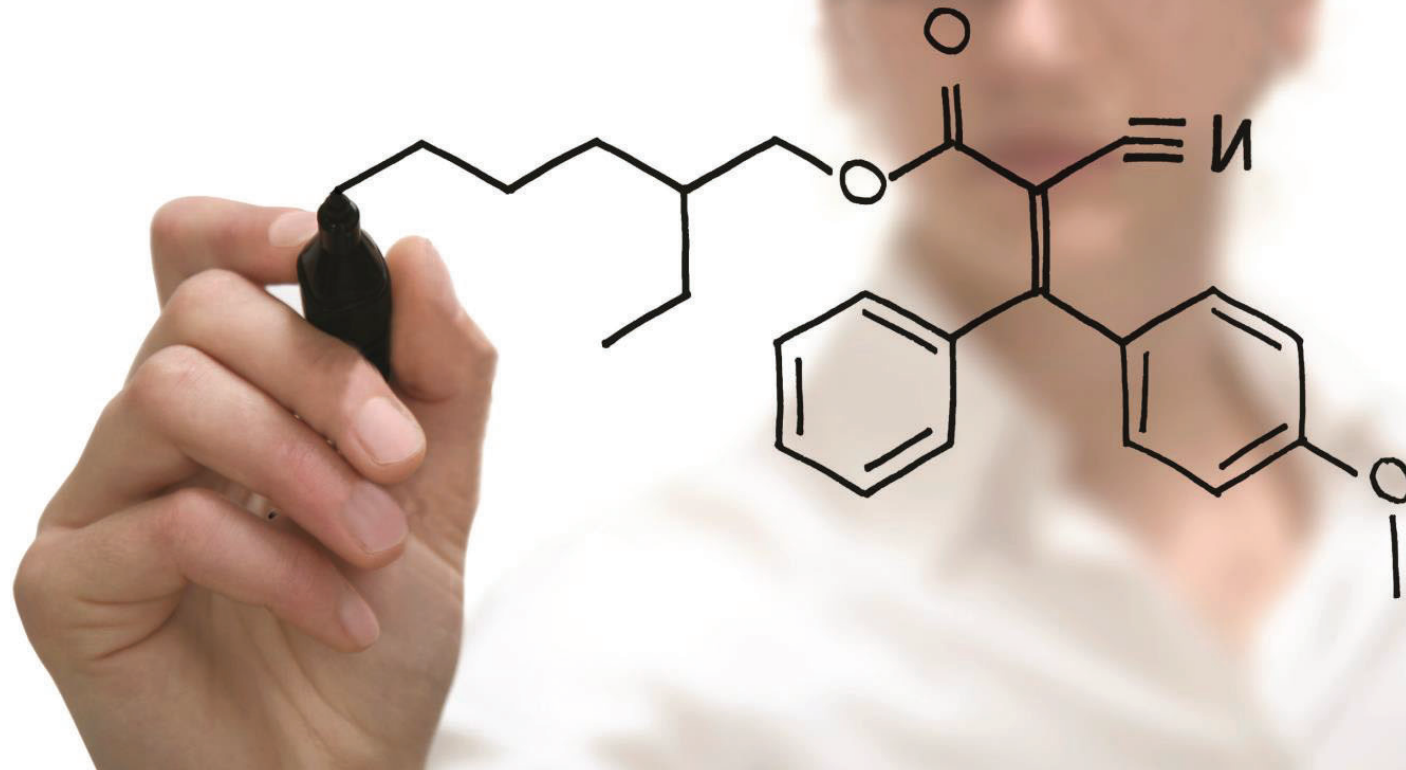


Hallstar Ester Plasticizers for SMP Sealants



Performance Advantages in SMP Sealants

- Esters for modification of SMP: MS & SPUR Sealants
 - Testing performed on a 1K Di-functional MS Polymer*
 - Kaneka S303H (High Modulus)
- Performance Goals
 - Meet/Exceed Phthalate performance
 - Increase Elongation
 - Reduction in Tg
 - Provide stability in Physical Testing after aging
- Compared HallStar Esters with: DIDP, DINP
- HallStar Products:
 - Plasthall 190
 - Paraplex A-9000
 - Plasthall 180 S
 - Plasthall PR-A610
 - TegMeR 809



