Cardolite

May 2016

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Cashew Liquid Technology

Cashew Nutshell Liquid (CNSL)

A naturally occurring, non-food chain, renewable oil from the shell of the cashew nut. CNSL is obtained as by-product of the cashew nut industry mainly in Brazil, India, and Vietnam.

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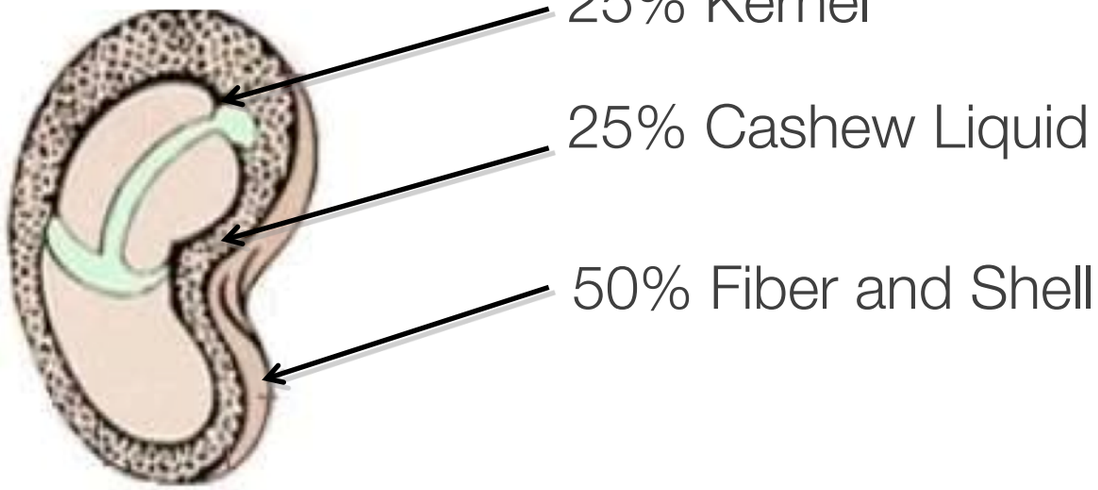
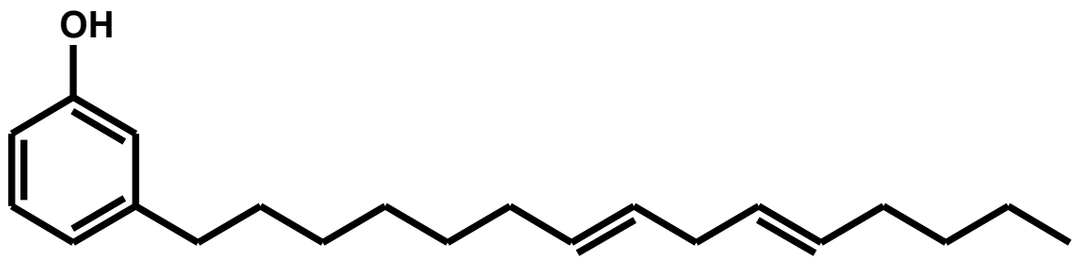
Cashew Liquid Technology

- CNSL is approximately 25% of the cashew kernel by weight.



- The primary component of CNSL is cardanol, a natural phenolic compound with a long unsaturated fatty side chain.



