



Formulate on the Cutting Edge

Denamer™ 1220

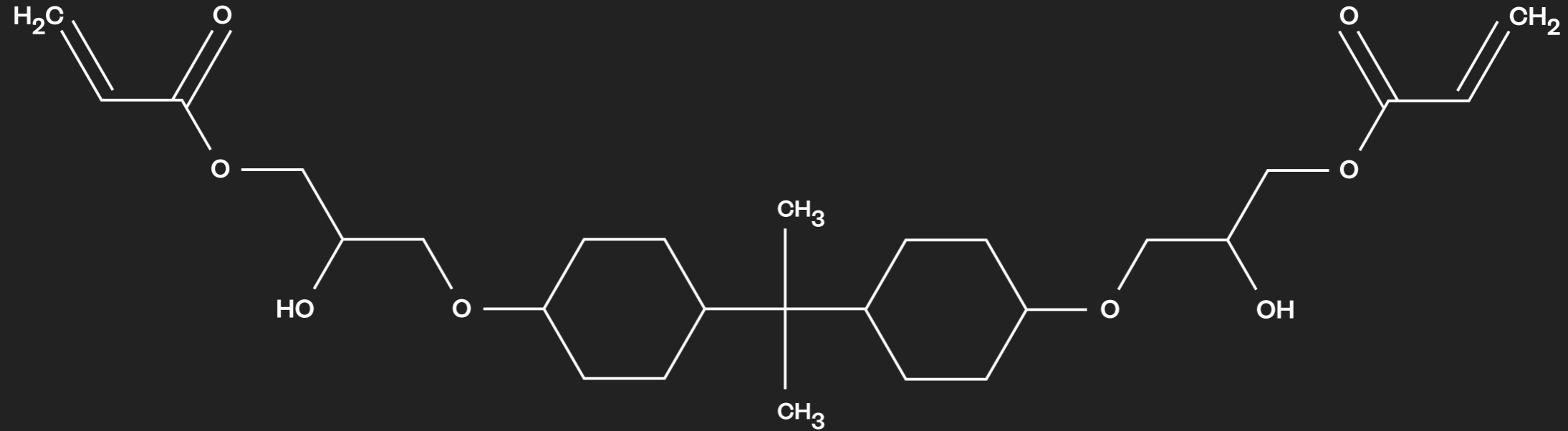
An Aliphatic Alternative to Bisphenol A Epoxy Acrylate

NAGASE Specialty Materials NA LLC

Background.

NAGASE & the Curing Industry

- **NAGASE** has a long history of differentiated materials for the UV/EB curing industry
- A segment of particular interest is dual-functional resins
- Hydroxy-functionality has shown to provide a variety of properties to acrylates
- Aromatic acrylates usually have good rigidity and toughness. However, they are known to yellow in a wide variety of applications



Denamer™ 1220 Chemical Structure.

Denamer™ 1220 is a di-functional acrylate that offers the strength and toughness of a cycloaliphatic backbone combined with two hydroxy groups that can serve a variety of purposes

Chemical Name	2-Propenoic acid, polymer with 2-(chloromethyl)oxirane and 4,4'-(1-methylethylidene)bis[cyclohexanol]
CAS No.	144952-38-5
Formula	C ₂₇ H ₄₄ O ₈
Formula Weight	496.19
Appearance	Pale Yellow Liquid
Purity	≥99%
Water Content	≤0.5%
Acid Content	<0.1%
T_g (by DMA)	92.5 °C
Viscosity (at 60 C°)	2,850 cP

Denamer™ 1220 Properties.

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Applications

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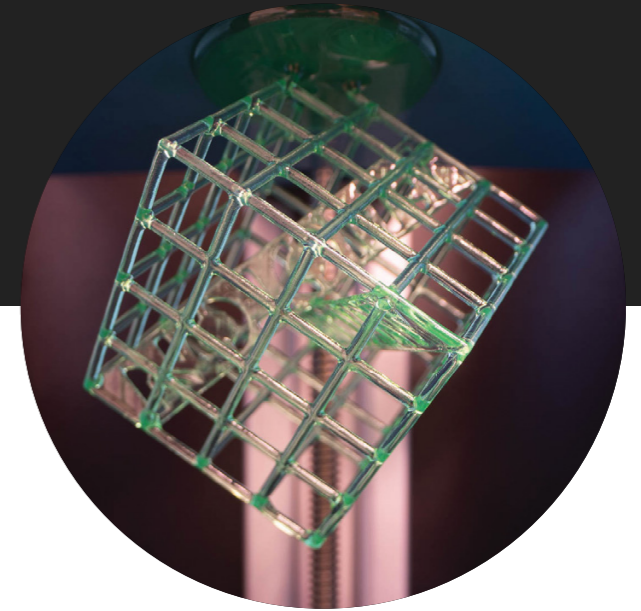
Adhesion



