How to Formulate Sustainable Solutions Based on Two-Component (2K) Polyurethanes & Polyureas?

November 3, 2022

Agenda

- Introduction to Vencorex
- Overview of Polyurethane Chemistry
- High Solids & Solvent-Free Polyurethanes
- High Solids & Solvent-Free Polyureas and Polyaspartics
- 2K Waterborne Polyurethanes
- Conclusion

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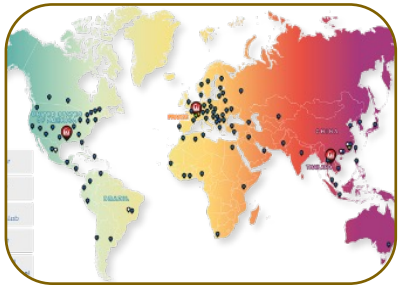
Who We Are

A fully-owned subsidiary of **PTT Global Chemical**, a leading global chemical company for better living

A leading manufacturer of **Specialty Isocyanates**



A Global Commercial Presence

3 manufacturing sites: located in France, the USA, and Thailand

R&D Center in France, + one lab in China

Our Values: **C**reativity, **O**pen-Mind, **R**esponsibility, **E**xcellence

Supported by **Multicultural** and **International** teams

2021 ecovadis Sustainability Rating

Committed to Safety, the Environment, and Sustainable Development

Vencorex in the Americas

Sustainable Development

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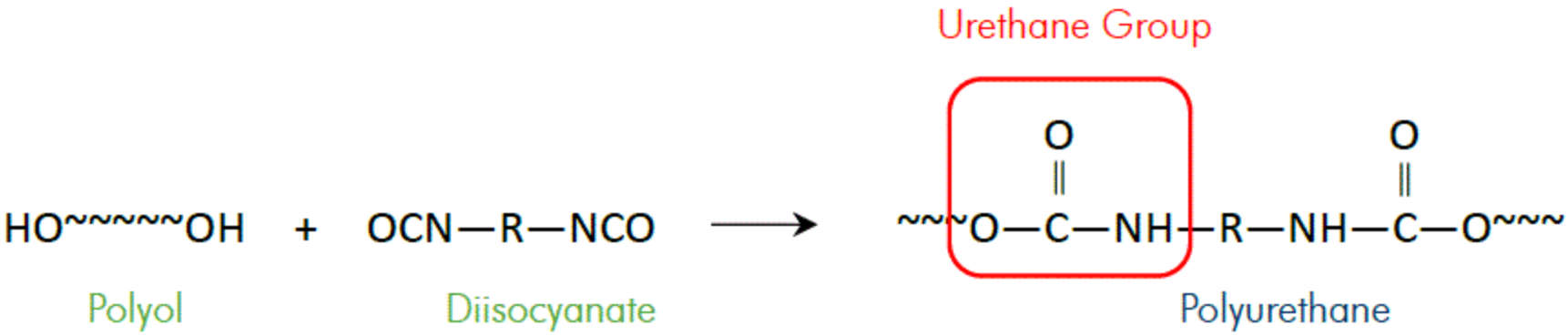
Introduction to Polyurethane Chemistry

Polyurethane (PU) : a reaction between a polyol with OH groups

(e.g. polyester or acrylic) and a (poly)isocyanate with NCO groups



Isocyanates Types

There are 2 types of isocyanates available on the market:

- **Aromatic isocyanates** (MDI, TDI):
  - Highly Reactive, but poor UV-light resistance (yellowing)
  - Main application: Foams

- **Aliphatic isocyanates** (HDI, IPDI) VENCOREX PRODUCTS
  - Exceptional resistance to UV / non-yellowing upon ageing
  - Applications: high end Coatings, Adhesives and Sealants (CAS)

Market Trends

The coating industry has been working on developing sustainable solutions for several years in order to:

- address consumers' expectations
- answer principal requests for eco-friendly and responsible products
- provide safe and easy-to-use products to end users
- comply with VOC regulations to have a positive impact on the environment

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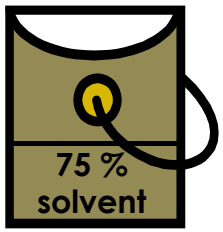
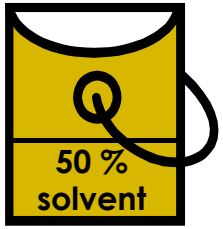
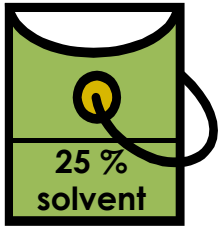
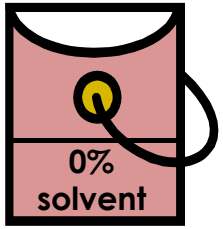
The Quest for Low VOC's