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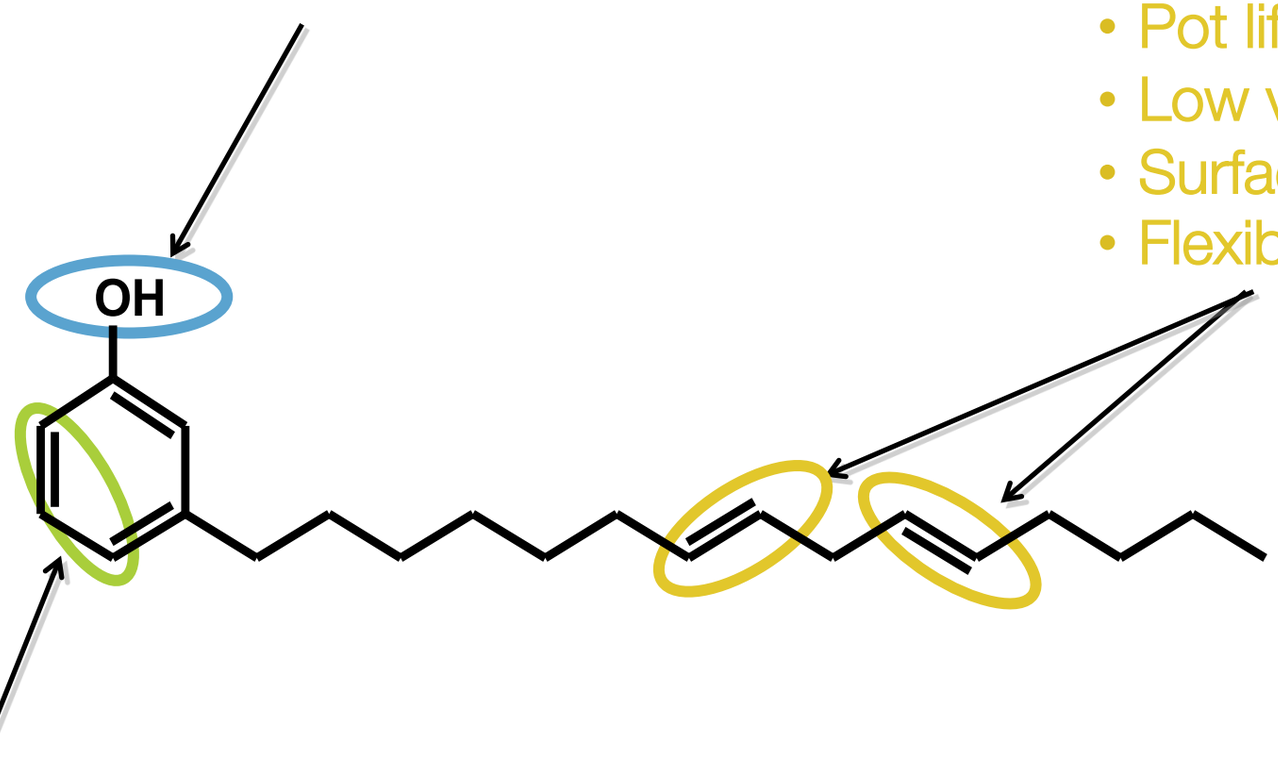
Average Structure and Benefits

- Adhesion
- Fast cure
- Low temperature cure

- Water resistance
- Humidity resistance
- Corrosion resistance
- Pot life
- Low viscosity
- Surface tension
- Flexibility



- Chemical & thermal resistance

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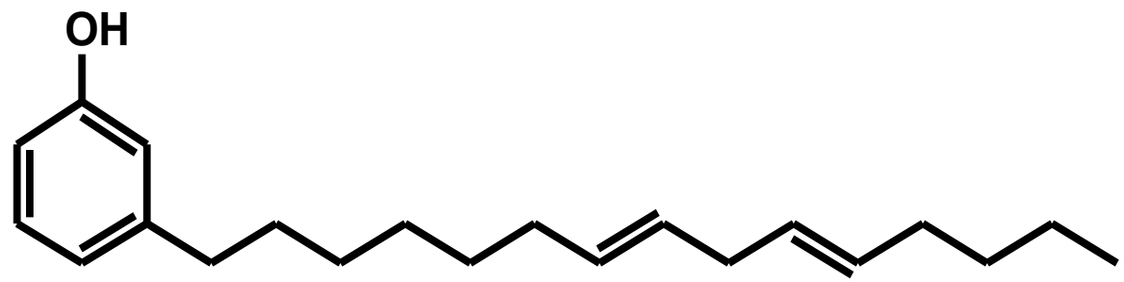
Cardanol Family

- Non-reactive diluents
- Accelerators
- Hydrophobicity for improved water resistance and corrosion protection
- Increased flexibility and impact resistance
- Non-toxic alternative to nonyl phenol
- Renewable
- Cost effective