Ester Evaluations in SMP

- Initial and Aged Ester Performance Evaluations in SMP
 - Viscosity, Brookfield
 - Skin Formation Time
 - Original Physical Properties ASTM D412
 - Modulus, tensile, elongation, hardness
 - Tg, DSC
 - Adhesion – Peel ASTM C794
 - Aluminum, float glass
 - Dry and wet
 - Slump ASTM D2202
- DINP and DIDP as standards



Variables / Formulation

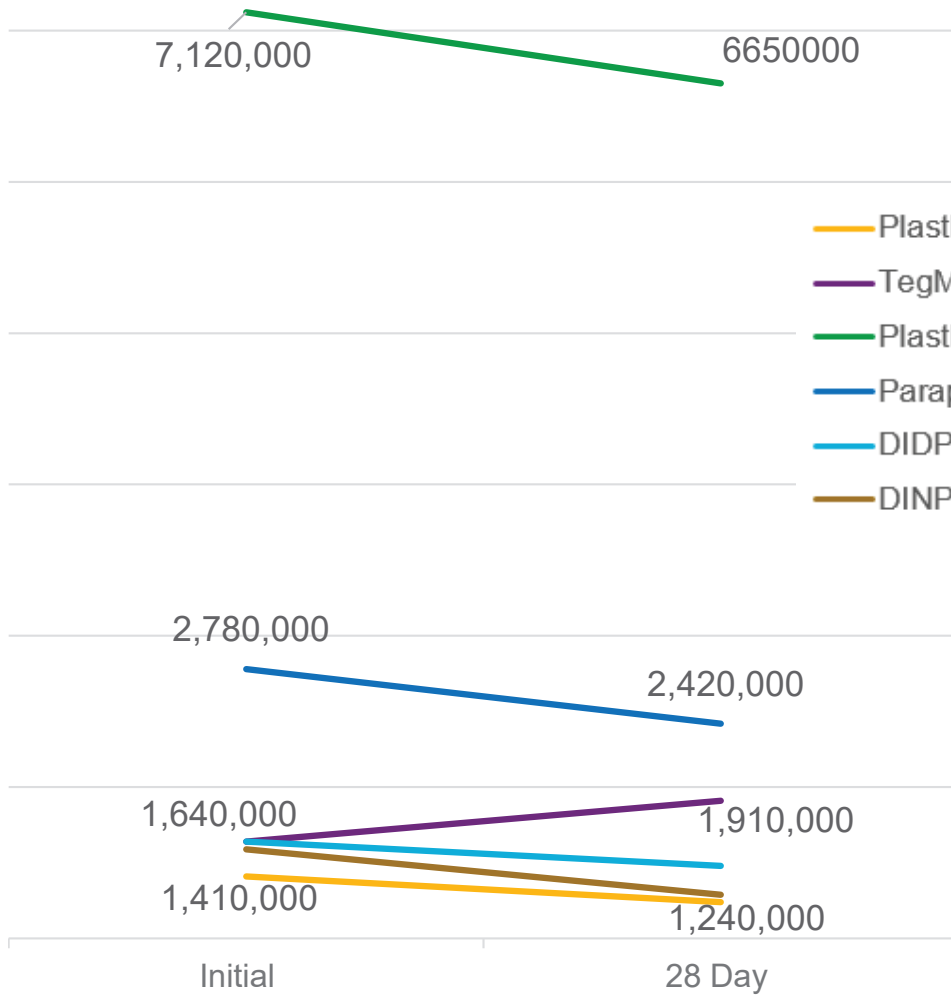
- SMP
 - Kaneka S303H
 - 1K Difunctional MS Polymer*
(high modulus)
- **Plasticizers**
 - Plasthall 190 (Aliphatic alkylated ester)
 - TegMeR 809 (Aliphatic PEG ester)
 - Plasthall PR-A610 (Renewable ester)
 - Plasthall 180S (Aliphatic linear ester)
 - Paraplex A-9000 (Aromatic Polymeric Phthalate)
 - DIDP (Aromatic Phthalate)
 - DINP (Aromatic Phthalate)

