

vercet ™

POLYOLS

CREATING PERFORMANCE THROUGH CHEMISTRY

Building upon decades spent advancing materials chemistry innovation, NatureWorks offers solutions based on lactides and lactide intermediates that help innovators within the coatings, adhesives, sealants, and elastomers (C.A.S.E.), toner and surfactant industries realize:



Significant, measurable product performance benefits

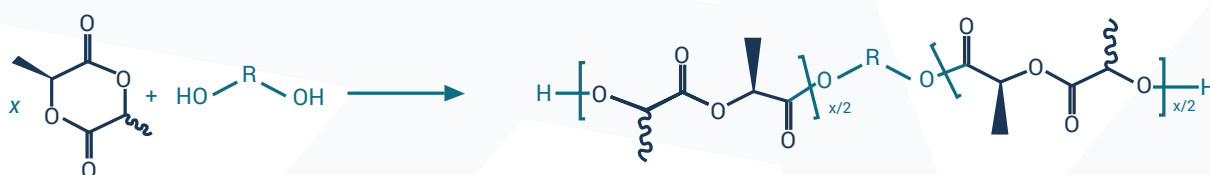


Move through the R&D process more efficiently and with minimal risk



Decrease systems costs via an optimized supply chain

VERSATILE VERCET LACTIDE CHEMISTRY



LACTIDE

- Reacts readily with alcohols, amines, glycols
- 100% solids
- No water loss
- Sustainably sourced

LACTIDE POLYOLS

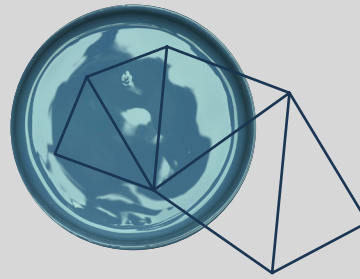
- Tg ranges ~ 0-60°C
- Hydroxyl values 12-112 mg-KOH/g
- Secondary hydroxyl functionality
- Readily reacts with isocyanates
- Readily soluble in esters and ketones
- Renewably-sourced biobased polyols and resins



LACTIDES

POLYOLS

RESINS



We achieve this by coupling tunable Vercet™ lactide-based chemistries with the knowledge of scientists and engineers who understand how to dial in the full capabilities of this versatile product line.

POLYOLS FOR POLYURETHANES

CUSTOM SOLUTIONS FOR COATINGS & ADHESIVES

Using Vercet polyester polyols for polyurethanes enables unique properties including excellent grease and oil resistance for both adhesive and coating applications.

COATINGS		ADHESIVES	
SUBSTRATES	MARKETS	SUBSTRATES	MARKETS
Wood Metal Cements Ceramics	Furniture Flooring Architecture Decorative	Wood Wood laminates Metal Mixed substrates	Furniture Flooring Nonwovens / hygiene Foams Electronics Packaging- rigid & flexible
PERFORMANCE BENEFITS		PERFORMANCE BENEFITS	
Excellent oil, grease, and solvent resistance High hardness polyurethanes Controlled functionality Controlled viscosity (hydroxyl values 12-112 mg-KOH/g) Low haze Solvent-borne & hot melt coatings		Tailored open times and work-life Excellent solvent resistance Solvent-borne & hot melt adhesives Renewably-sourced building block	

POLYOLS FOR URETHANE ADHESIVES

Vercet polyols show compatibility with a variety of polyols such as 2000 molecular weight adipate-based polyols.

Vercet Grade	<i>f</i>	T _g (°C)	Viscosity @100°C (Pa*s)	OHV ¹ [mg-KOH/g]	Performance Features
P1025X	1	15	1.3	25	Chain stopper
P2025X	2	40	11.3	25	High modulus & hardness. Oil & grease resistance.
P2056X	2	25	2.1	56	
P20112X	2	5	<1.0	112	
P2225X	2	35	13	25	High modulus & hardness. Oil & grease resistance. Improves flexibility & toughness.
P2256X	2	21	2	56	
P22112X	2	-1	<1.0	112	
P3025X	3	40	19.1	25	Crosslinker