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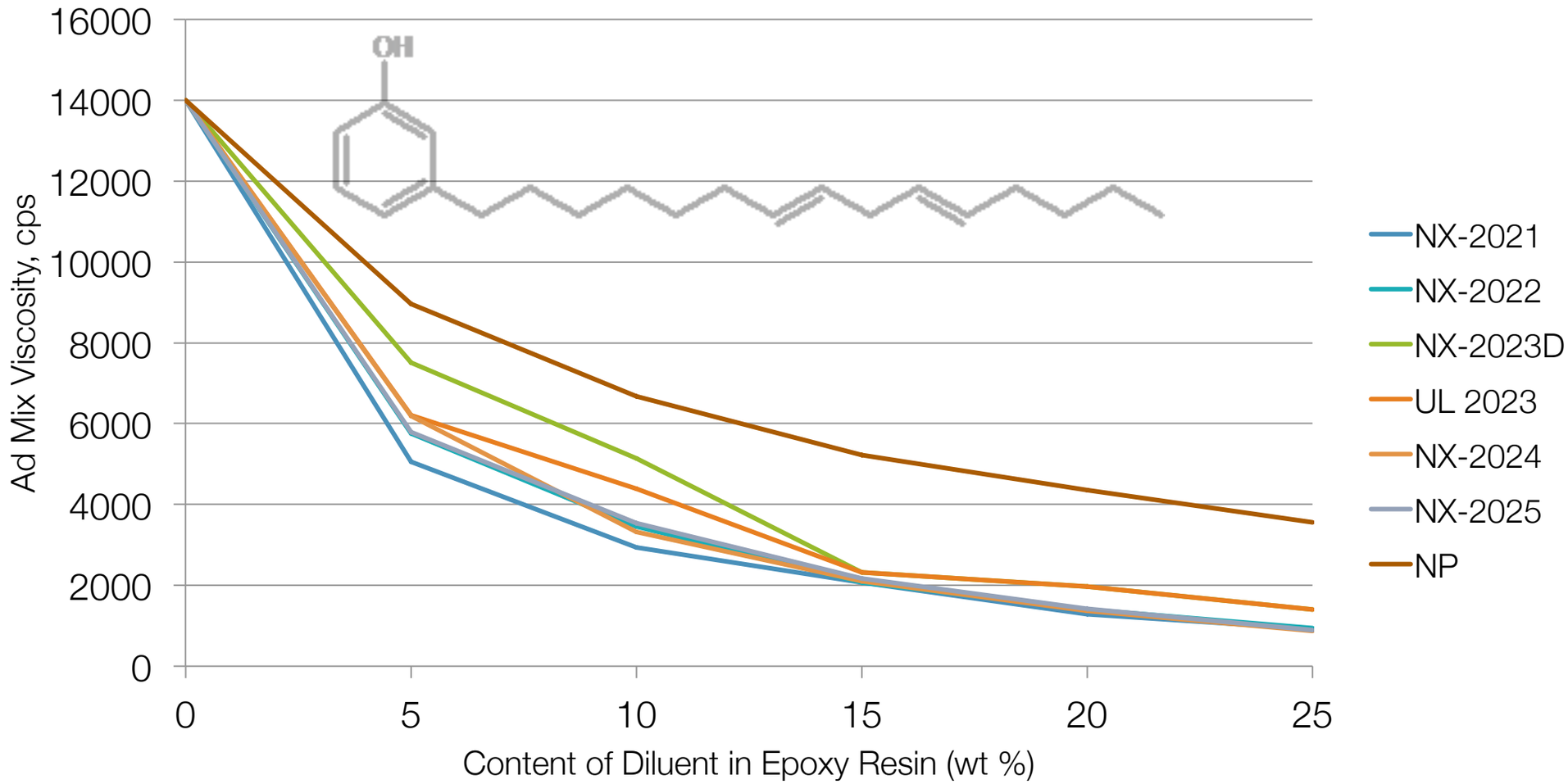
Cardanol Grades vs. Nonyl phenol

Material	Viscosity, cps @25°C	Color	Label	Description
Nonyl phenol	~1,200	~1	Health hazard	
NX-2021	45 - 75	≤ 18	nontoxic	Standard cardanol
NX-2022	40 - 60	≤ 8	nontoxic	High purity cardanol
NX-2023D	80 - 140	≤ 15	nontoxic	Dark, wet color stable cardanol
NX-2023	40 - 100	≤ 6	nontoxic	Light, wet color stable cardanol
Ultra LITE 2023	40 - 100	≤ 1	nontoxic	Ultra light, wet color stable cardanol
NX-2024	45 - 60	≤ 9	nontoxic	Low odor, std purity cardanol
NX-2025	≤ 60	≤ 5	nontoxic	Low odor, high purity cardanol
NX-2026	≤ 60	≤ 2	nontoxic	Very light, wet color stable cardanol, neutral pH