Hardness



Shrinkage



3D Printing

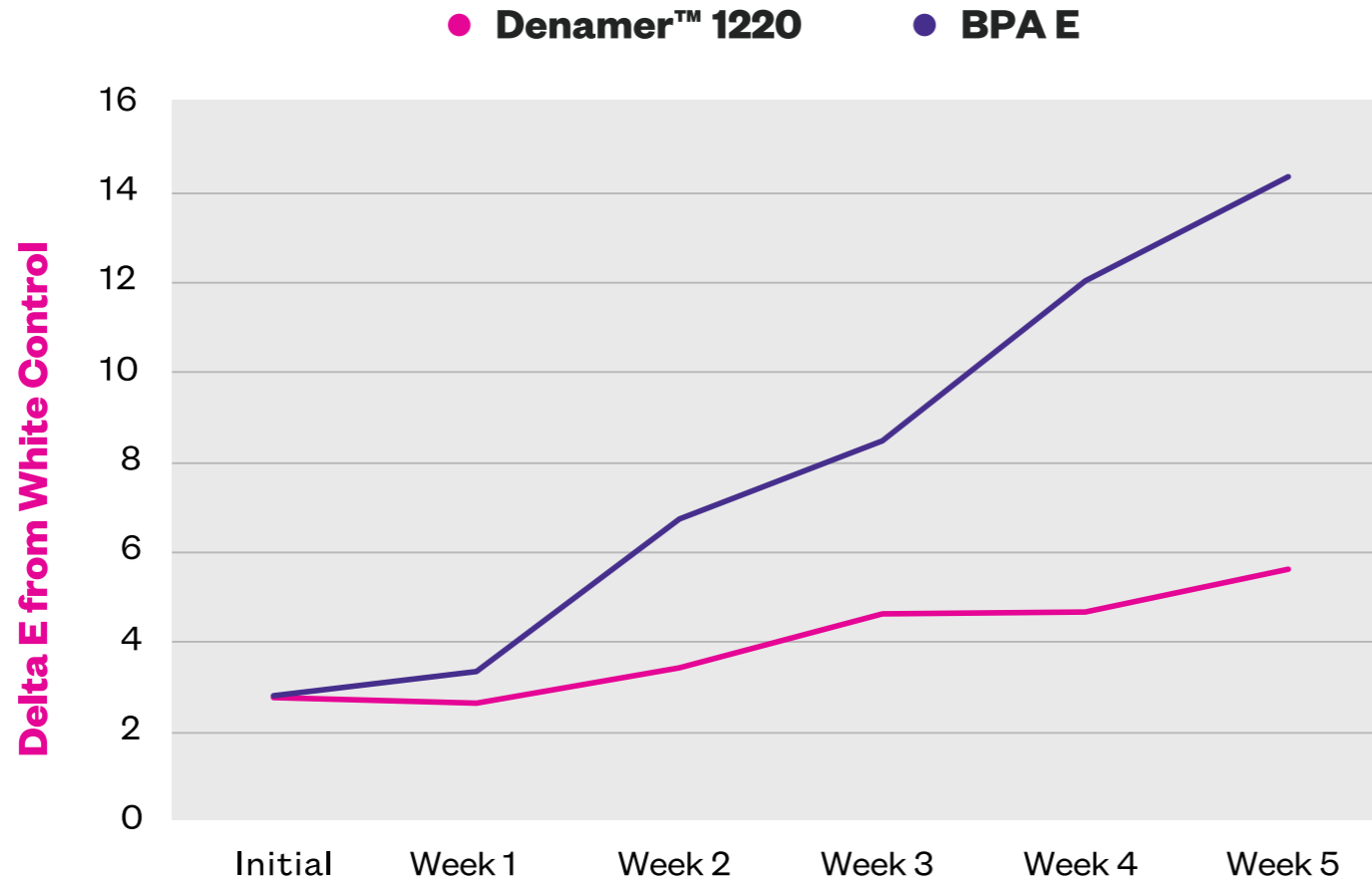
Products	Control Formulation Component (%)	Denamer™ 1220 Formulation Component (%)
Aliphatic HexaFunctional Urethane Acrylate	34.9	34.9
BisPhenol A Epoxy DiAcrylate	40.6	-
Denamer™ 1220	-	40.6
2-HEA	4.4	4.4
HDDA	6.6	6.6
AS2010	6.3	6.3
XC SB 302	0.2	0.2
PBZ	3.5	3.5
CPK	2.3	2.3
TPO	1.2	1.2

Denamer™ vs. BPA Epoxy DiAcrylate.