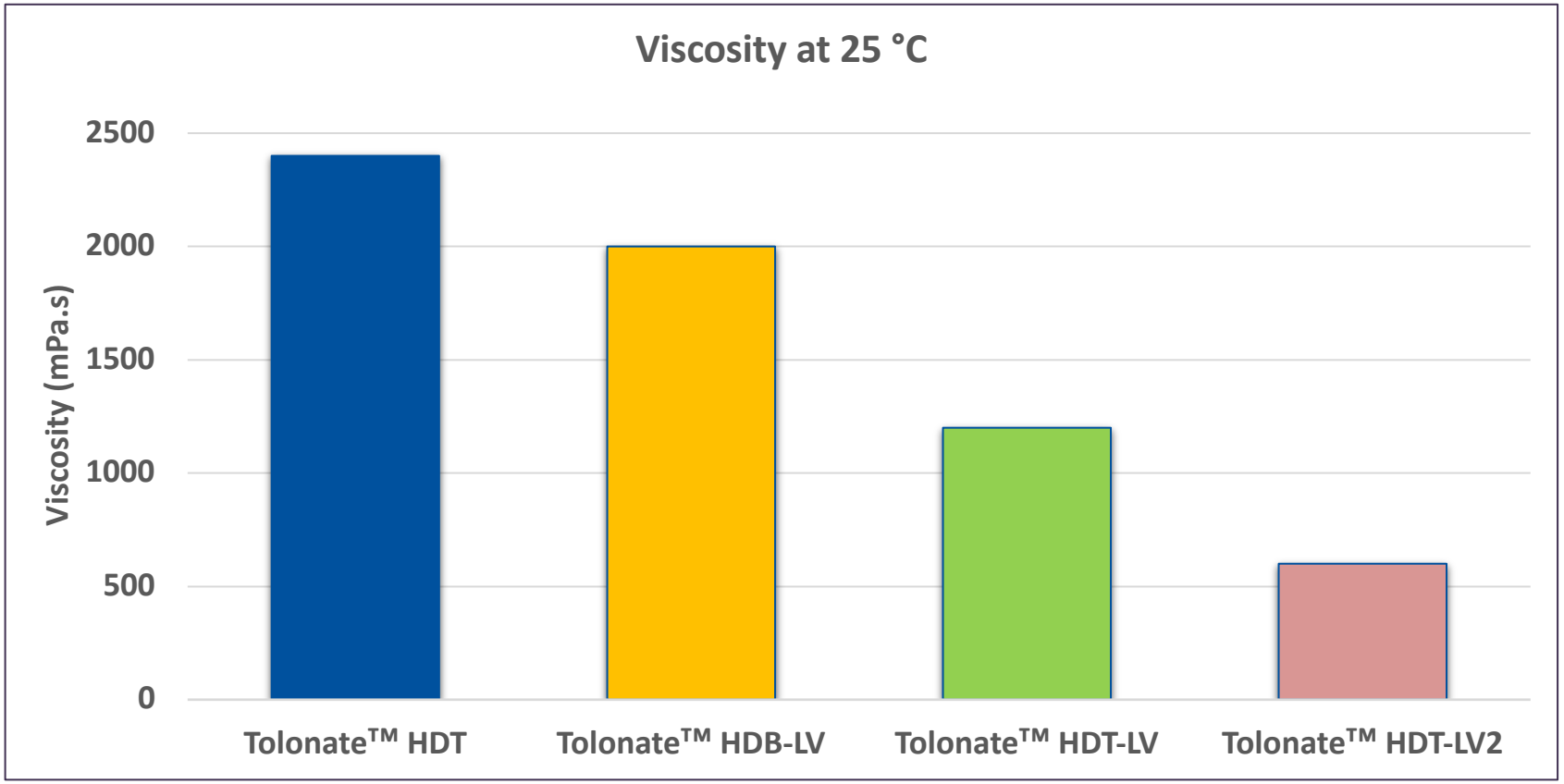
1950's-1970's
- Lacquers
- Mn =10^6

1970's-1990's
- High solids
- Mn =10^4

1990's-
- Very high solids
- Mn = 10^3

2000's-
- Solvent free
- New Tech?

Low Viscosity Polyisocyanates



High Solids Polyurethanes

Tolonate™ HDT-LV2:

Suitable to develop solvent-free formulations

Application: Self-leveling floor coatings, protective coatings, ...

Tolonate™ HDT-LV:

Preferred crosslinker for demanding high solids formulations

Application : Transportation, Car Refinish, …

Clearcoat based on Setalux FC 1925 BA 75 and Tolonate™ HDT-LV :

Formulation characteristics	
VOC Content	420 g/l (calculated) at 17s DIN 4
Pot Life	1h50
Tack Free Time	1h10

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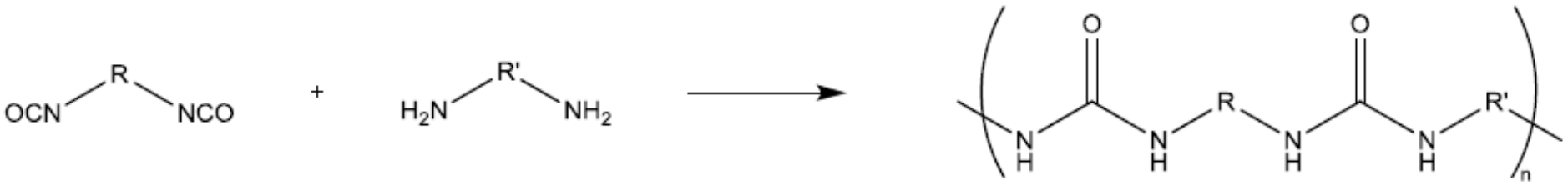
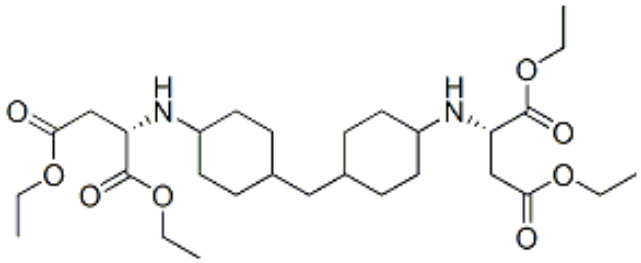
Polyurea/Polyaspartic

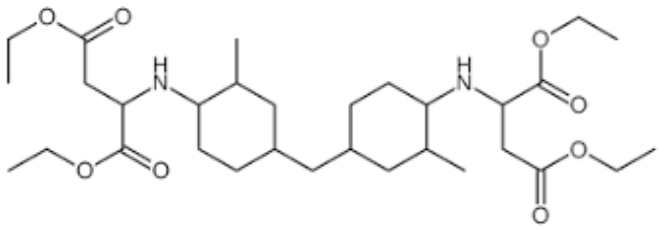
Polyurea formed by reaction of polyamine with polyisocyanate:



Polyaspartic Resins :