Dilution Power vs. Nonyl Phenol



- Renewable source
- Better dilution effect
- Comparable cost
- Comparable acceleration
- Non-toxic

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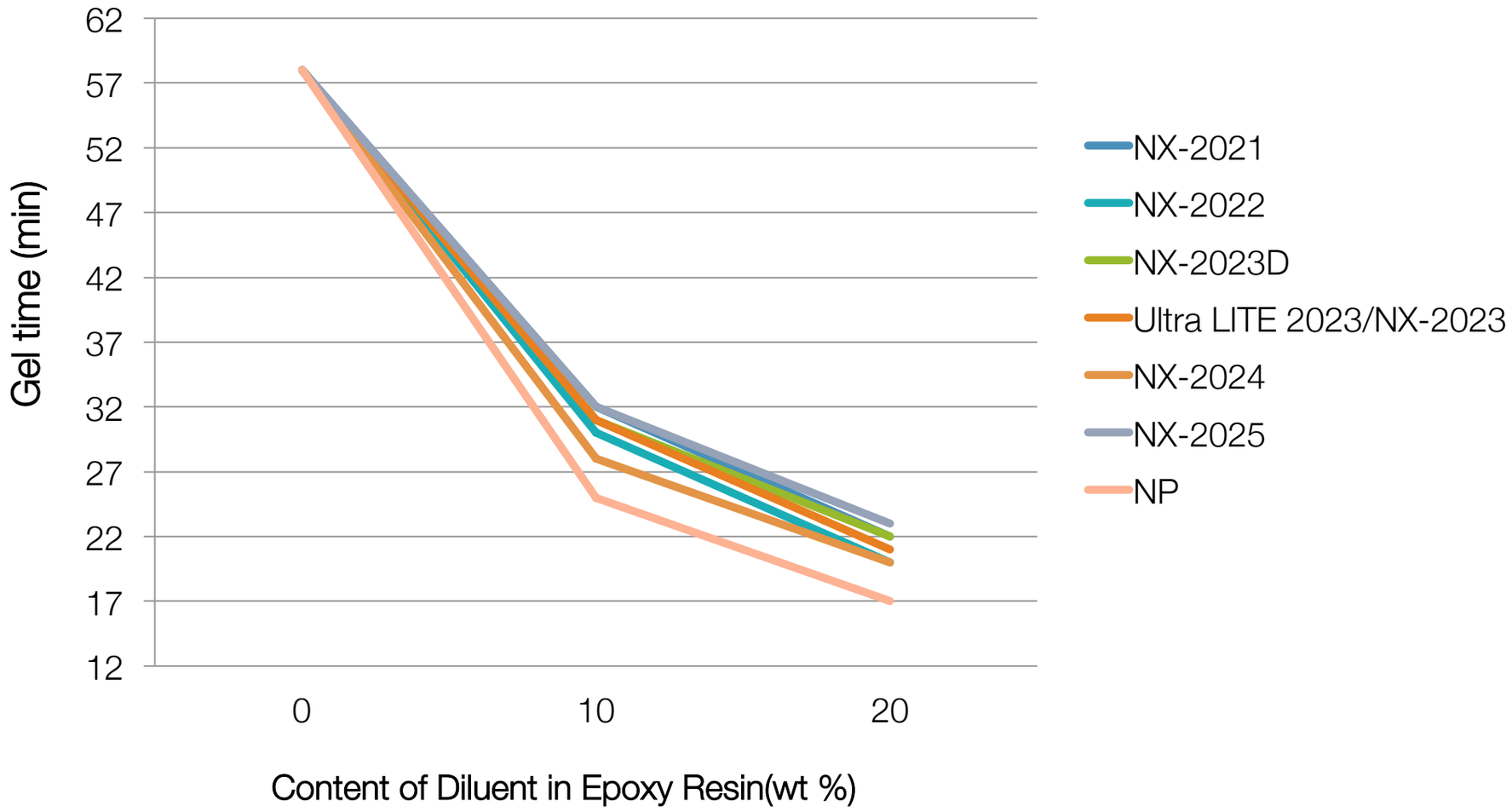
Acceleration Effect