	Control	Denamer™ 1220
Pencil Hardness on PET #3 Rod DD	9H	9H
Adhesion (Pass or % Failure)		
PET- 600 Tape	Pass	Pass
PET- 810 Tape	Pass	Pass
Raw PET - 600 Tape	Pass	Pass
Raw PET - 810 Tape	Pass	Fail
Aluminum - 600 Tape	Pass	Pass
Aluminum - 810 Tape	Pass	Pass
Poly carbonate - 600 Tape	Fail	Pass
Poly carbonate - 810 Tape	Fail	Pass

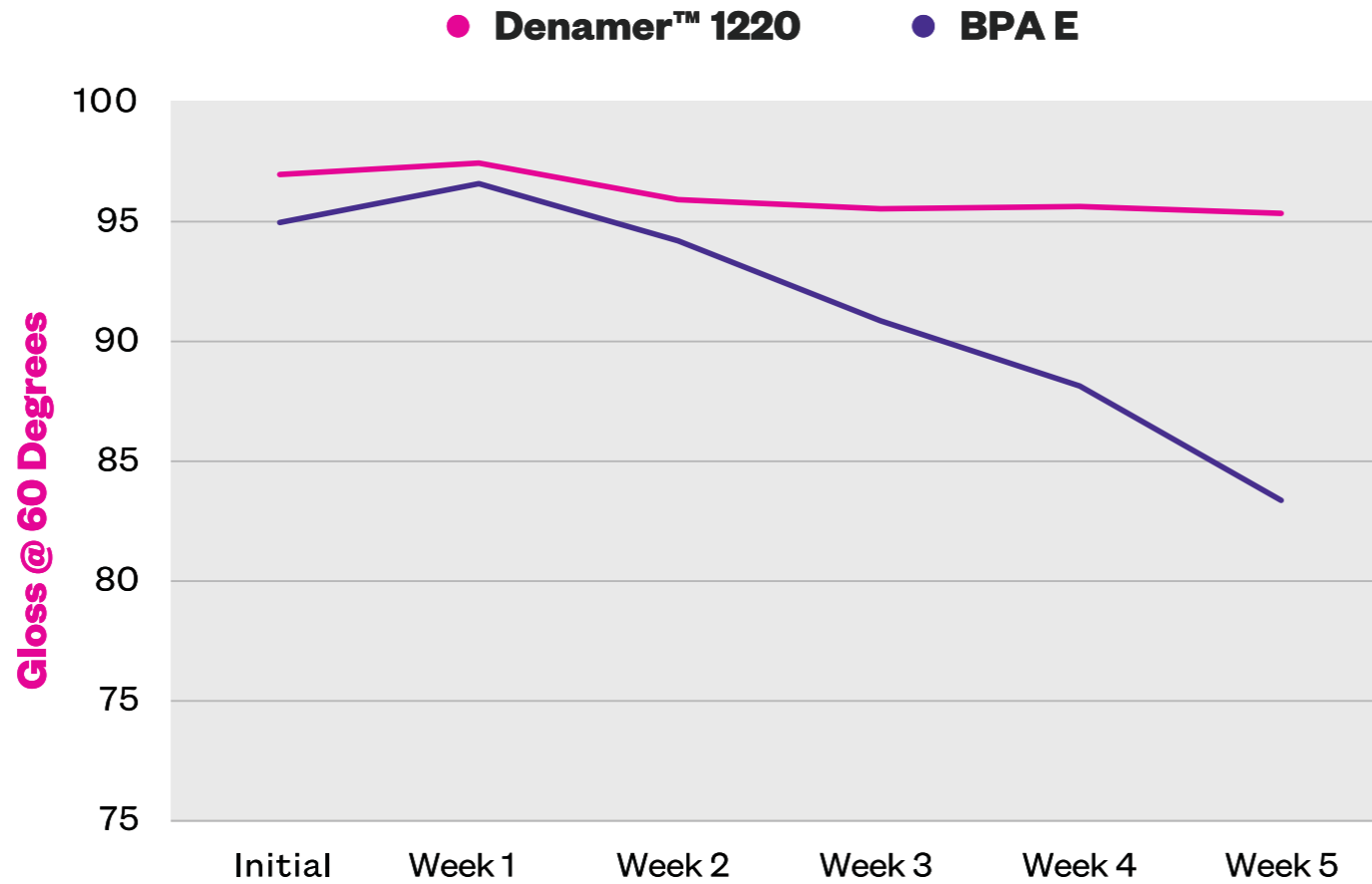
Denamer™ vs. BPA Epoxy DiAcrylate.