Fast Grade



Slow Grade

Polyaspartics vs. Polyurethanes

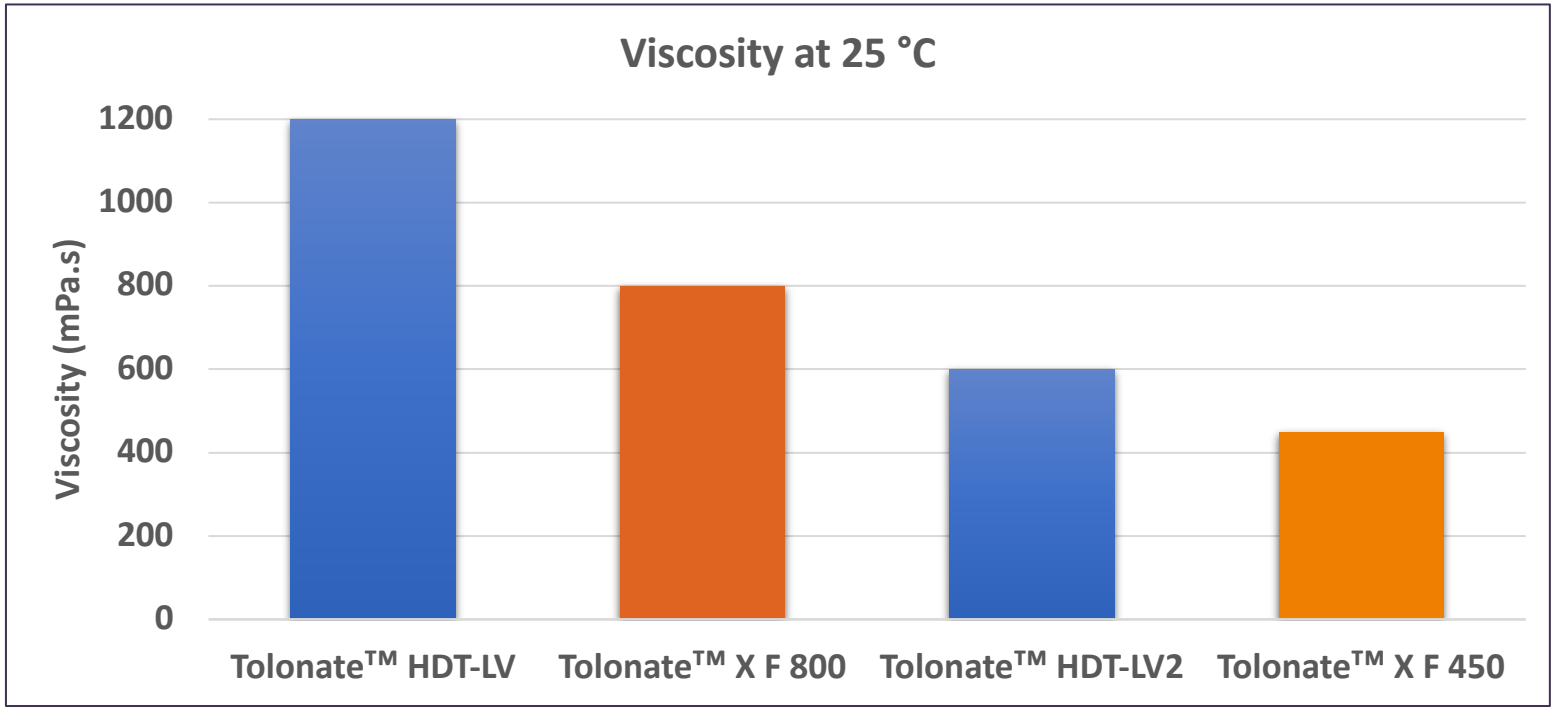
Advantages compared to traditional PU:

- High Reactivity -> low energy needed for curing
- Higher Film Build -> higher productivity
- High Solids -> low VOC emissions

With some shortcomings:

- Relatively brittle
- Short pot life
- Catalysed by moisture

New Flexible Grades

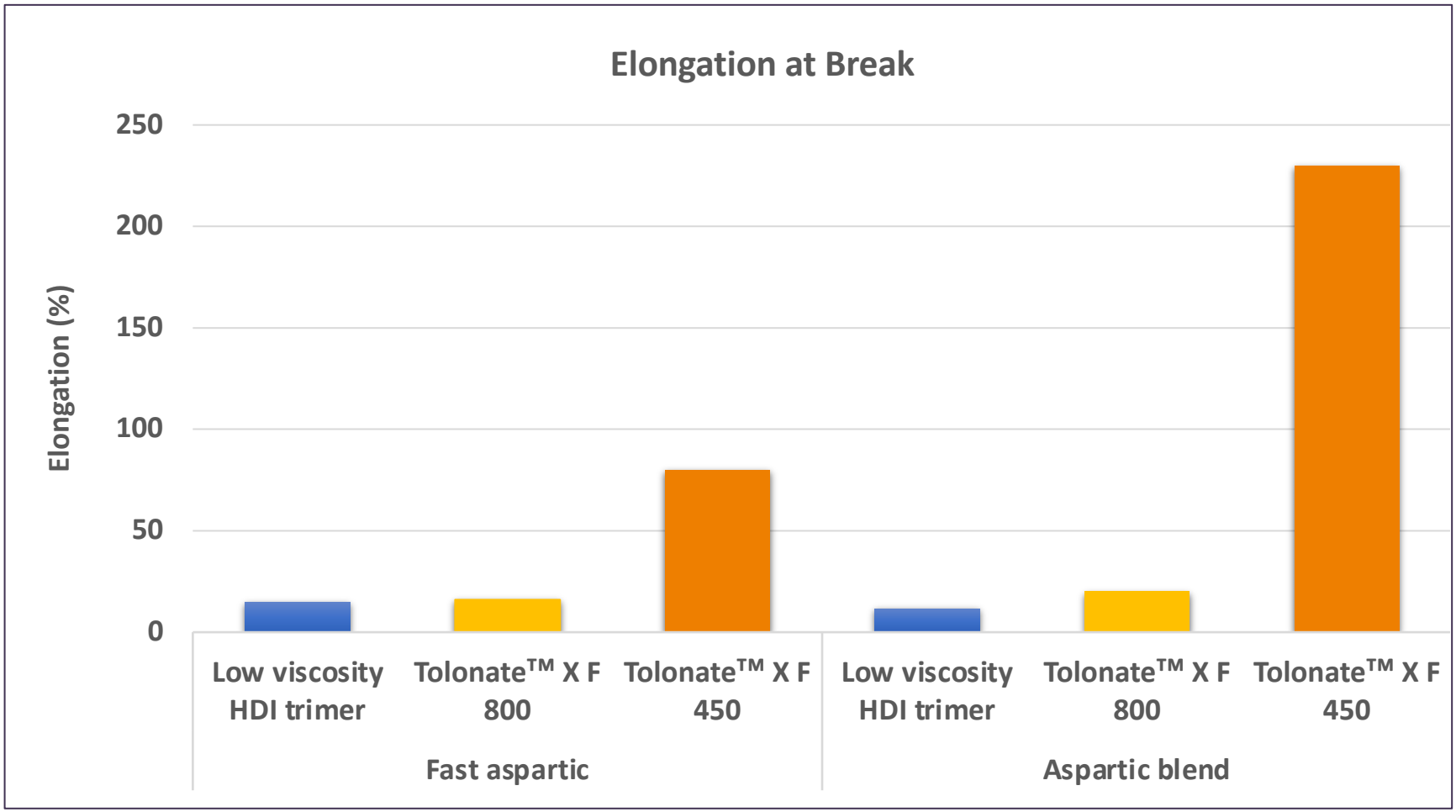


Physical Properties	Tolonate™ X F 800	Tolonate™ X F 450
NCO (%)	**20,6**	**16,3**
Viscosity at 25 °C (mPa.s)	**800**	**450**
Solid content (%)	**100**	**100**

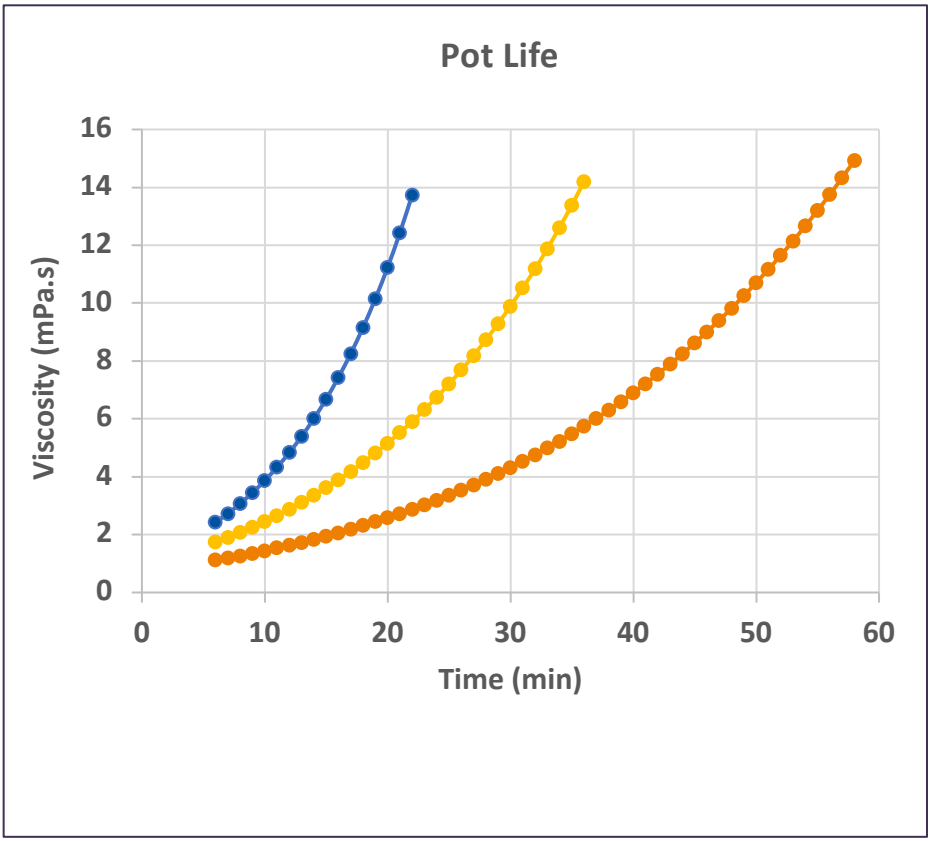
Good Balance of Flexibility & Hardness

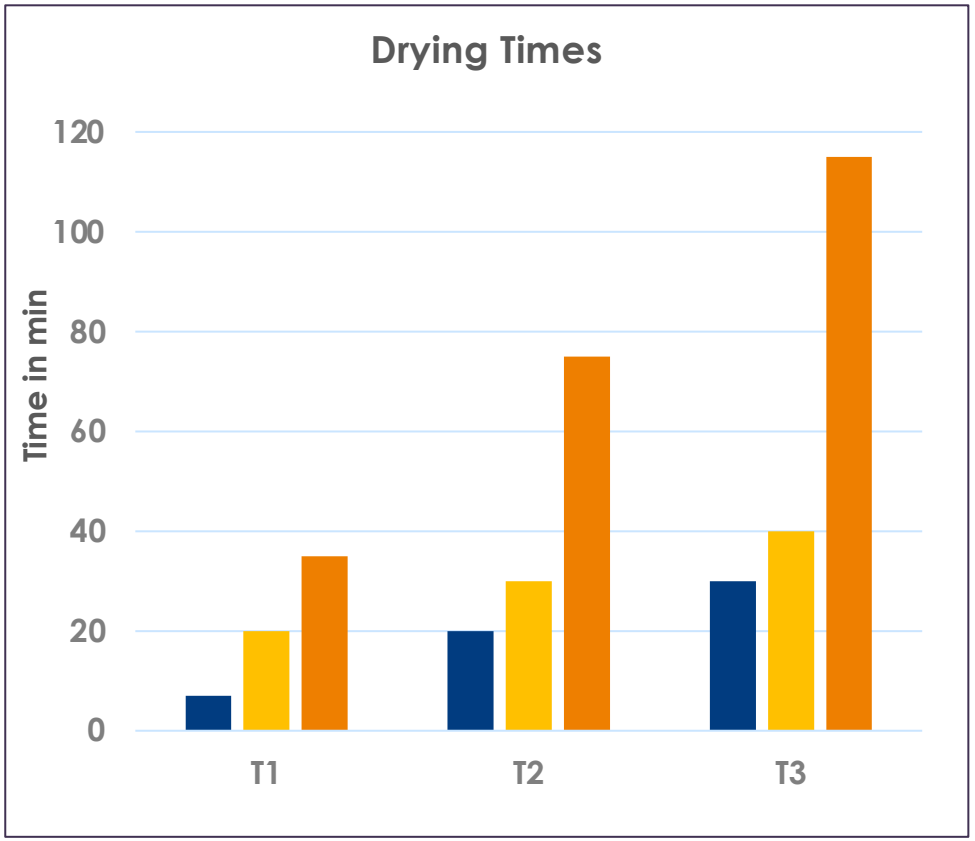
Products	Reverse Impact (AFNOR)	Conical Mandrel	Koenig Hardness
Low Viscosity Trimer	20 cm	✗	90
Tolonate™ X F 800	> 100 cm	✓	83
Tolonate™ X F 450	> 100 cm	✓	75