1. OHV-Hydroxyl Value as determined by ASTM E1899

PROPERTIES POLYURETHANES FORMULATED WITH VERCET POLYOLS

Polyurethane with Polyol	Vercet P2025X	Control (Based on AA-HDO) ⁸
Wt% - Polyol / MDI ⁶ / 1,2 PDO ⁷	85.3/12.5/0.8	86.6/11.6/0.8
Polyol OHV ¹ [mg-KOH/g]	30	29
Gel Time [sec] 120°C	158	60
Hardness ² [Shore A / D]	84/71	70/33
T _g /T _m ³	T _g 51-55°C	T _m peak 55°C
Resiliency ⁴	17	23
Water Pickup ⁵	0.9%	0.6%



1. OHV – Hydroxyl Value as determined by ASTM E1899

2. Hardness as determined by ASTM 2240, 4 weeks

3. DSC mid-point, 20°C/min, 2nd heat

4. Resiliency as determined by ASTM D2632

5. Immersion testing, 8 days at 25°C

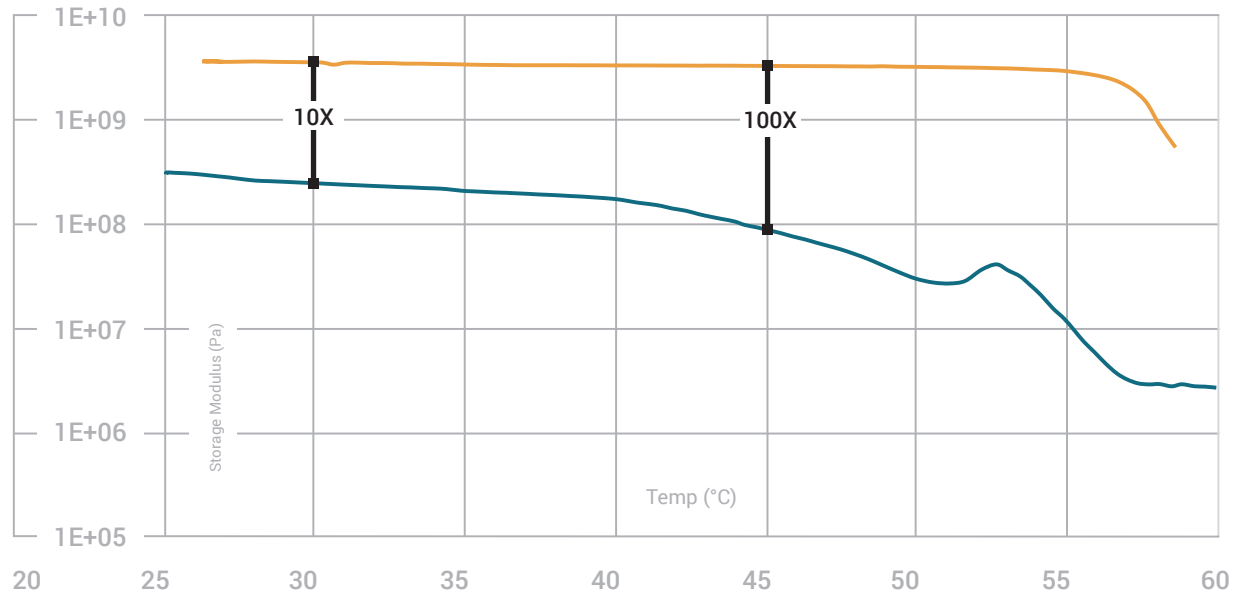
6. 4,4' - Methylene diphenyl diisocyanate

