Hydrophobic Polymers for Highly Durable Wood Coatings

Coatings Trends & Technologies Summit
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HEXION
Responsible Chemistry

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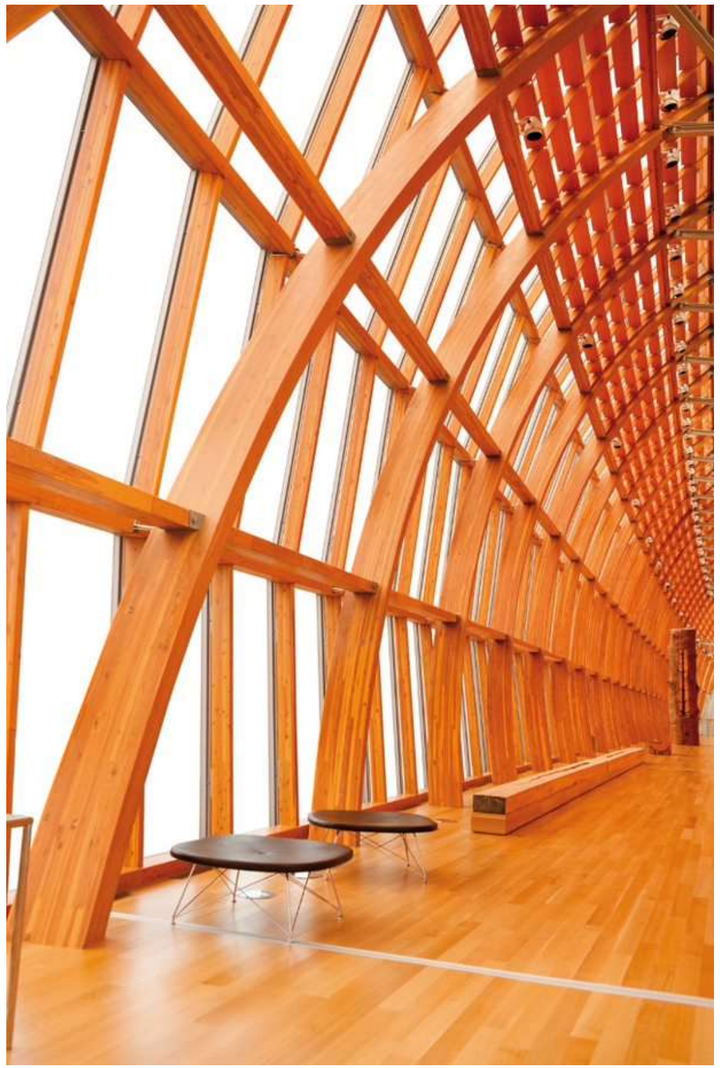
Introduction

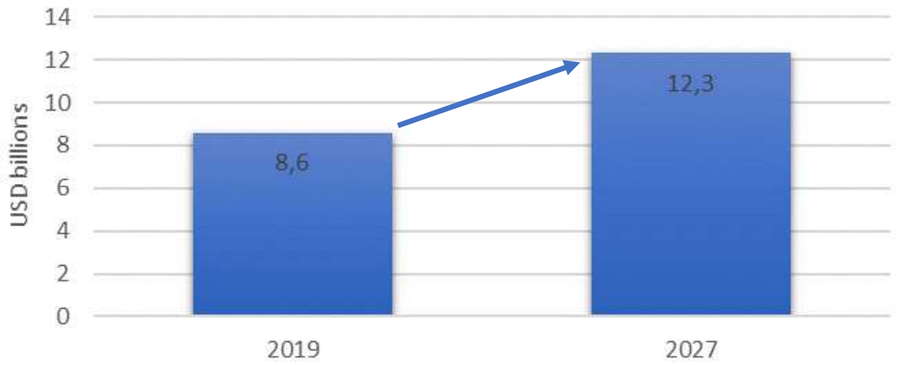
Wood Coatings Technologies and Applications