Base Formulation	
Silane modified polyether	100.0
UV stabilizers	2.0
Precipitated calcium carbonate	160.0
Calcium carbonate	54.0
Titanium oxide	20.0
Plasticizer	90.0
VTMO - dehydrate	3.0
DAMO – adhesion promoter	3.0
Catalyst	2.0

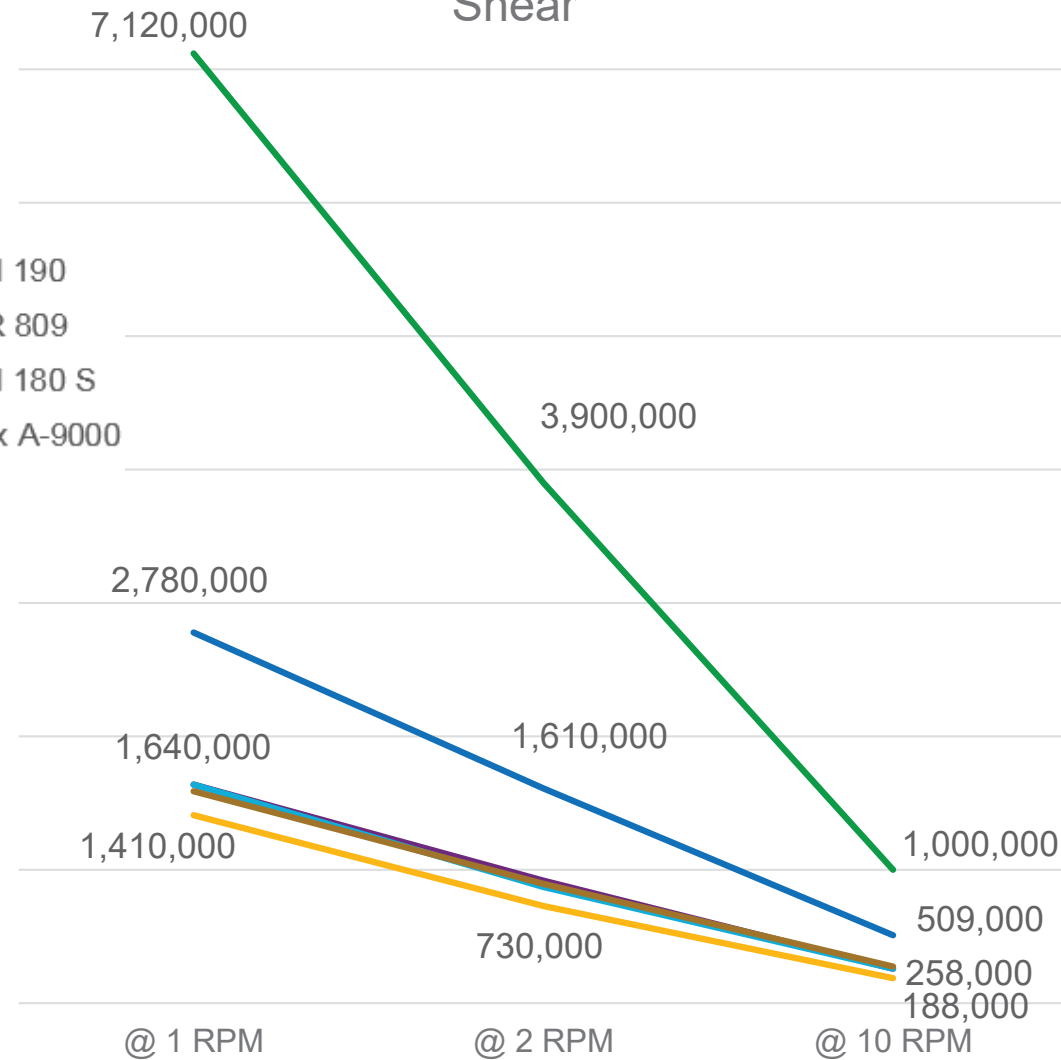
*MS Polymer is a registered trademark of Kaneka Corporation