Superior Flexibility



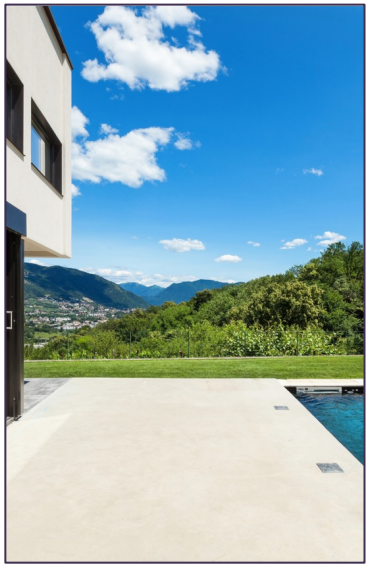
Good Balance of Pot Life & Cure Speed





Low viscosity trimer Tolonate™ X F 800 Tolonate™ X F 450

Areas of Application



Product	Description	Polyurethane	Polyaspartic	Typical Applications
Tolonate™ X F 450	**Elastic** Hardener	**Only in Blends**	**As a standalone**	Water-Proofing, Protective Coatings, Plastics, Sports Flooring
Tolonate™ X F 800	**Flexible** Hardener	**As a standalone**	**As a standalone**	Industrial Flooring, GI, ACE, & Plastics

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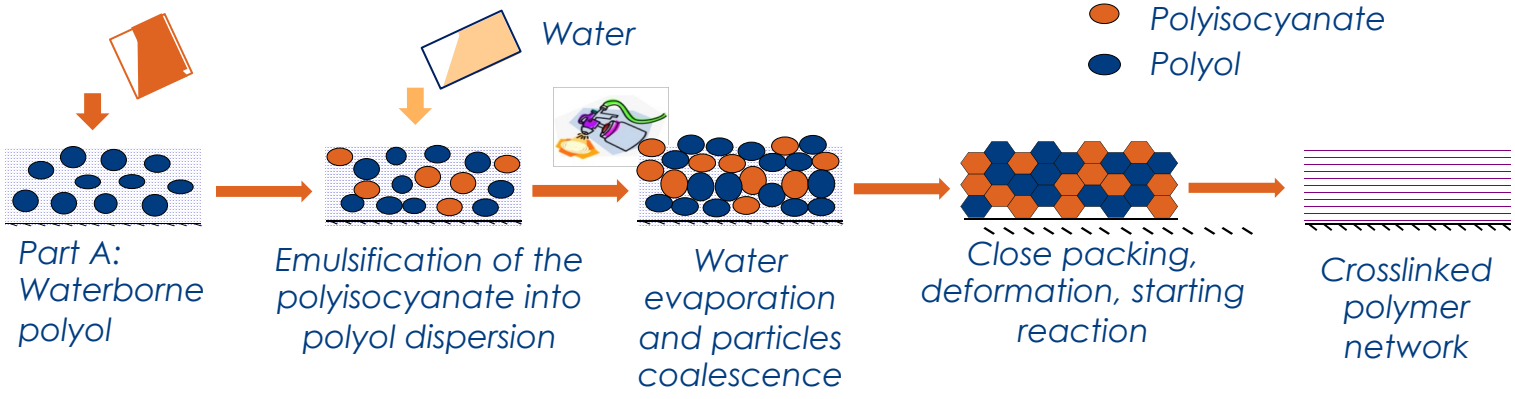
2K Waterborne Polyurethanes

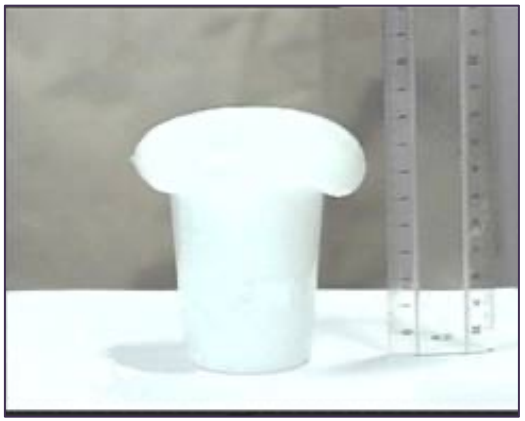
How does it work ?

Solvent-based or solvent free ***polyisocyanate*** *crosslinker*



Challenges

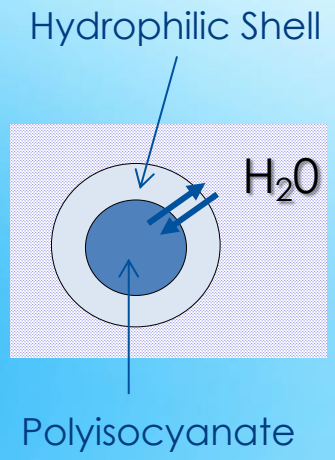
- Isocyanates react with water
  - ⇨ urea fwhite particles with gas formation (CO2)
  - ⇨ foam formation
- Hydrophobic Isocyanate difficult to mix with water