General Requirements and Unmet Needs

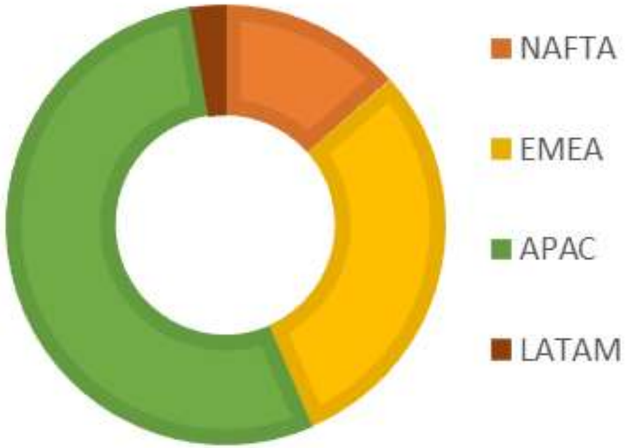
Wood Coatings Market



Global wood coating market

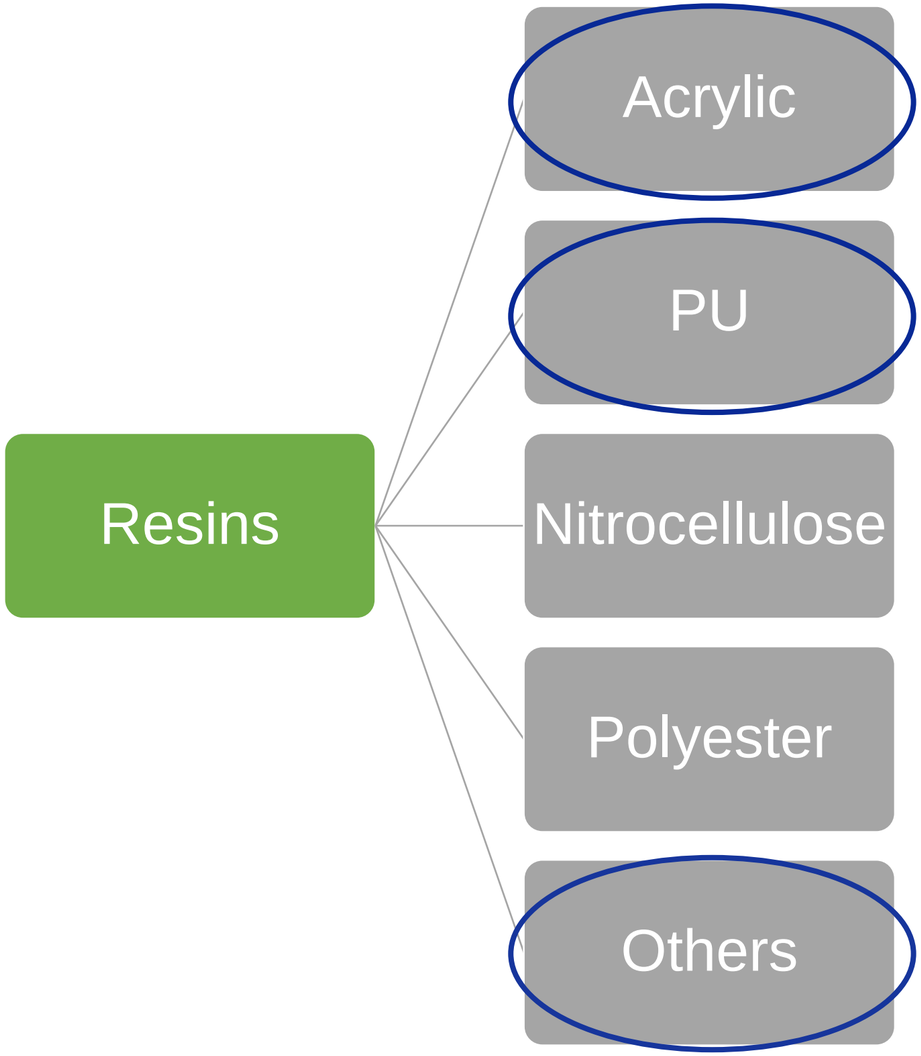


Market split by regions



Reference: GLOBAL PAINT & COATINGS 2019-2024
KUSUMGAR, NERLFI & GROWNEY

Wood Coatings Technologies and Applications



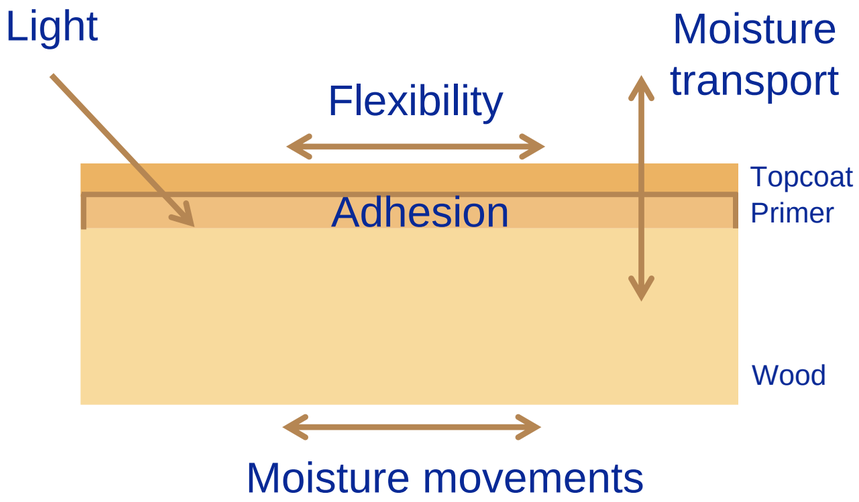
Sustainability is Key Driver

Increased performance

Reduced environmental impact

Reduced cost of ownership / process

General Requirements for Wood Coatings



Wood Coating Degradation

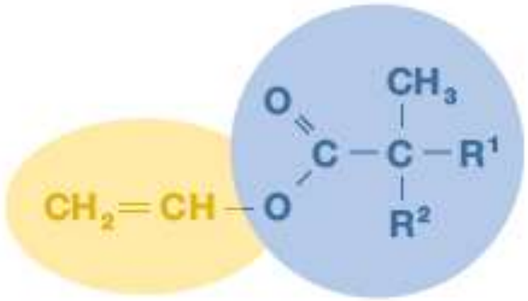
- Water resistance/repellence
- UV resistance/weathering resistance
- Outdoor durability
- Flexibility/Blocking resistance balance
- Adhesion on aged alkyd coating
- Open time
- Resistance to mold/fungi
- Good applicability

Section 2

Highly Hydrophobic Monomers

Highly Versatile Molecules

Vinyl neodecanoate



■ Vinyl Ester

Easily copolymerisable with vinyl acetate and (meth)acrylates

■ Aliphatic bulky structure

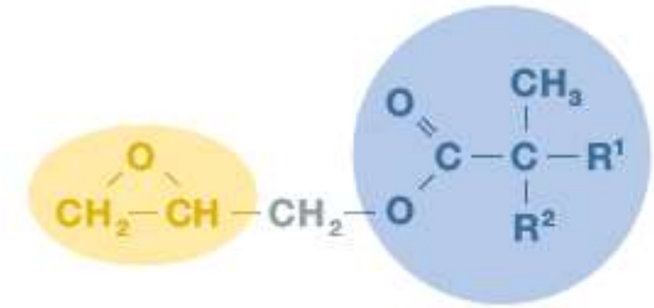
$R^1 + R^2 = 7$ carbon atoms

- Bulky alkyl chain
- Steric hindrance

Performance:

- Hydrophobicity
- Hydrolytic stability
- UV stability
- Low surface tension

Glycidyl neodecanoate

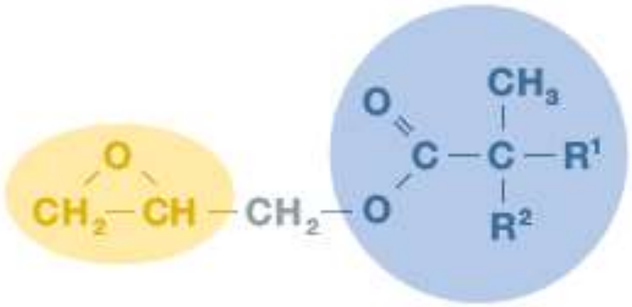


■ Glycidyl Ester

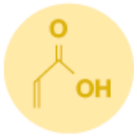
Ring opening with acids generates OH

Monomers with inherent properties enabling high performance wood coatings

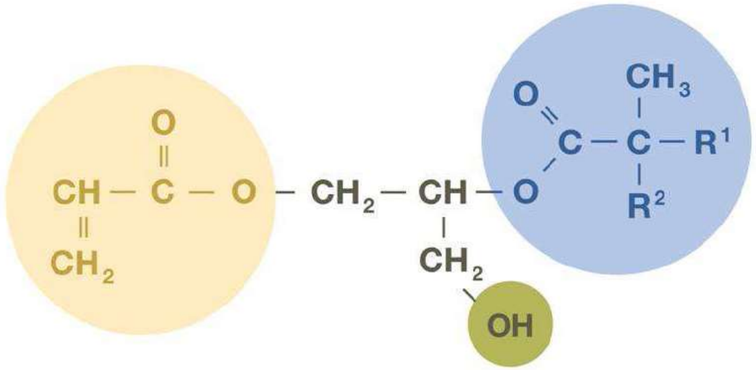
Highly Versatile Molecules



Glycidyl neodecanoate



- + acrylic acid



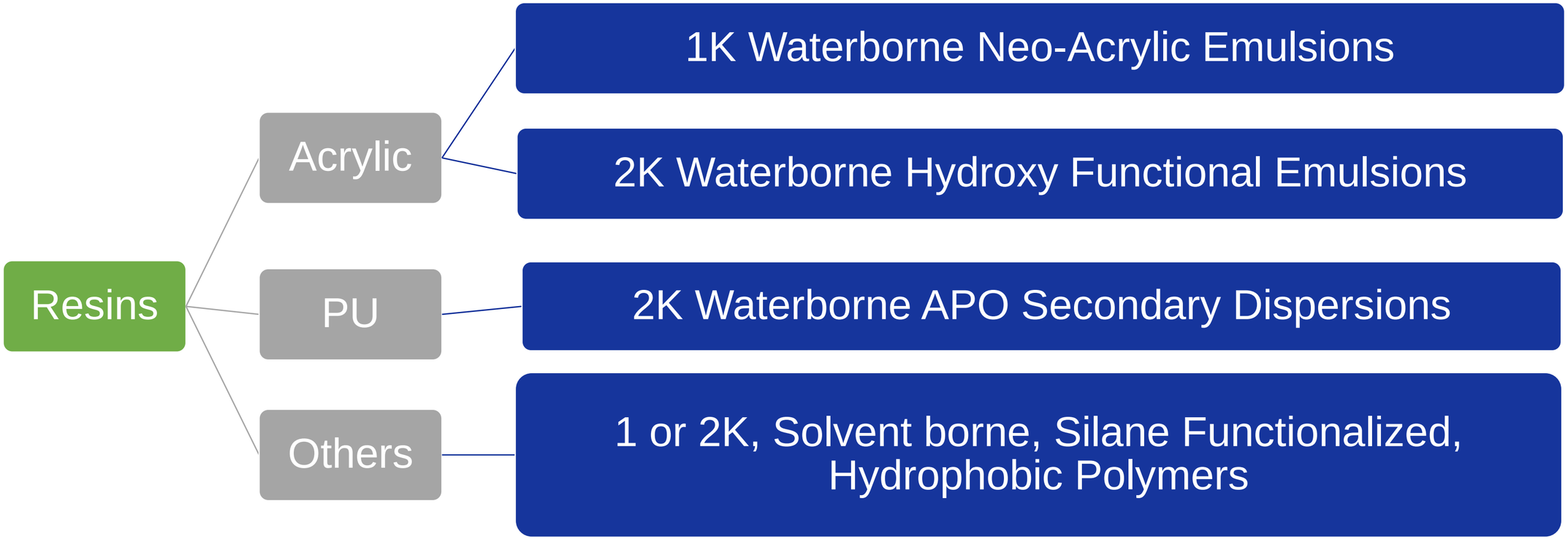
Acrylated glycidyl neodecanoate (AGN)