Viscosity

Viscosity Stability(1 RPM)



Shear



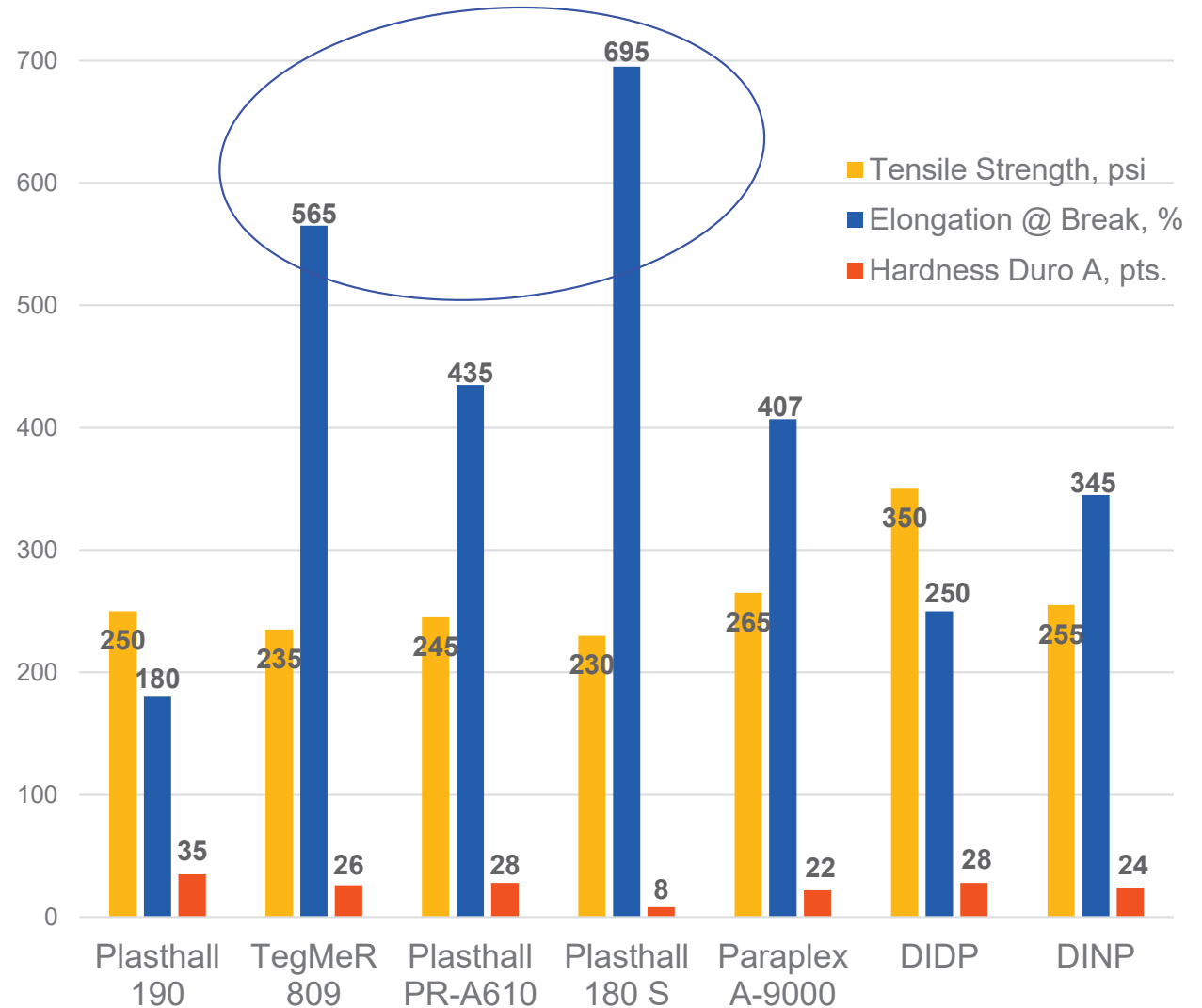
- Plasthall 180 S high viscosity, with exceptional shear reduction
- Plasthall 190 / TegMeR 809 low viscosity= faster extrusion