Cardanol grades do not reduce gel time as much as Nonyl phenol

*Cured with Cardolite NX-2003

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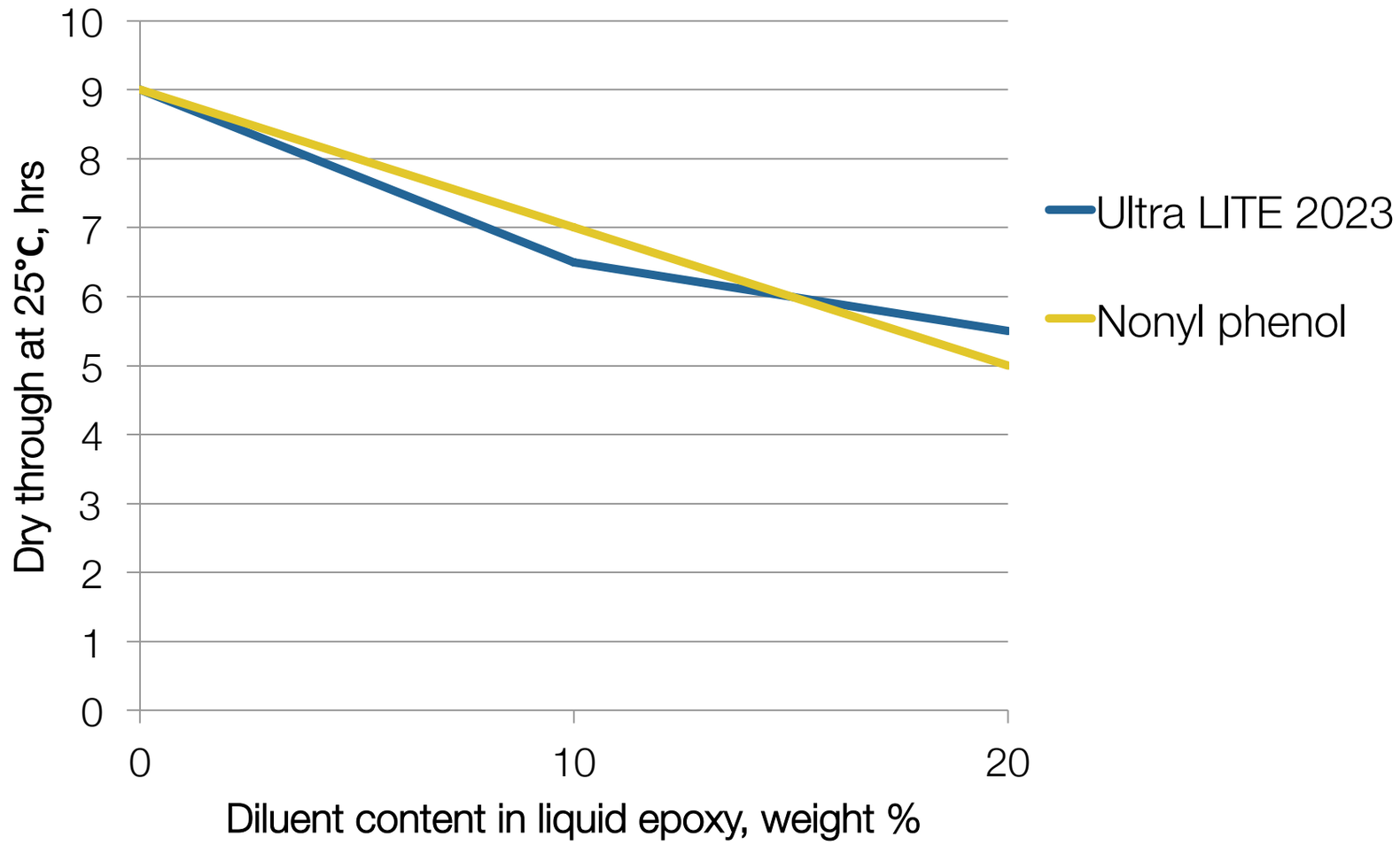