- Acrylic reactivity
- Primary OH functionality

Section 3

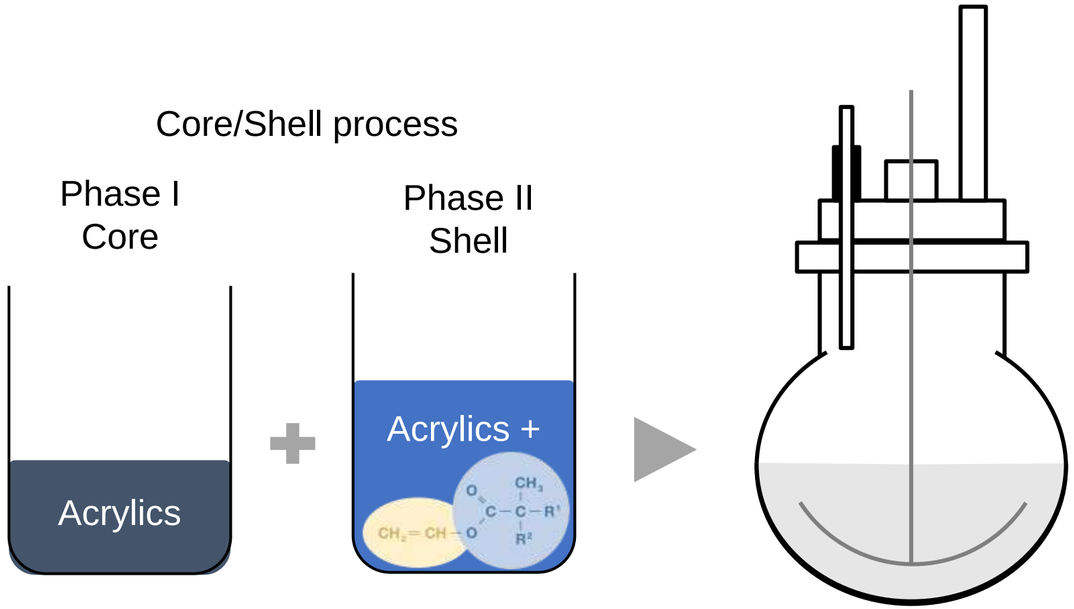
Four Technologies Examples for Wood Applications

4 Technologies Examples for Wood Applications

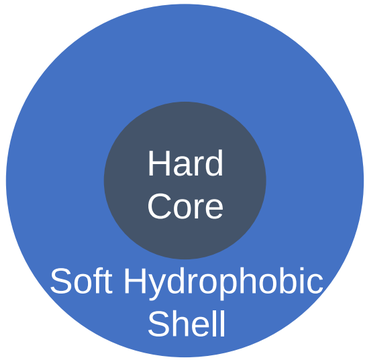


Example 1: 1K Waterborne Neo-Acrylic Emulsions

Neo-Acrylic = Acrylates + Vinyl neodecanoate



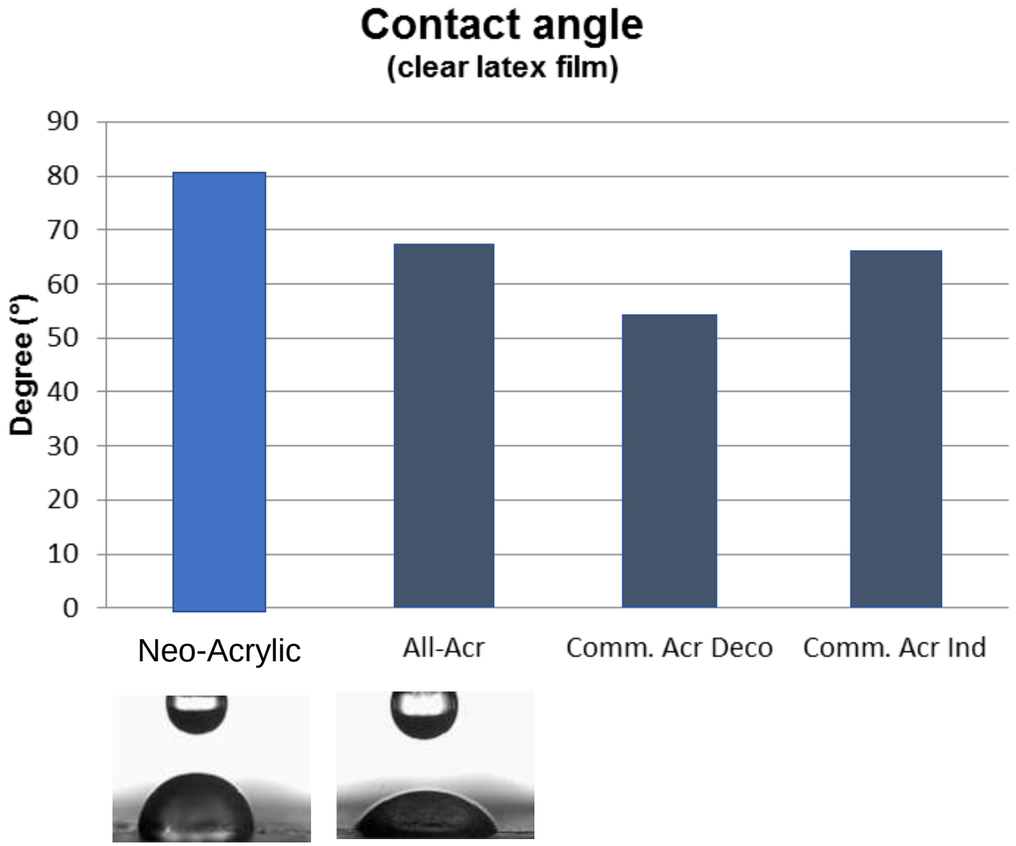
Hard Core	→	Blocking resistance
Soft Shell	→	Flexibility, Low MFFT, Hydrophobicity