Physical testing

Elongation / Tensile (ASTM D 412)

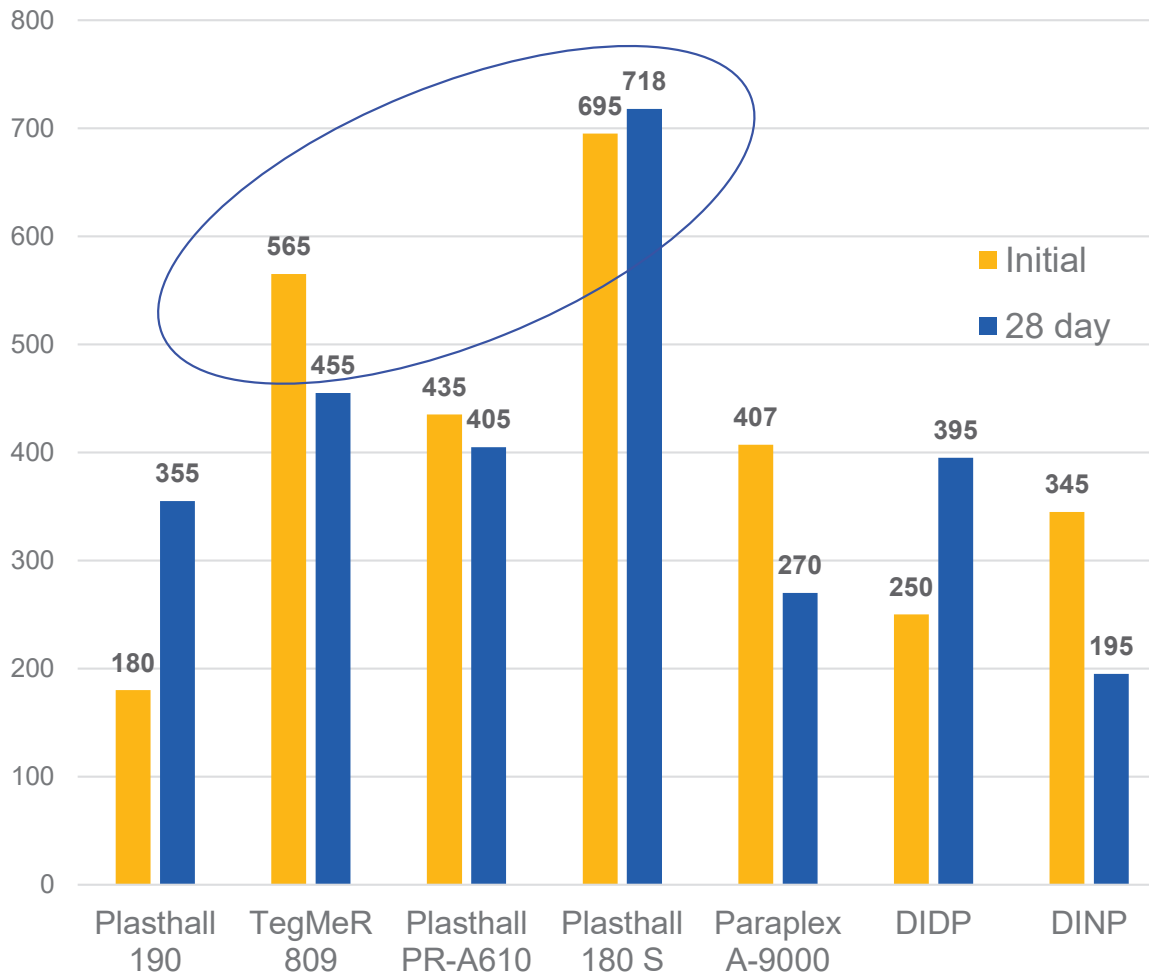
Hardness (ASTM C661)

- High Elongation
 - Plasthall 180 S
 - TegMeR 809
- High Tensile
 - DIDP
- High Hardness
 - Plasthall 190