7. 1,2 - Propanediol

8. 1,6 - Hexanediol adipate

POLYURETHANE PERFORMANCE

HIGHER MODULUS CREATES HIGHER STRENGTH OVER EXTENDED TEMPERATURE RANGE

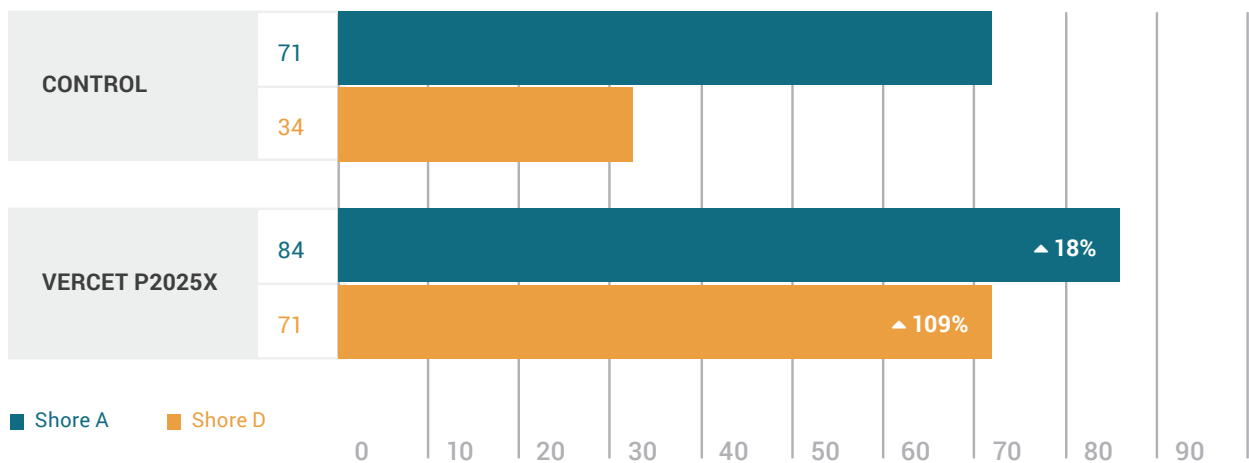


	Tg (°C, DSC)	Tg (°C, DMA)	E' (MPa, 30°C)	E' (MPa, 35°C)	E' (MPa, 45°C)	E' (MPa, 50°C)
CONTROL TPU	41-44 Tm (onset)		24	21	8.8	3.0
VERCET P2025X	49-52	56	347	331	321	315

ASTM Method D790. 3 point bend fixture heated 3°C per minute.

POLYURETHANE PERFORMANCE

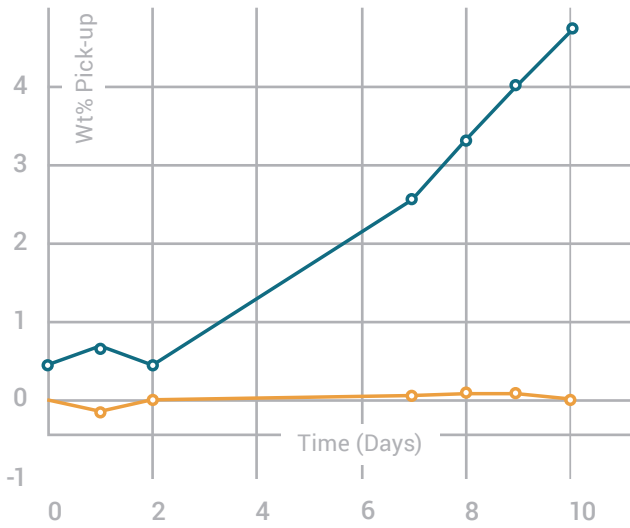
EXCELLENT HARDNESS AT LOW MDI CONTENT USES LESS ISOCYANATE



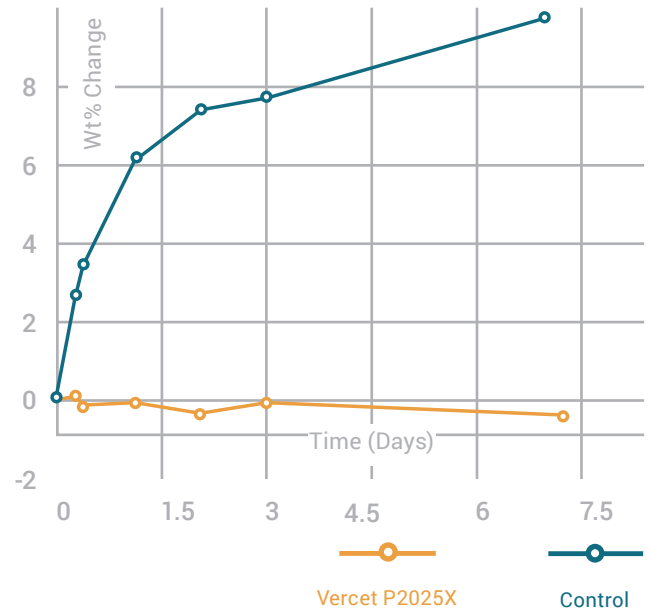
ASTM Method 2240. Measured after 4 weeks.