ΔE vs. Time for Denamer™ 1220 vs. BPA Epoxy DiAcrylate



**QUV Weathering Data
for a Non-Optimized
Formulation.**

Gloss vs. Time for Denamer™ 1220 vs. BPA Epoxy DiAcrylate



**QUV Weathering Data
for a Non-Optimized
Formulation.**

Products	Control Formulation Component (%)	Denamer™ 1220 Formulation Component (%)
Aliphatic HexaFunctional Urethane Acrylate	33.1	-
Denamer™ 1220	-	33.1
Aliphatic DiFunctional Urethane Acrylate	40	40
Monomer (Confidential)	20.1	20.1
Light Absorber (Confidential)	1	1
Light Stabilizer (Confidential)	2	2
Photoinitiator (Confidential)	3.8	3.8

Exterior Durable Protective UV-Coating.

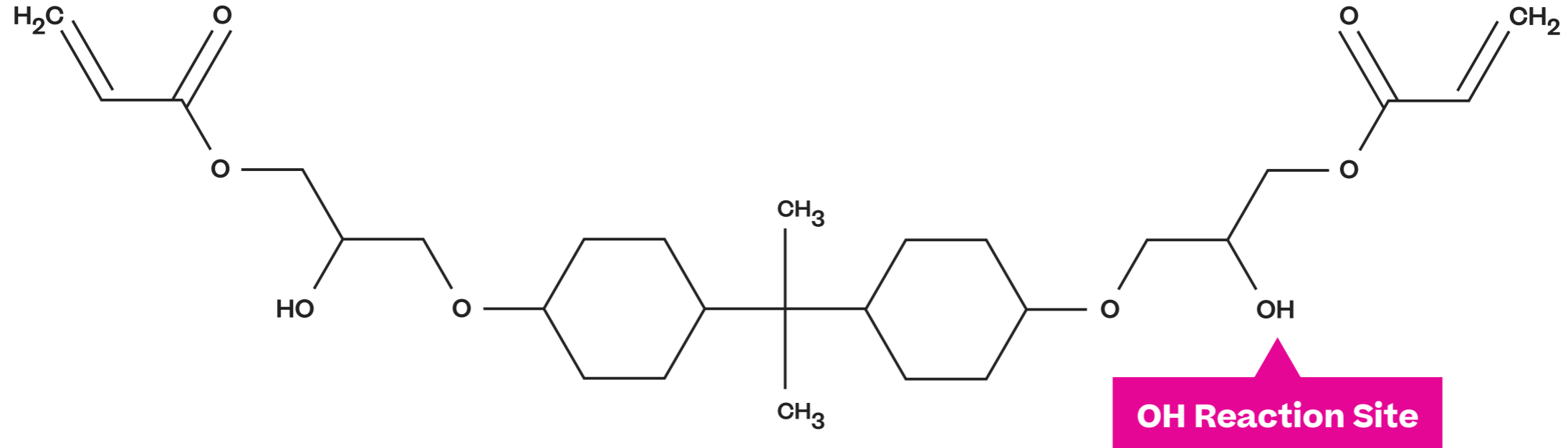
	Target Specifications	Control	Denamer™ 1220
Taber (Haze)	14.8	26.4	25.1
Pencil Hardness	6H	9H	6H
FTIR Conversion (%)	-	98.3	98.7

Results of Exterior Durable Protective UV-Coating.

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Reaction Sites

Formulate on the Cutting Edge



Potential Reaction Site.

- OH groups can be used to make new acrylate-functional resins
- Hydroxy groups can react in hybrid acrylate/cationic systems where green strength is important

Summary.

Denamer™ 1220, a New Cycloaliphatic Epoxy Acrylate From NAGASE

- **Denamer™ 1220** has a unique combination of a hydrogenated bisphenol A backbone and hydroxy groups, which results in strong physical properties with good weatherability, adhesion, and the ability to react into hybrid radical/cationic formulations where high green strength is critical
- The OH-groups also serve as potential functional sites for reactions with isocyanates, for example, to produce acrylate-functional resins
- **Denamer™ 1220** shows promising use in photopolymer 3D printing and additive manufacturing, inks, exterior durable hard coatings, photoresists, and adhesives
- **Denamer™ 1220** is TSCA-listed and commercially available and manufactured in the US



denamer.nsm-na.com/1220