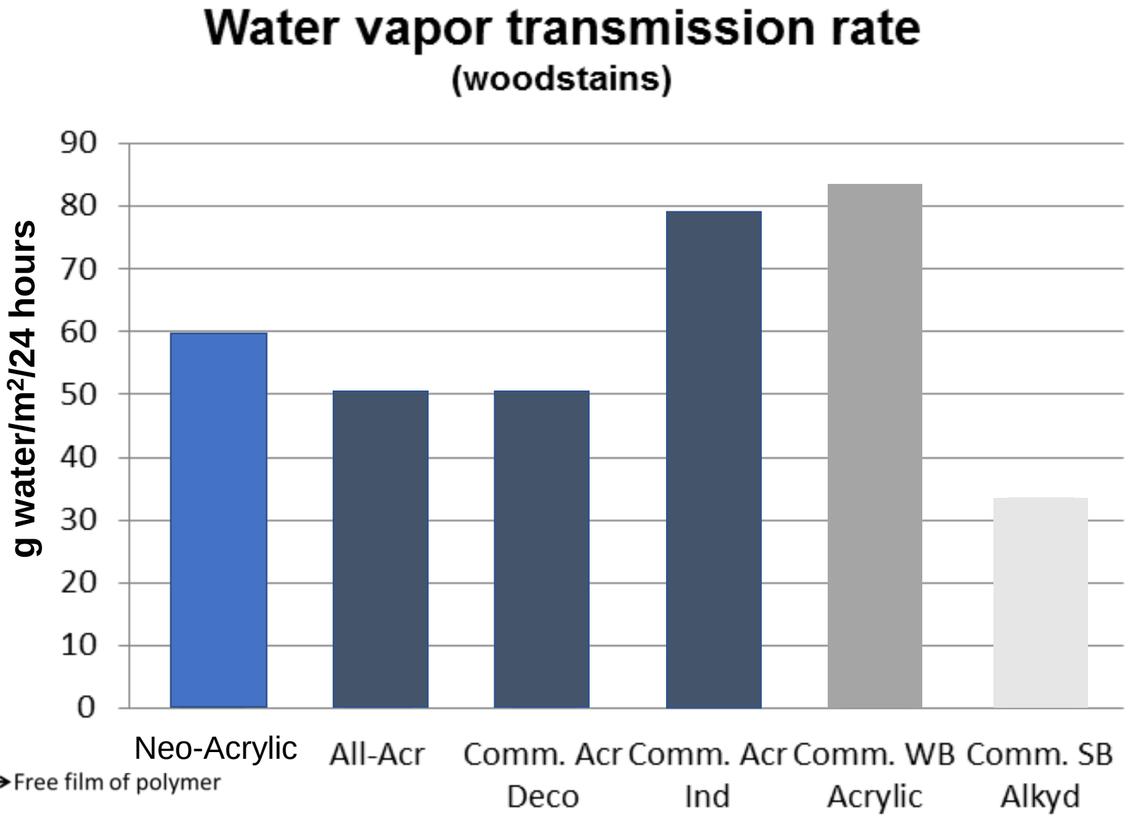


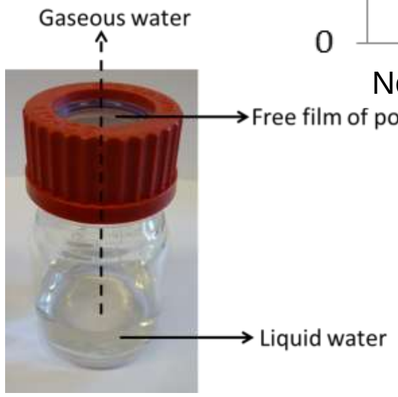
Self-crosslinkable

Neo-Acrylic core/shell technology enables flexibility/blocking optimization

Neo-Acrylic Water Beading Effect

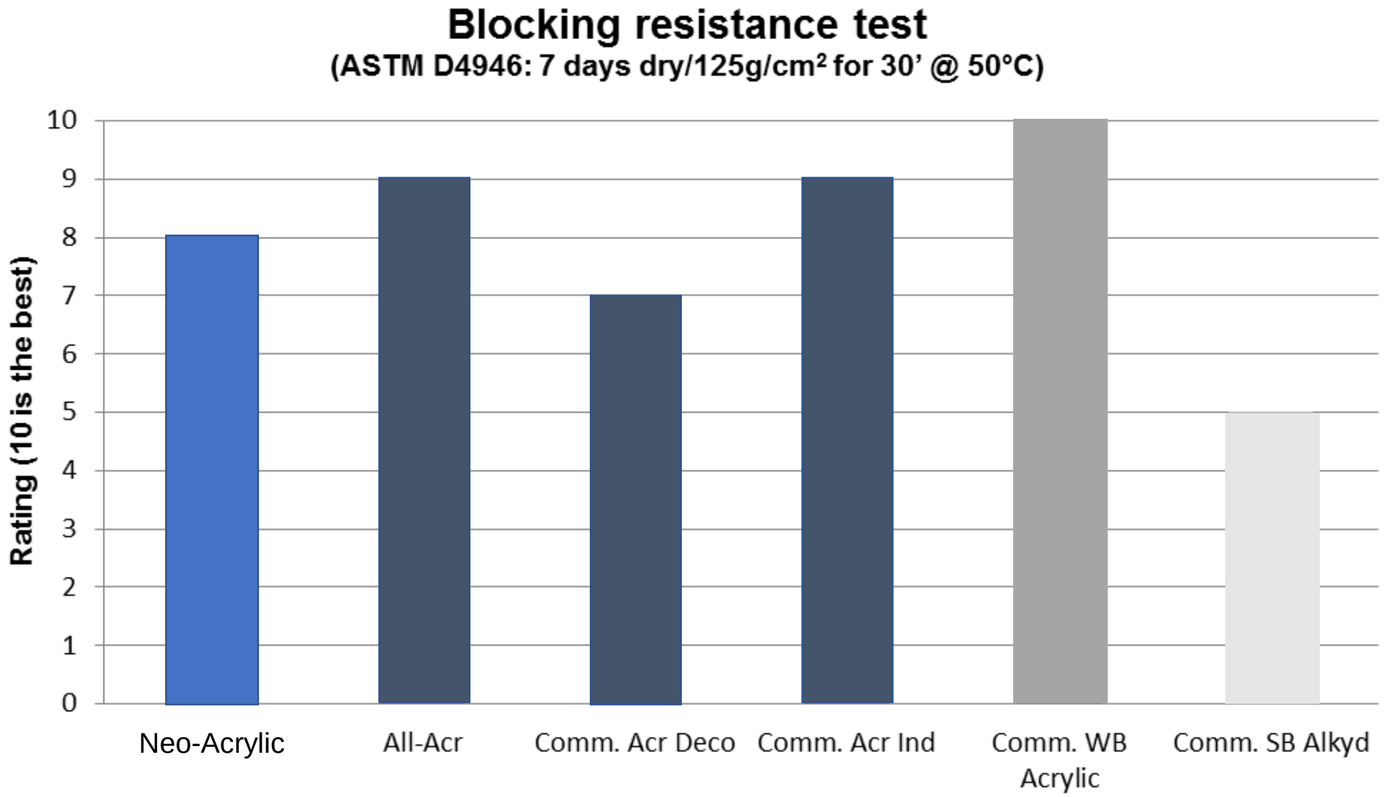






Neo-Acrylic polymers exhibit high water repellence while maintening good water vapor permeability