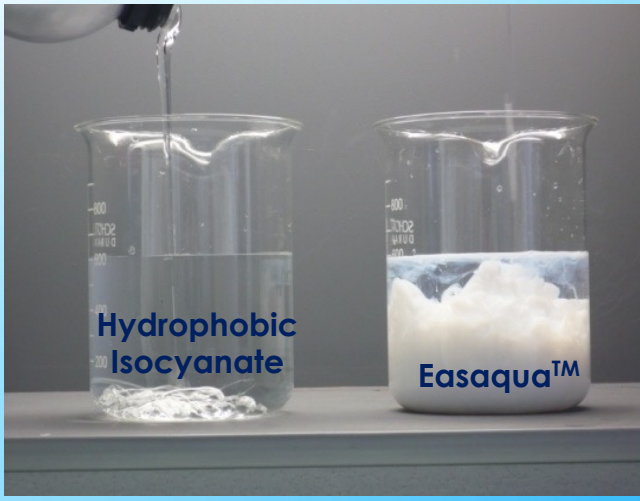


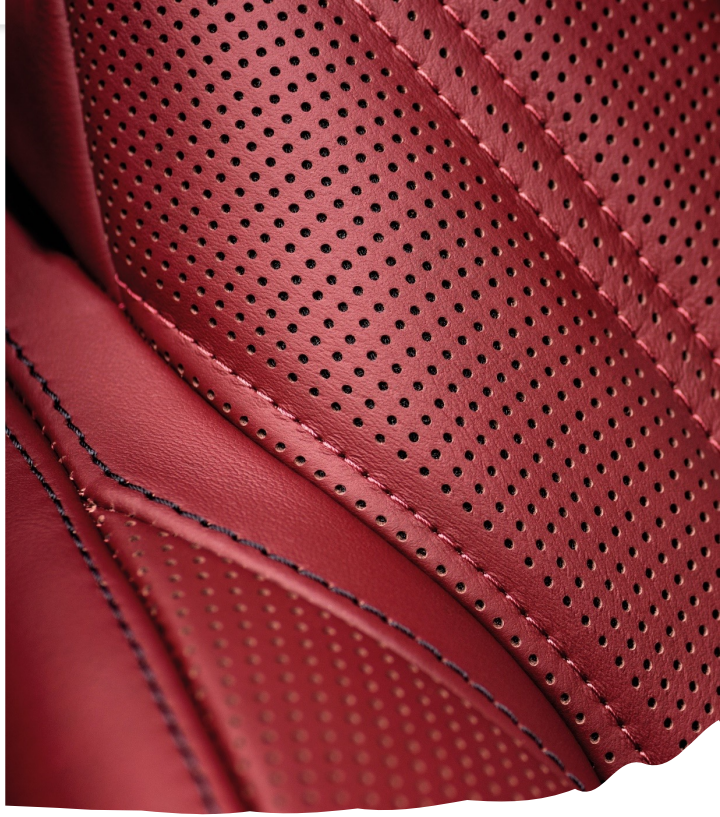
Easaqua™ Solutions for Waterborne Formulations

« Self-Emulsifiable » / Hydrophilic Polyisocyanates

- **Spontaneous Emulsification** process
- **Stable** Emulsion - physically and chemically - for several hours