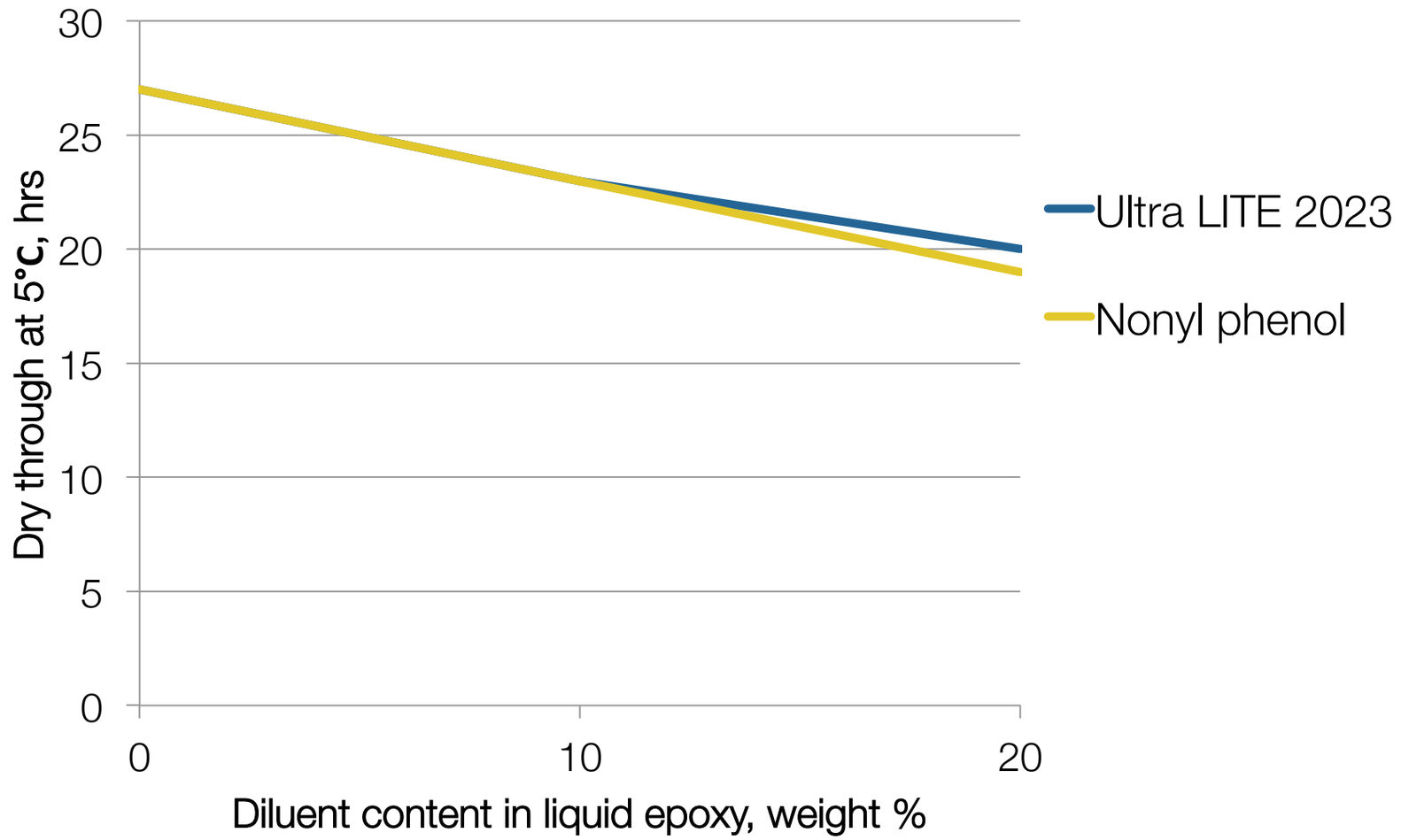
Acceleration Effect at 25°C



- Ultra LITE 2023 can be used as an accelerator.
- Ultra LITE 2023 provides similar acceleration to nonyl phenol at 25°C