HOT OIL SWELL SHOWS EXCELLENT OIL RESISTANCE

WT% CANOLA OIL PICK-UP 68°C



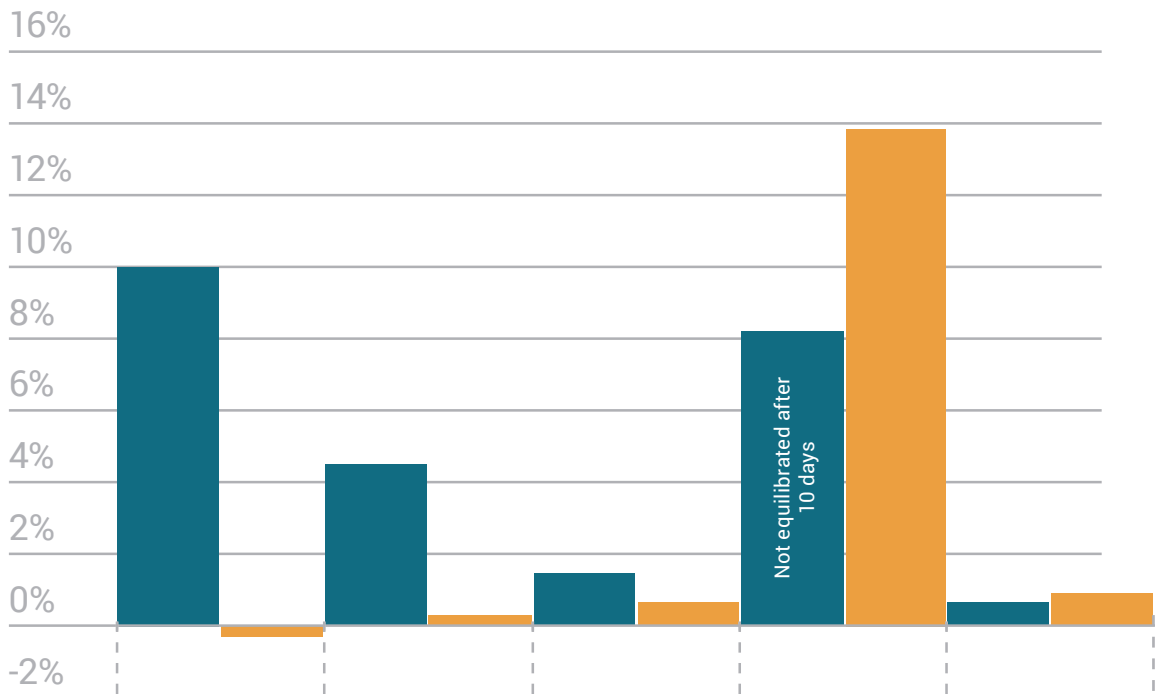
WT% IRM 903 OIL PICK-UP 68°C



MEASURABLE PERFORMANCE

VERCET-BASED POLYURETHANE SOLVENT RESISTANCE: 10 DAY SWELL VALUES

WT% SOLVENT PICK-UP



	IRM 903 OIL	CANOLA OIL	N-HEXANE	ETHANOL	WATER
CONTROL	10.00%	4.50%	1.50%	8.10%	0.60%
VERCET P2025X	-0.20%	0.20%	0.60%	13.90%	0.90%

Wt% data collected 68°C

POLYOLS FOR POLYURETHANES IN REACTIVE HOT MELT ADHESIVES

Polyol	Vercet P2025X	Control, (HDO-Adipate)
%NCO	2.0	2.5
Viscosity (mPa*s, 120°C)	+100,000	14,000
DSC Transition (°C)	51	53

PREPOLYMER FORMULATION

- 85% Vercet-based polyol
- 15% 4,4' MDI
- Isocyanate index 1.05
- Reaction time 2-3 hours