Blocking Resistance

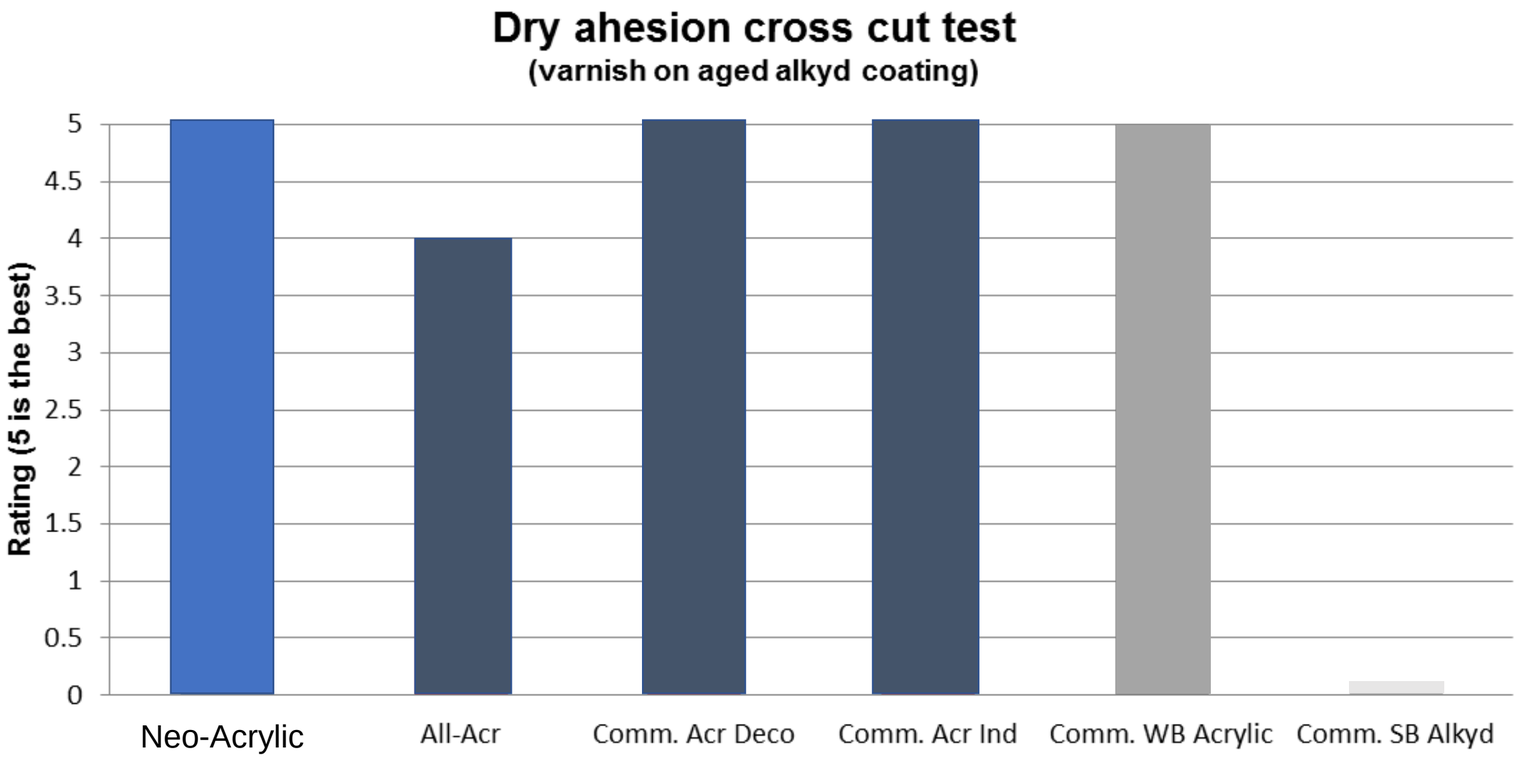


Score	Dimension	Performance
10	No tack	Perfect
9	Trace tack	Excellent
8	Very slight tack	Very good
7	Very slight to slight tack	Goot to very good
6	Slight tack	Good
5	Moderate tack	Fair
4	Very tacky, no seal	Poor to fair
3	5 to 25% seal	Poor
2	25 to 50% seal	Poor
1	50 to 75% seal	Very poor
0	75 to 100% seal	Very poor

Neo-Acrylic provides competitive blocking resistance performance

Adhesion on Aged Alkyd Coatings

Crosscut method : ASTM D3359



Neo-Acrylic shows excellent dry adhesion on aged alkyd coatings

Weathering Resistance

1. Outdoor Exposure
EN927-3 (45°south)
3 coat wood stains

2. Accelerated weathering (EN 927-6)

Step	Function	Temperature	Duration
1	Condensation	45°C	24 h
2	Sub cycle : steps 3 & 4	144 h: cycles of 3 hours consisting of steps 3 & 4	
3	UV: UVA 340 lamp	(60 +- 3)°C	2,5 h
4	Spray 6-7 l/min, UV light off		0,5 h

Each cycle takes 168 hours. The test repeats the cycle 12 times for total exposure duration of 2016 hours.

Weathering Resistance Outdoor Exposure 3 Years

Neo-Acrylic

All-Acr

Comm. Acr Deco

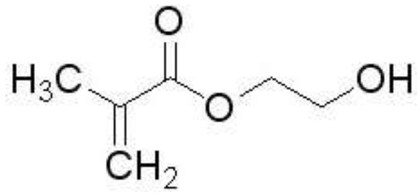
Comm. Acr Ind

Comm. WB Acrylic

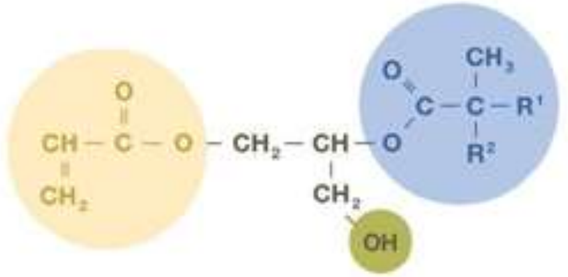
Comm. SB Alkyd

Example 2: 2K Waterborne Hydroxy Functional Emulsions

Water Soluble HEMA as the main OH monomer



HEMA



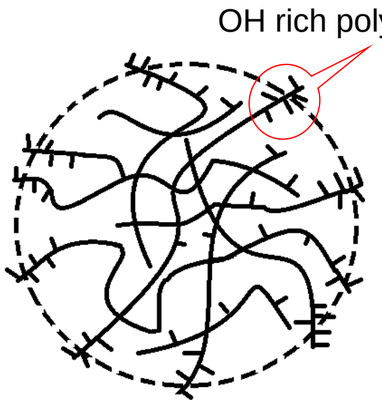
Acrylated glycidyl neodecanoate

Conventional OH-functional Emulsion

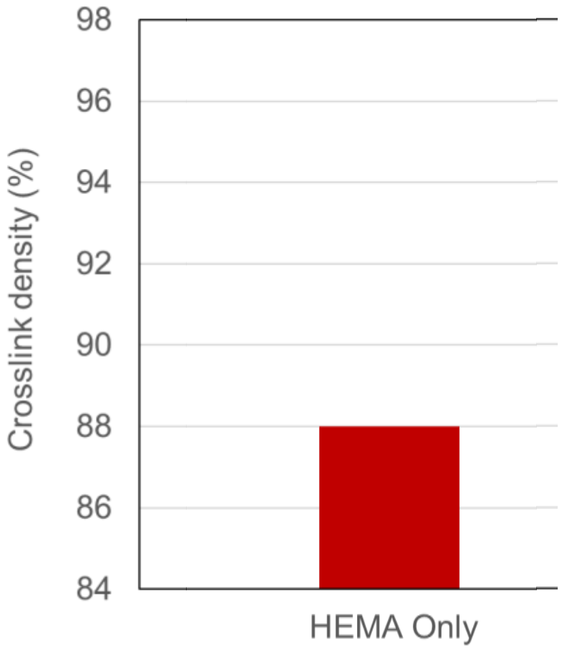
- Difficult to make high OH content emulsion
  Grits issue during polymerization
- Poor coatings performance: Haze, appearance issue, low water/chemical resistance

Acrylated glycidyl neodecanoate overcomes many issues associated with the use of HEMA