**Cured with Cardolite NX-2003

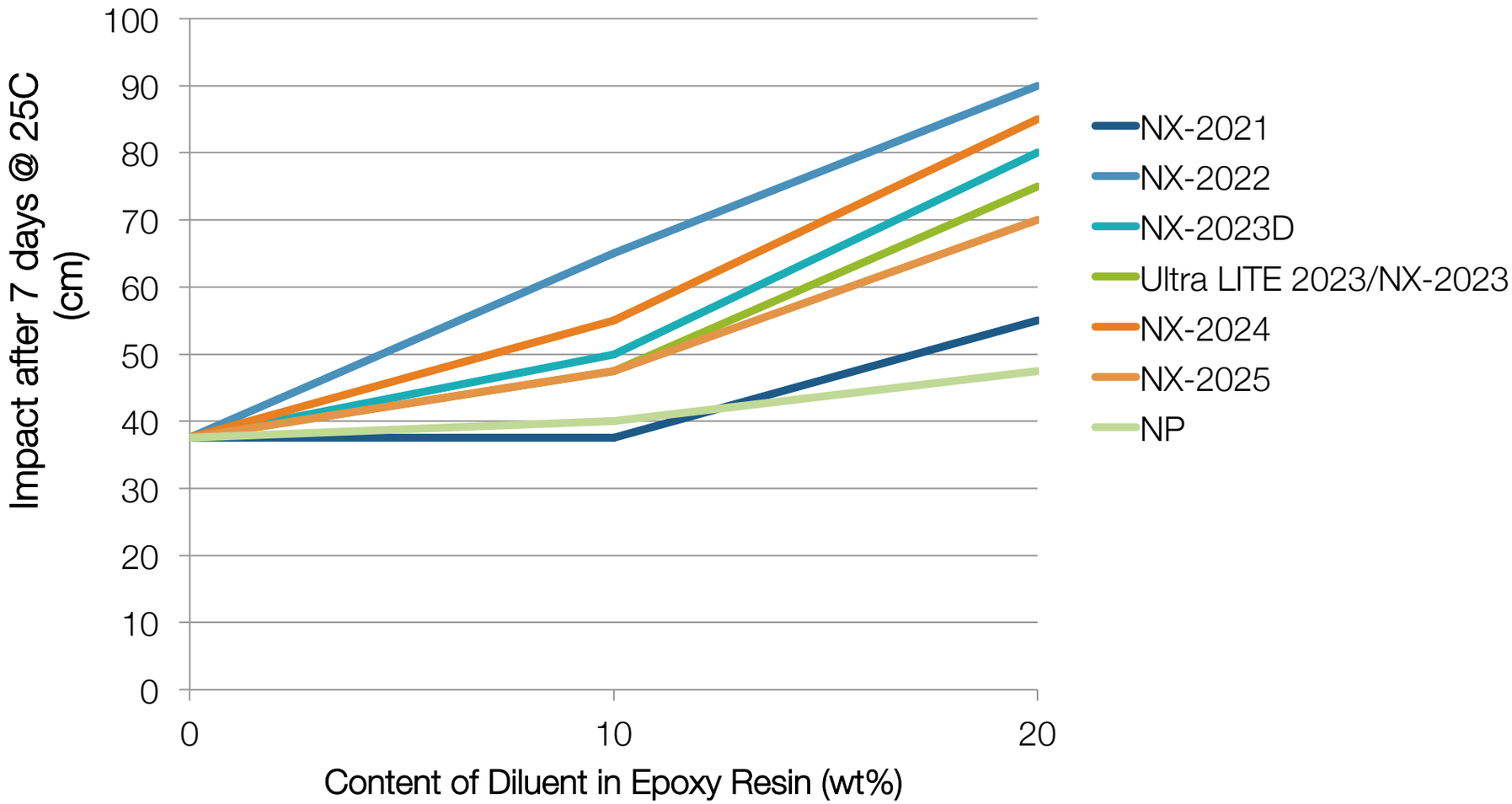
Acceleration Effect at 5°C



- Ultra LITE 2023 can be used as an accelerator at low temperatures
- Ultra LITE 2023 provides similar acceleration to nonyl phenol at 5°C