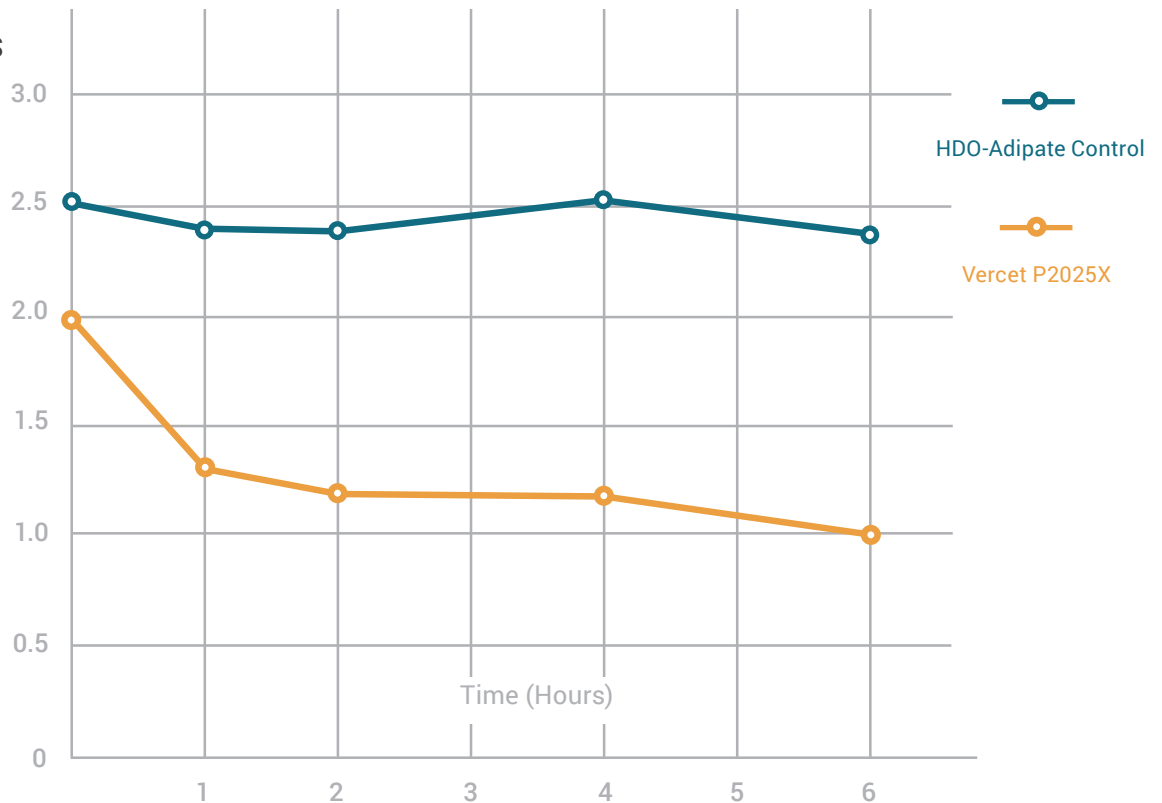
ADHESIVE FORMULATION

- 88 Wt% Vercet-based prepolymer
- 10 Wt% DEG-adipate prepolymer
- 1.0 Wt% Epoxy silane adhesion promoter
- 1.0 Wt% DMDEE catalyst

