2

# Corrosion resistance over primer

ASTM B117 over shot-blasted steel