Elongation after Aging (ASTM C794)

Elongation @ Break, %

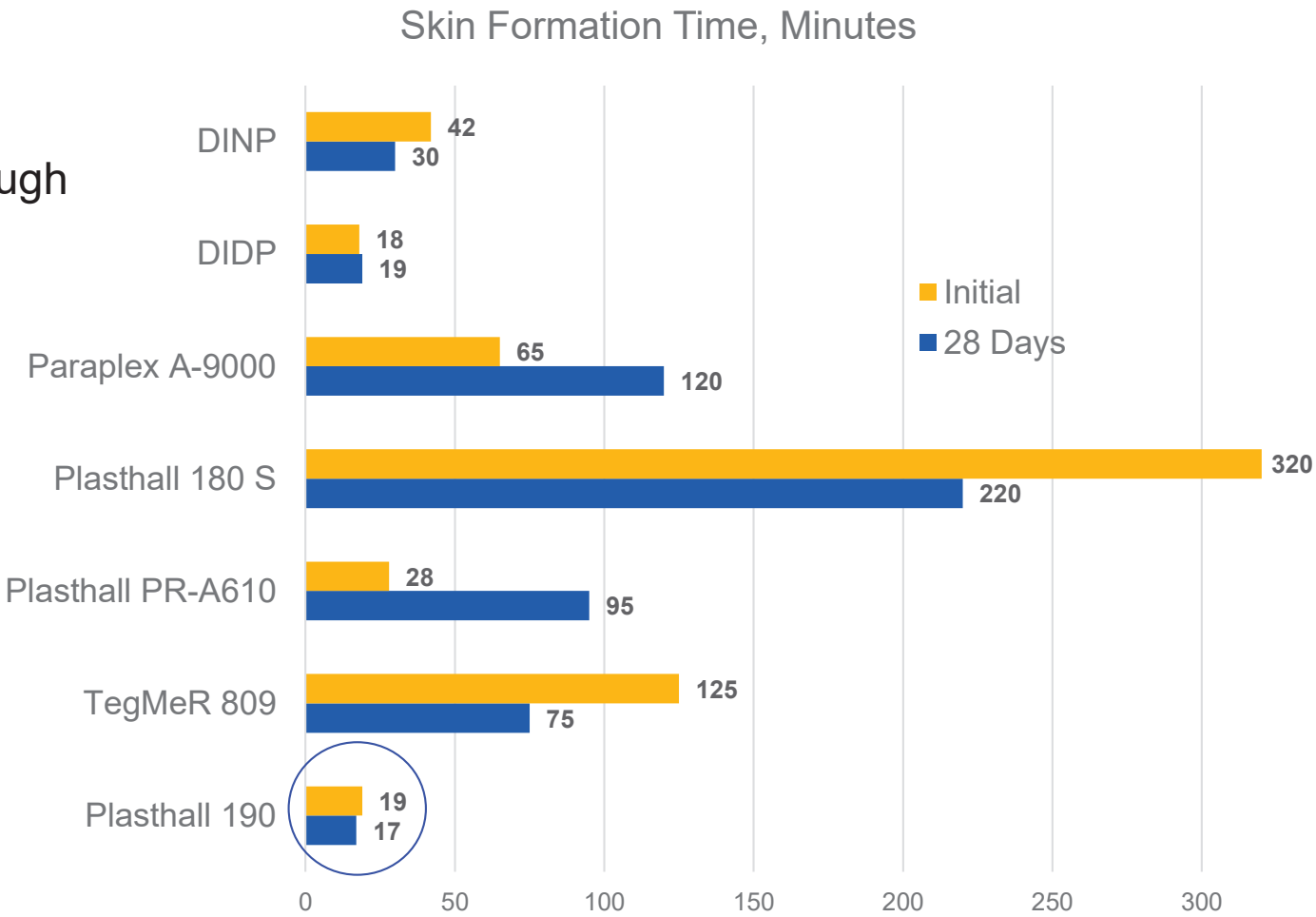


- Heat Age (21 Day@ 70°C)
 - High Elongation
 - Plasthall 180 S
 - TegMeR 809

Tack Free Time/Skin Formation (ASTM C679 Modified)