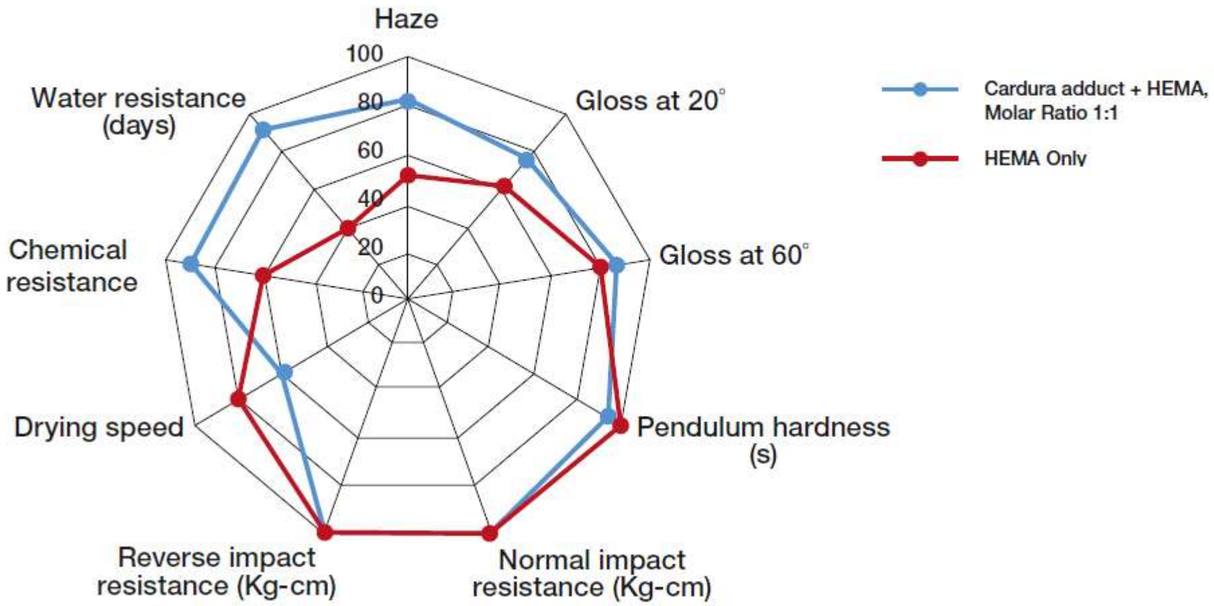
Increased Crosslink Density Leading to Better Properties



HEMA-based latex particle

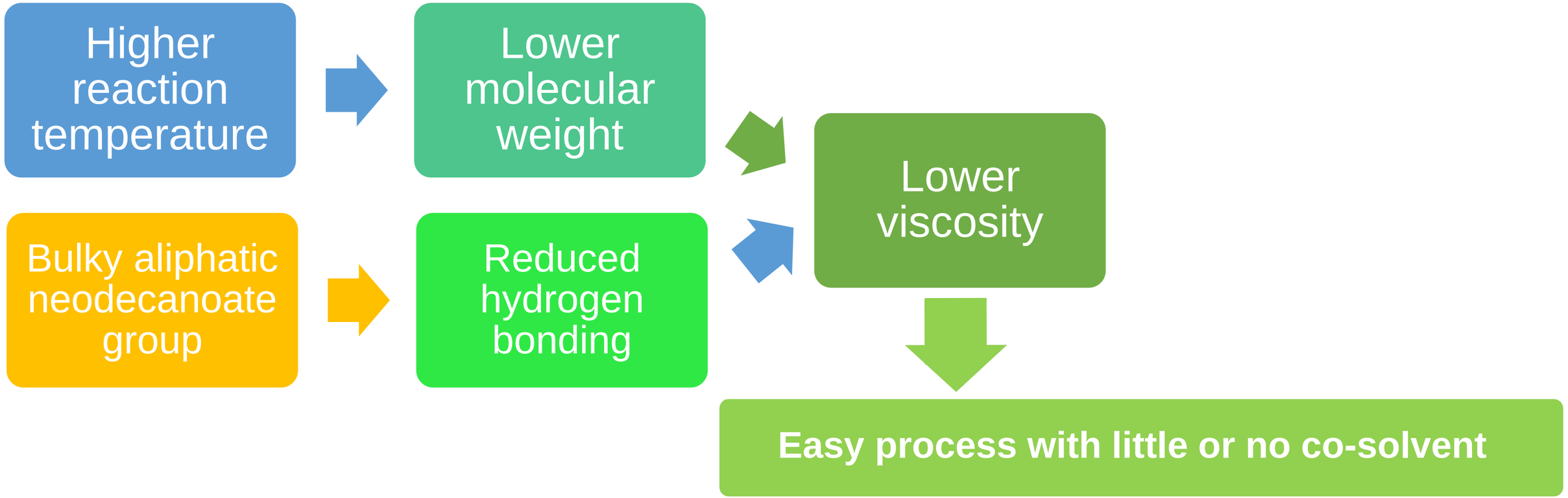


High OH-value emulsion (4% OH-content)



Example 3: 2K Waterborne APO Secondary Dispersions

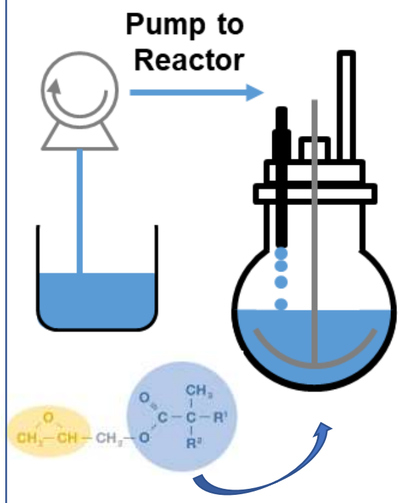
Glycidyl neodecanoate process advantages



Glycidyl Neodecanoate Waterborne Acrylic Polyol Synthesis

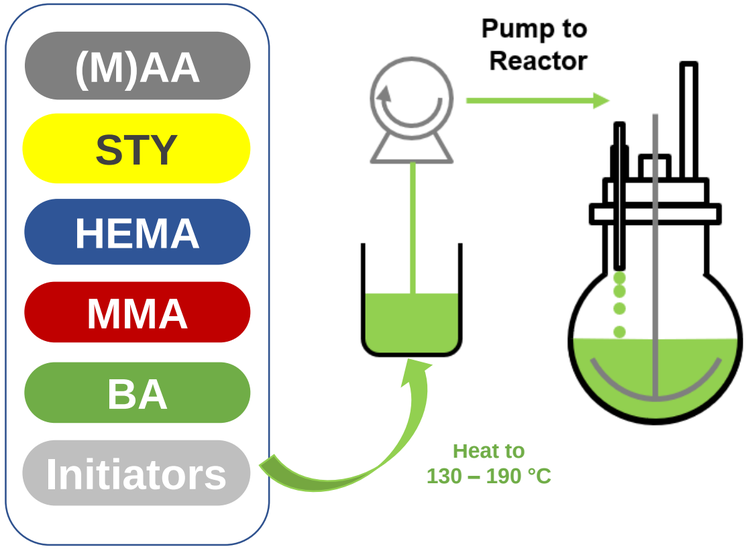
Step 1.
Glycidyl neodecanoate heating

Key Property
- High Boiling point: 251 – 278 °C



- Solvent optional
- Heat solvents to reaction temperature

Step 2.
Polymerization

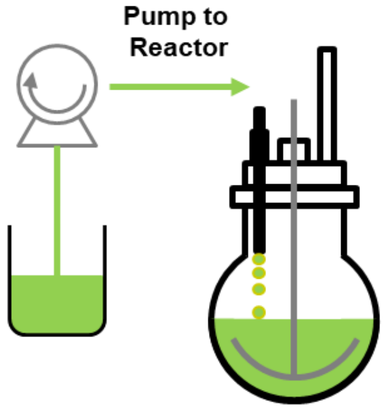


- Monomers and initiator feed
- High polymerization temperatures possible, no need for pressure reactors