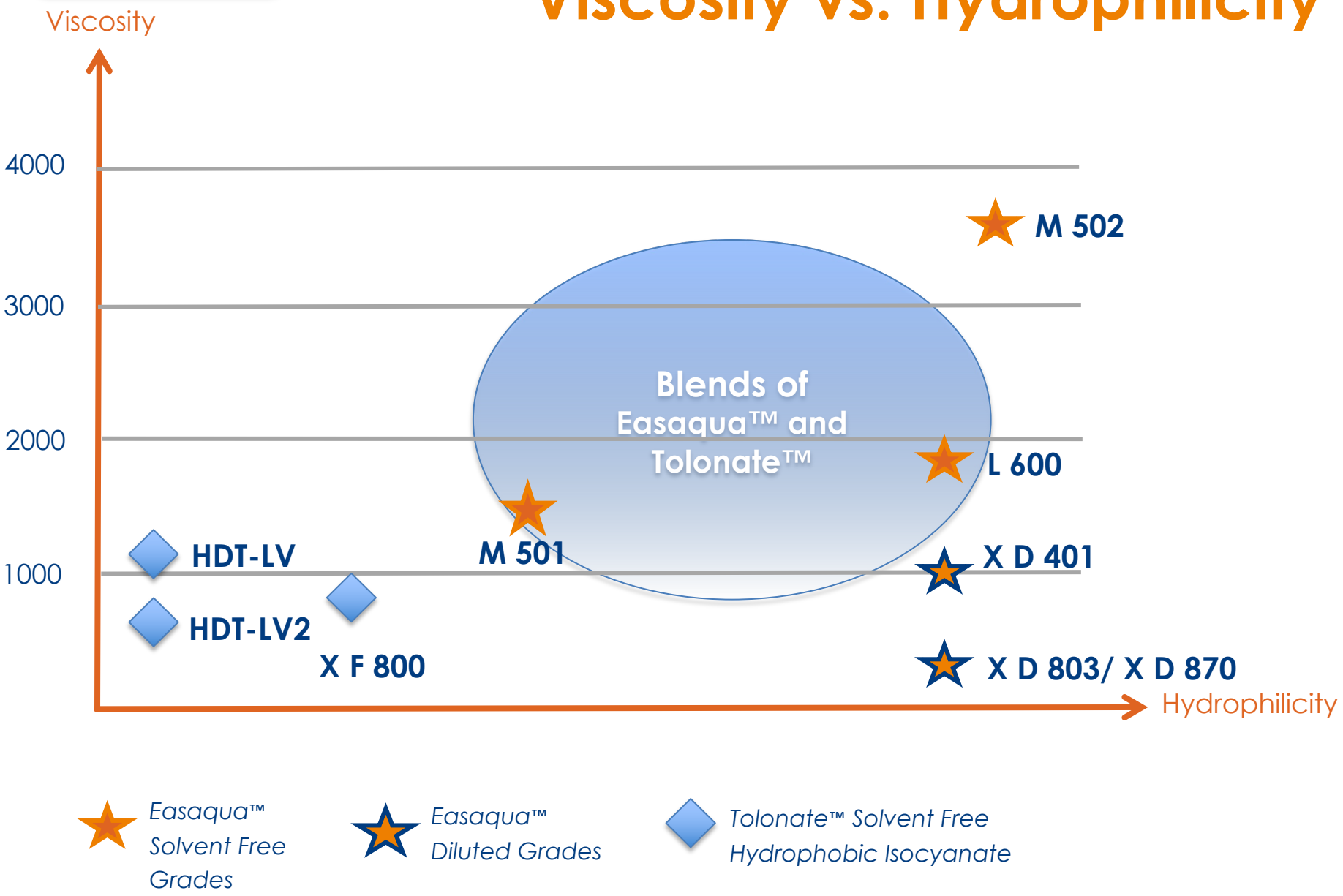


Easaqua™ Range

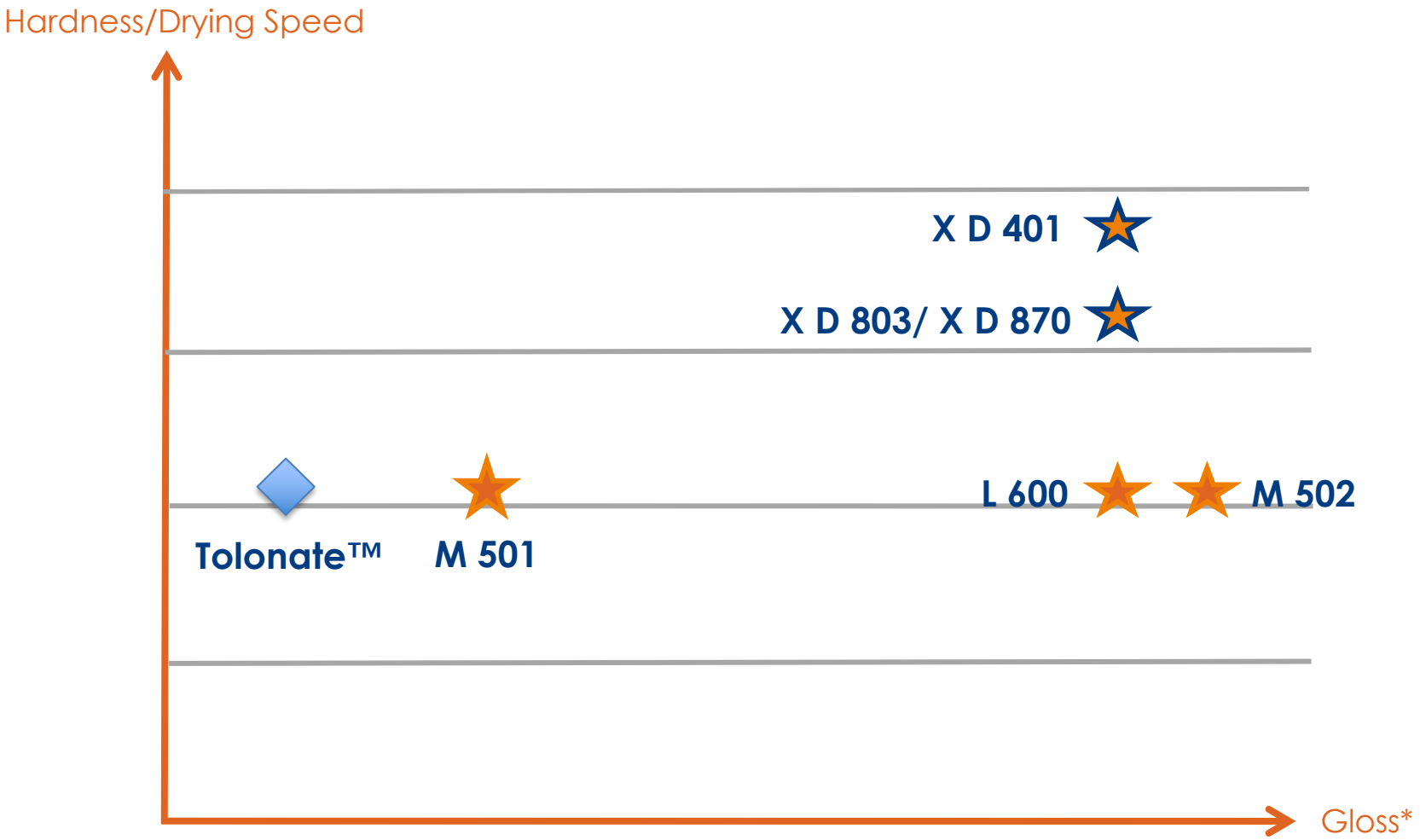
- Easaqua™ M 502
- Easaqua™ M 501
- Easaqua™ L 600

- Easaqua™ X D 803
- Easaqua™ X D 870
- Easaqua™ X D 401

Viscosity vs. Hydrophilicity



Gloss vs. Hardness & Drying



Easaqua™ Solvent Free Grades

Easaqua™ Diluted Grades

Tolonate™ Solvent Free Hydrophobic isocyanate

** for hand mixing*

Fast Drying Easaqua™ Grades

Differentiated by type and amount of co-solvent used

Easaqua Grade	Solids Content (%)	Solvent Type	NCO % (as delivered)	Viscosity at 25°C
X D 401	85	Butyl acetate	15.8	1 050 mPa.s
X D 803	69	Butoxyl	12.2	200 mPa.s
X D 870	69	PGDA	12.4	380 mPa.s

- Easaqua™ X D 401: Industrial processes, higher NCO%
- Easaqua™ X D 803: Manual mixing, lower viscosity
- Easaqua™ X D 870: Low odor, environmentally friendly solvent