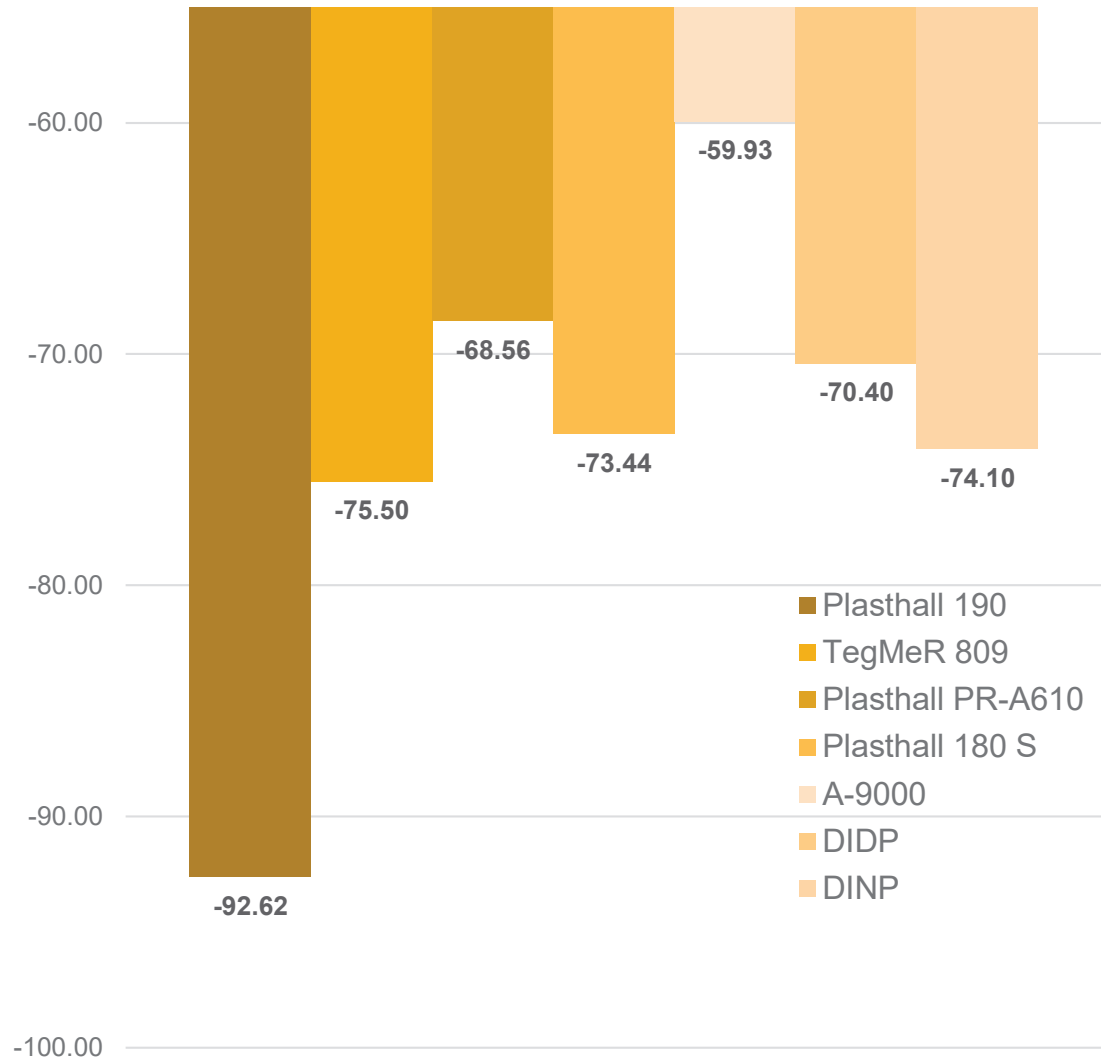
- Fast Skin Time
 - Plasthall 190
 - Predicting fast cure through