Step 3.
Solvents removal

No need to remove solvent

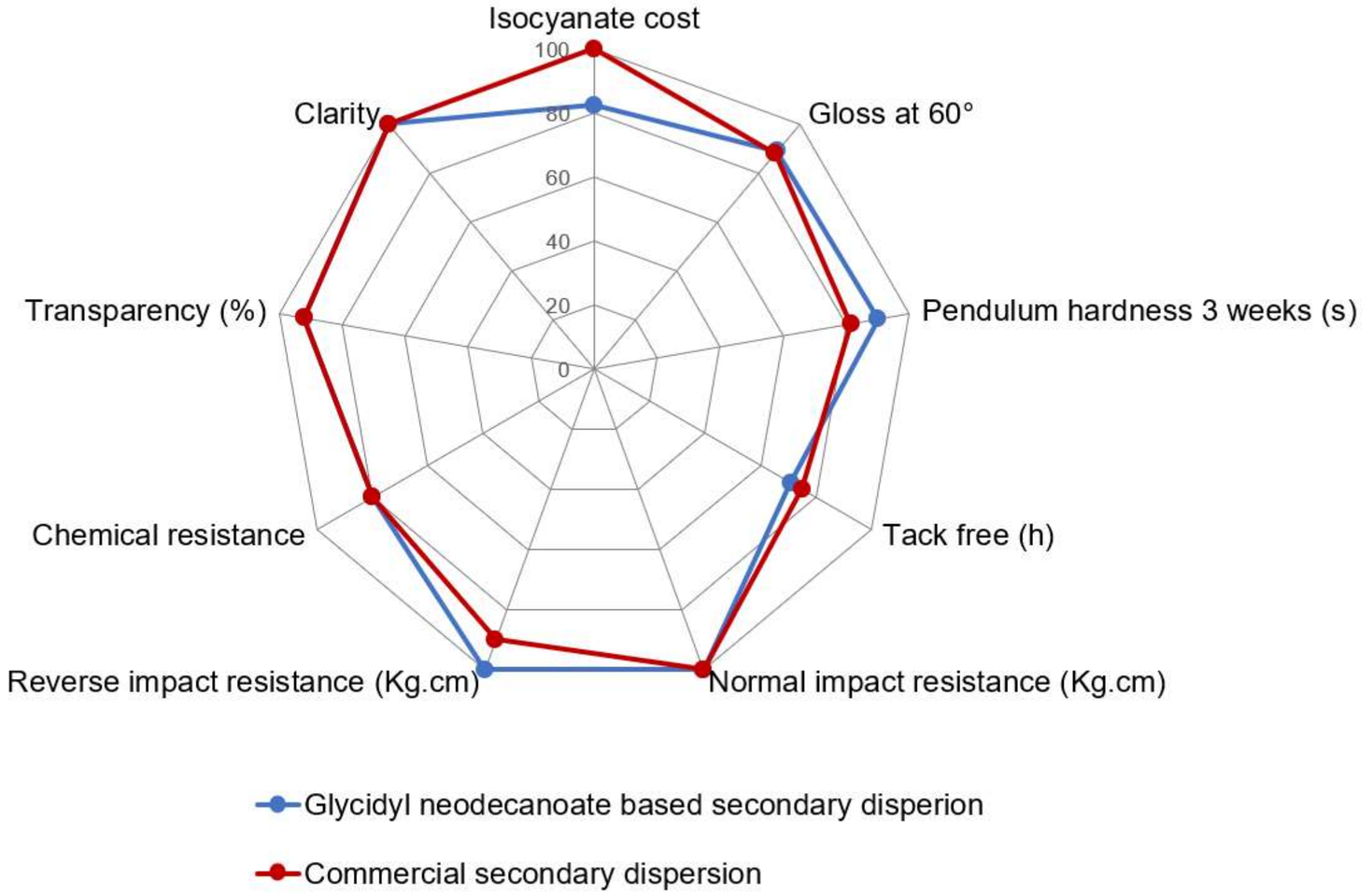
Step 4.
Dispersion in water



- Neutralization and immediate dispersion in water

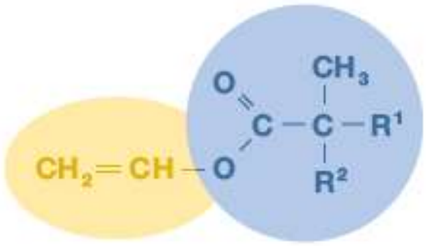
➔ **Glycidyl neodecanoate in APO synthesis offers unique processing advantages**

Performance Comparison in a 2K Clearcoat

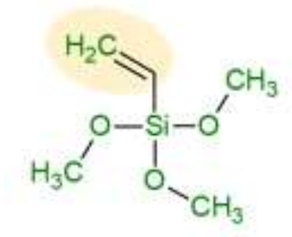


Secondary dispersions made with glycidyl neodecanoate provides process, cost and ease of use benefits while being similar performance vs commercial benchmark

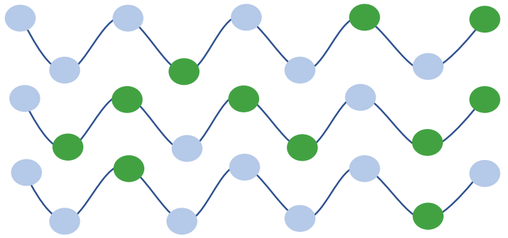
Example 4: Silane Functionalized, Hydrophobic Polymers