REACTIVE HOT MELT ADHESIVES PERFORMANCE

STABLE NCO PREPOLYMER ENSURES STORAGE AND POTLIFE STABILITY

%NCO OF PREPOLYMERS OVER TIME AT 120°C



VERCET POLYOLS IN SOLVENTBORNE URETHANE COATINGS

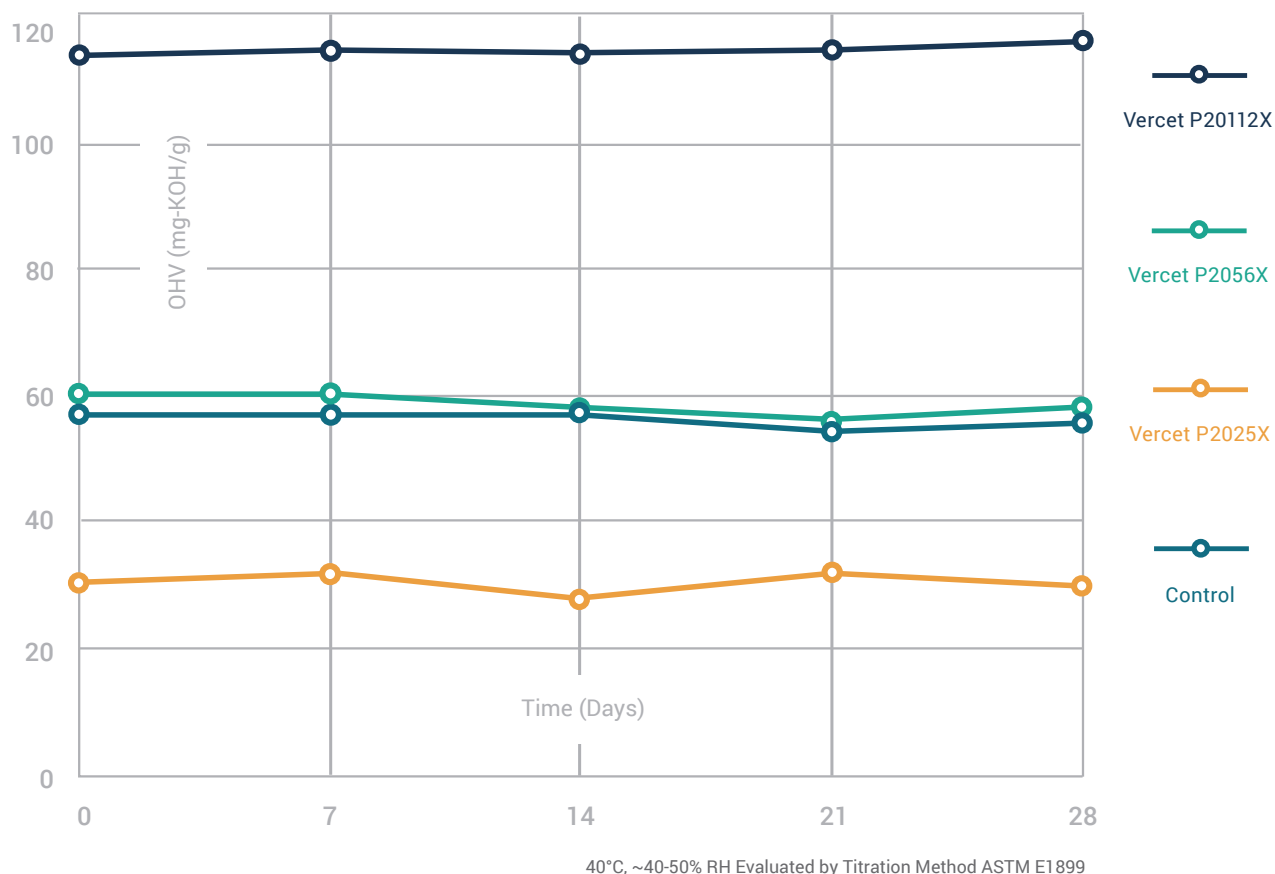
Excellent gloss, adhesion and hardness in urethane coatings.

Sample	60° Gloss	Cross-hatch Adhesion	Konig Hardness	Pencil Hardness	Weight % Solvent Swell Canola Oil @ 68°C
Vercet P2025X	95	5B (<5% removed)	73	2B	0.05
PU Control	40	1B (35-65% removed)	45	<8B	5.0
Uncoated Metal	83	NA	220	NA	NA

- Solvent borne TPU coated on metal Q panels
- Ethyl acetate ~20% solids, bar coated DFT ~30 um thick
- RT dried, no crosslinking reagent