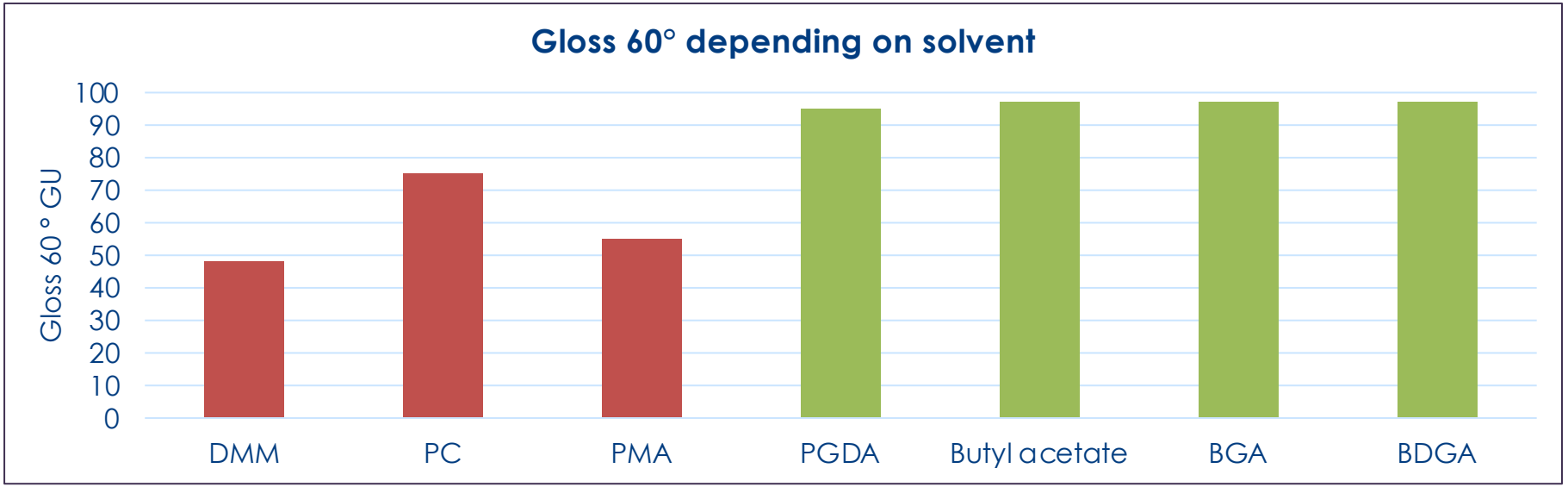
2K Waterborne PU: Formulation Tips

Key parameters

- Nature of the resin / polyol / PUD
- Choice of co-solvent

Good compatibility

Compatibility issue

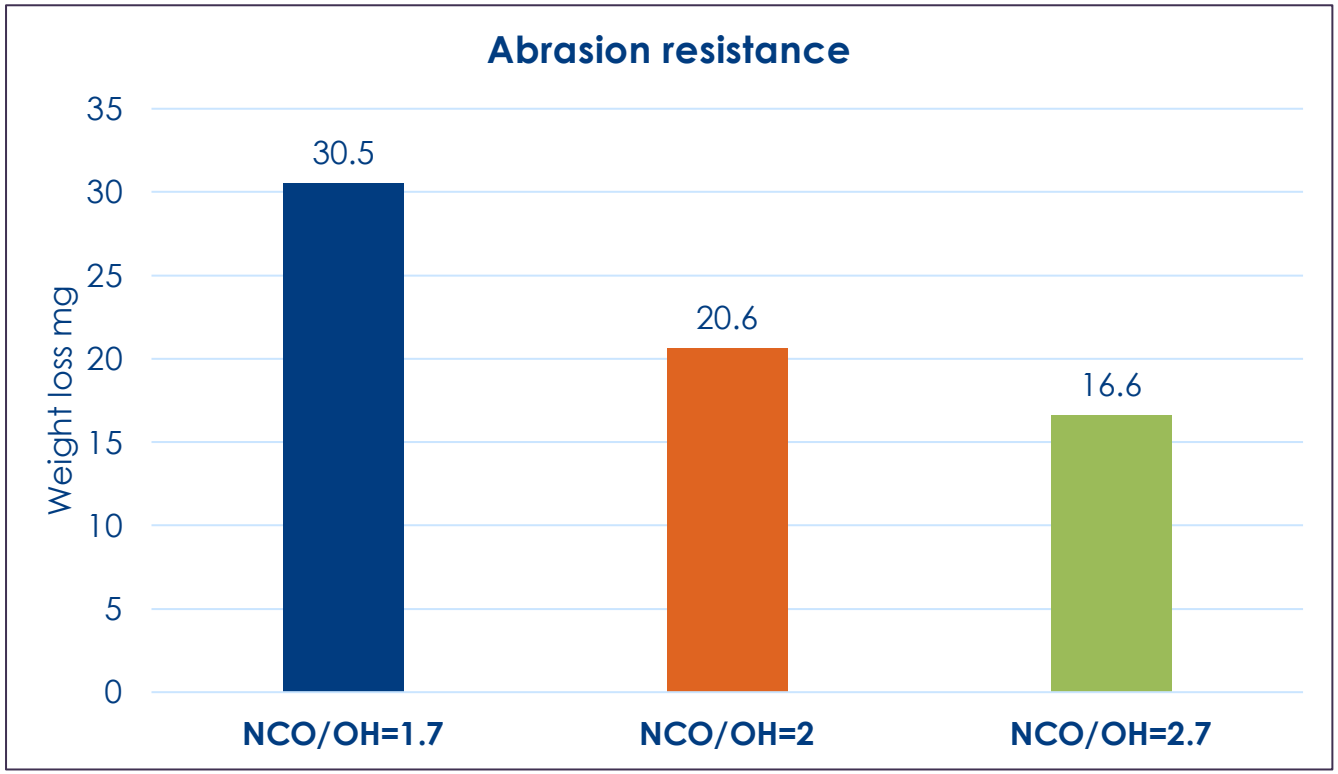


Formulation NCO/OH=1.3
Crosslinker Easaqua™ L600/Solvent, 80/20, Formula TI 2159

2K Waterborne PU: Formulation Tips

NCO/OH ratio

- Recommended NCO/OH ratio: **1.2 – 1.5**
- Molar ratio > 2.0 for the highest chemical and mechanical resistance



Formula TI 2227,Test conditions: CS10 – 1000g – 1000 rotations

Easaqua™ Range Summary

Easaqua™ HDI Based Grades

- Easaqua™ M 502: High gloss, easy mixing
- Easaqua™ L 600: High chemical resistance
- Easaqua™ M 501: Matte finish coatings and adhesives

Easaqua™ HDI/IPDI Based: Fast Drying Grades

- Easaqua™ X D 803: Lowest viscosity
- Easaqua™ X D 870: Low odour
- Easaqua™ X D 401: High hardness

Easaqua™ Range Applications

Plastics

Wood

Concrete Flooring

also well adapted for Adhesives, Leather Finishing, Metal Coatings…

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Vencorex's Sustainable Solutions

- **Tolonate™ LV grades: low viscosity** isocyanates for **high solids & solvent free** systems
- **Tolonate™ X F 800 and Tolonate™ X F 450:** solvent free isocyanates for **flexible Polyureas & Polyaspartics**
- **Easaqua™:** a range of hydrophilic isocyanates to formulate **high performance 2K Waterborne** Coatings & Adhesives

Thank You for your Attention

For any questions please contact
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or visit our website:
www.vencorex.com