**Cured with Cardolite NX-2003

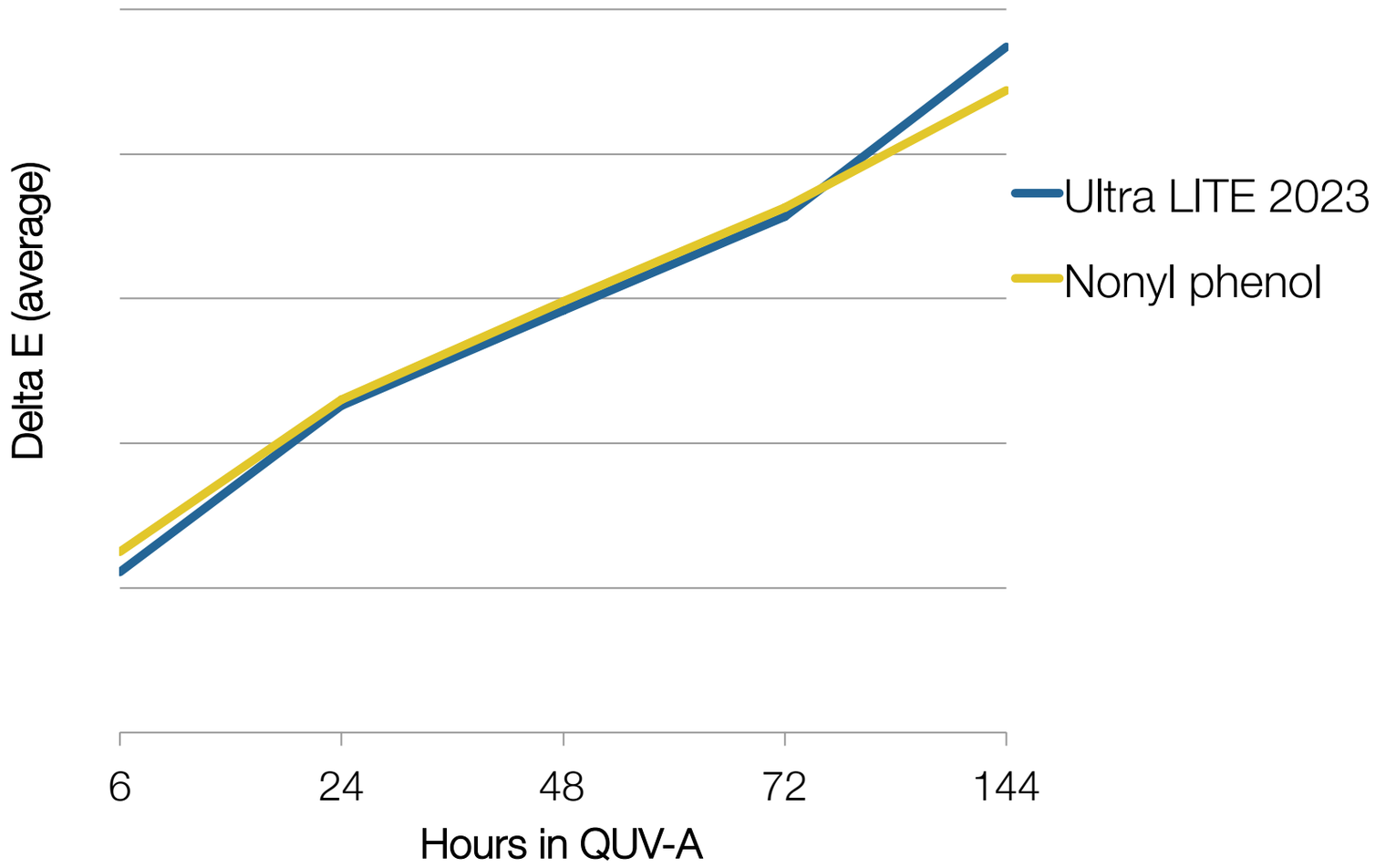
Impact Resistance



*Cured with Cardolite NX-2003

Cardanol grades improve impact resistance of epoxy systems due to long aliphatic side chain. Improvement is more significant than for Nonyl phenol.

Color Retention



Ultra LITE 2023 shows similar yellowing to nonyl phenol

**Average delta E based on cure with different phenalkamines

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