VERCET POLYOL THERMAL STABILITY

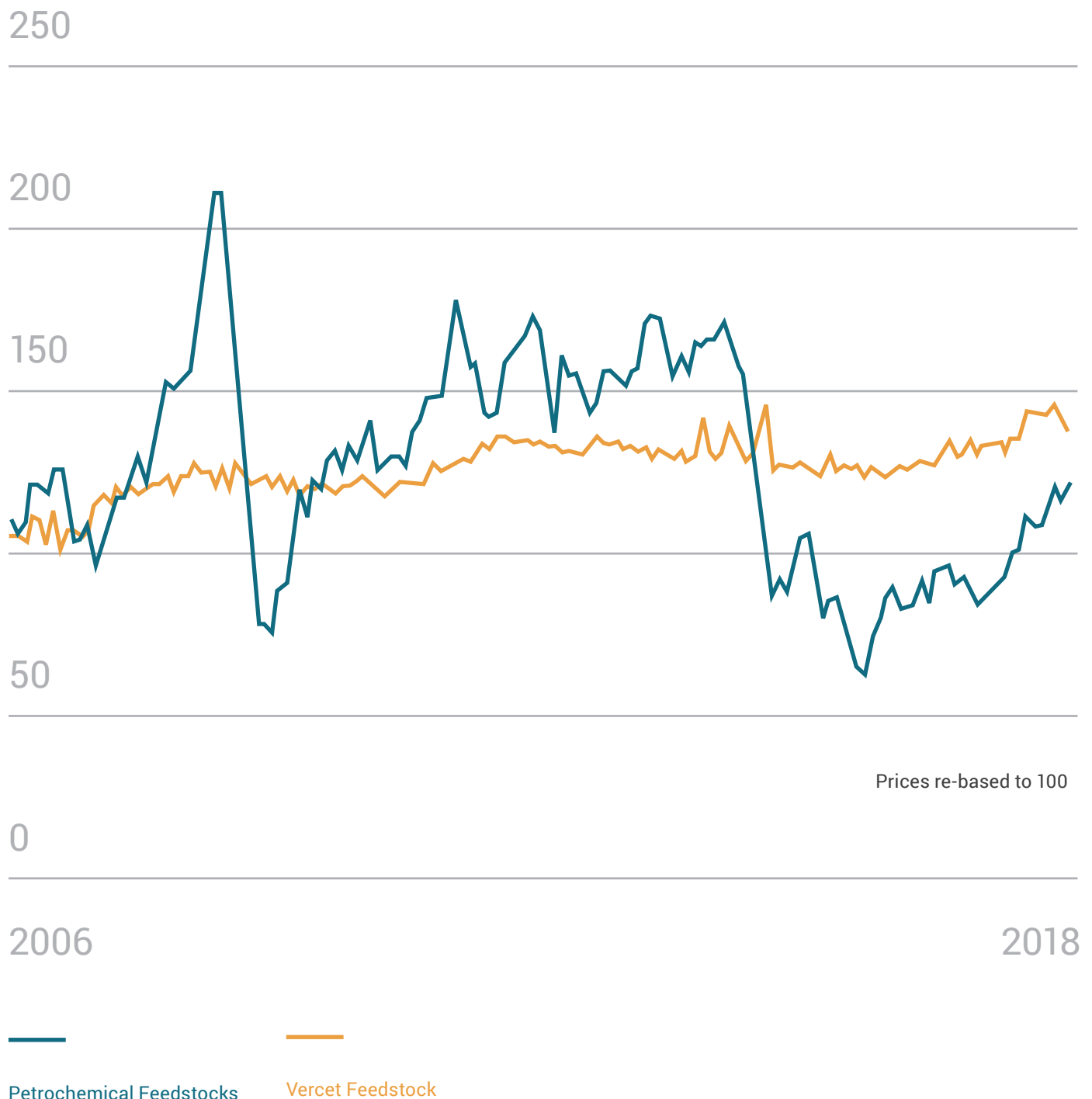
No significant change to hydroxyl value after thermal aging.



BENIGN BY DESIGN

REDUCING VOLATILITY IN PRICING THROUGH ALTERNATIVE FEEDSTOCKS

Renewably-sourced Vercet lactide-based products bring sensible, elegant, and cost-effective solutions based squarely on the principles of green chemistry to supply chains that, until now, were coupled with traditional fossil-petroleum solutions and their inherent price volatility.





HOW CAN WE HELP YOU?

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To learn more about Vercet custom solutions, please contact a member of our Performance Chemicals team.

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