Vinyl neodecanoate



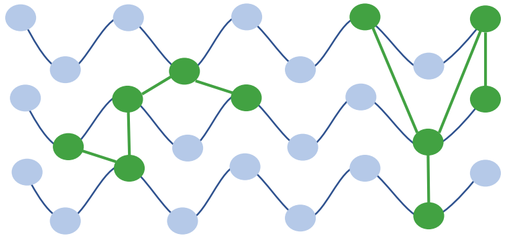
Silane functional monomers



Vinyl silane polymer

Coating application

Moisture curing

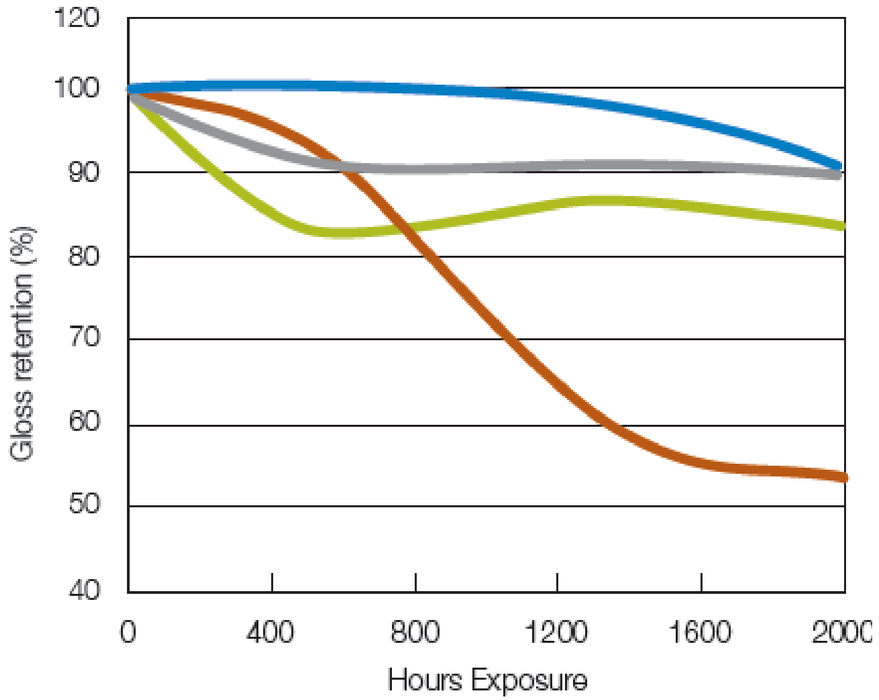


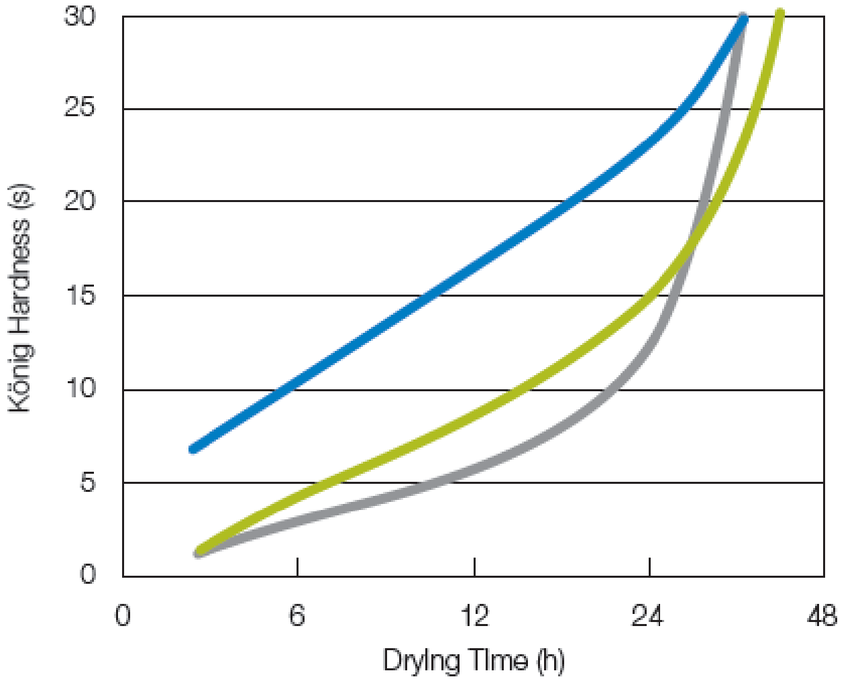
Cured coating

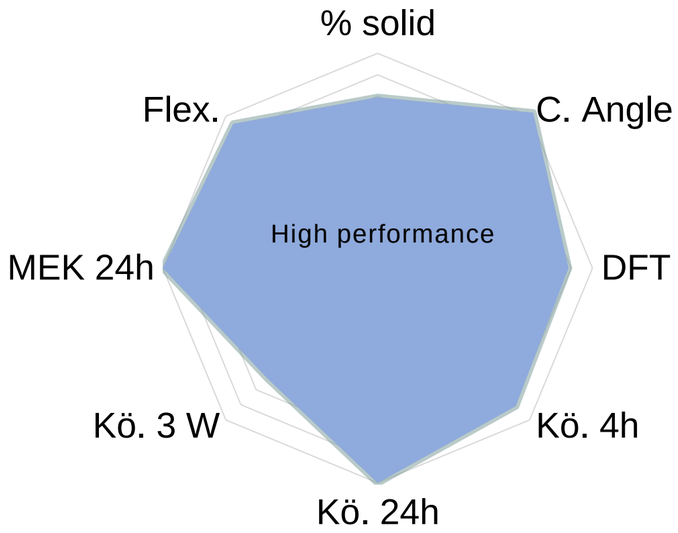
- ✓ Copolymerization of **Vinyl neodecanoate** and Silane monomer
- ✓ Moisture-cure, **Isocyanate-free**
- ✓ **Cost benefit** vs high performance polymers
- ✓ **Performance** benefit over conventional 2K solvent borne systems
- ✓ **Less waste (1K) / Easy to handle**

Silane Functionalized, Hydrophobic Polymers Performance

New High-Performance Binder for Coatings







Silane Functionalized Hydrophobic Polymer

2k Polyurethane B

Epoxy Polysiloxane

Acrylic Polysiloxane A

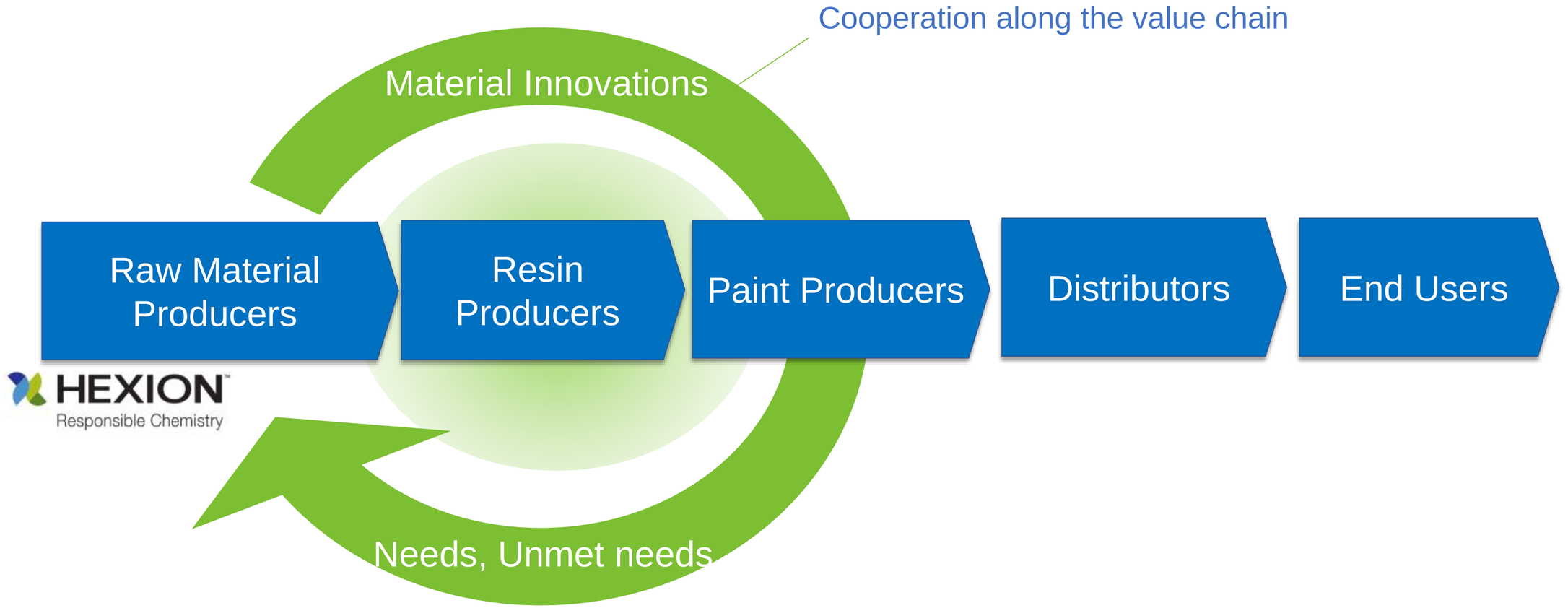
Section 4

Conclusions

Vinyl neodecanoate, Glycidyl neodecanoate, the molecules of choice for **high quality wood coatings** with **higher durability**

Hexion Versatics

Customer-Driven Innovation Approach



Come to discuss with us

Thank you

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