- Slow Skin Time
 - Plasthall 180 S
 - Use as elongation additive

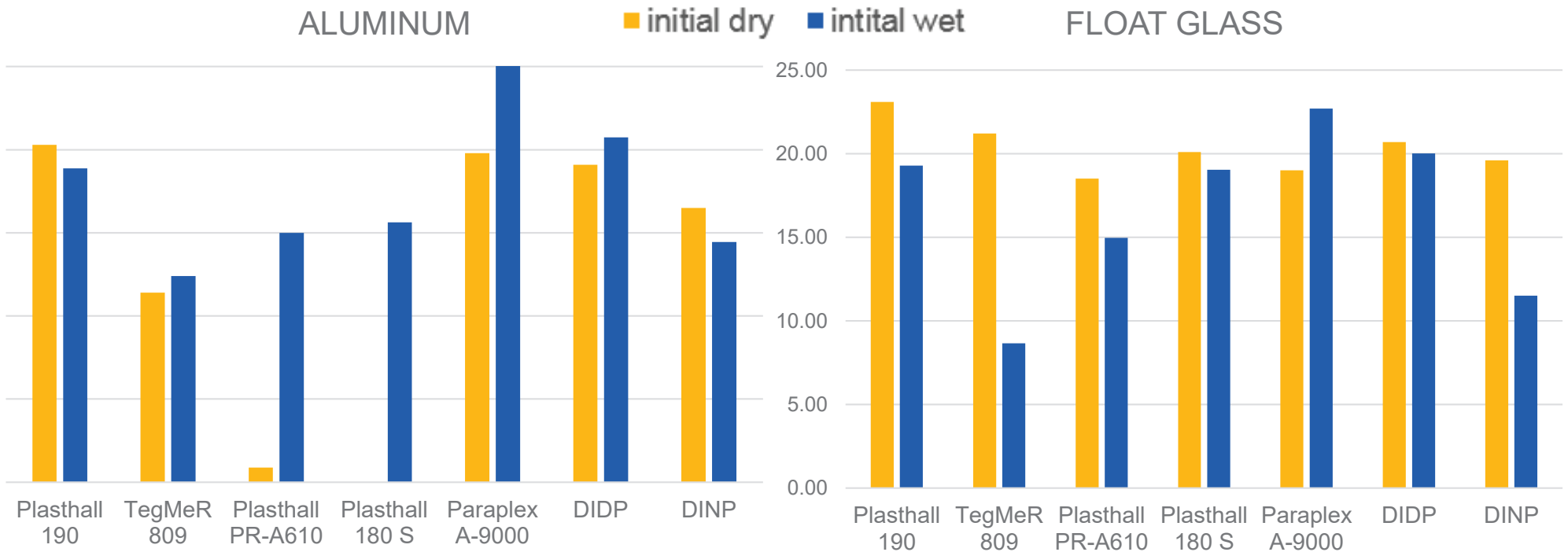


Tg by DSC (°C)

- Ultra Low Tg
 - Plasthall 190



Adhesion in Peel (ASTM C794)



- Stability
 - Plasthall 190, TegMeR 809
- Moisture required
 - Plasthall 180 S (use less dehydrant)

- Stability
 - Plasthall 190, Plasthall 180S
 - Paraplex A-9000

Hallstar Ester Summary in SMP

- TegMeR 809
 - Increase Elongation
 - Maintain Tensile, Hardness
 - Stable after aging/weathering
- Plasthall 190
 - Ultra Low Tg
 - Fast Skin time/cure through
 - High Hardness
 - Stable after aging/weathering
- Paraplex A-9000
 - Good Elongation while maintaining Tensile strength
 - High adhesive strength
- Plasthall 180 S
 - Significant Increase in Elongation
 - Potential use as elongation additive



What's next at Hallstar in SMP?

- Next Round of SMP sealant evaluations to include:
 - SPUR (vs. MS tested)
 - Additional Polymeric Ester Plasticizers
 - Ester Blends (for optimization)
 - Weathering Testing (Xenon Arc/QUV)
 - Recovery/Rebound



Thank you