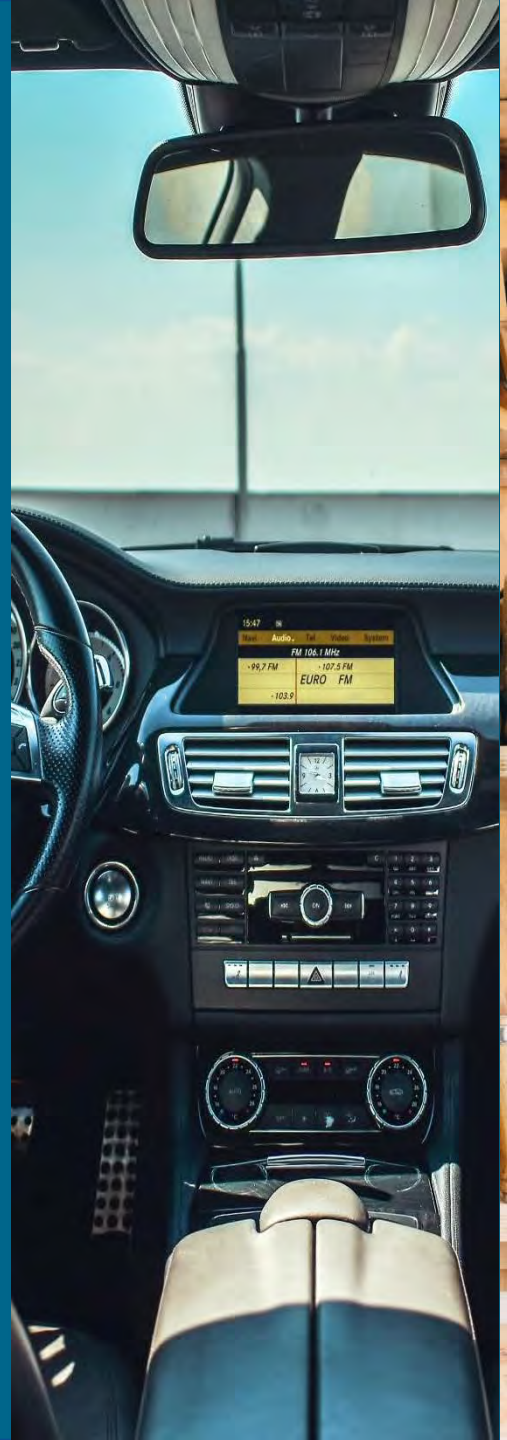
# Aerafin™ 35 polyolefin polymer

*Expanding Eastman's portfolio of amorphous polyolefins*

EASTMAN




# Eastman APO growth platform

**Eastoflex**
**Aerafin 17**
**Aerafin 180**

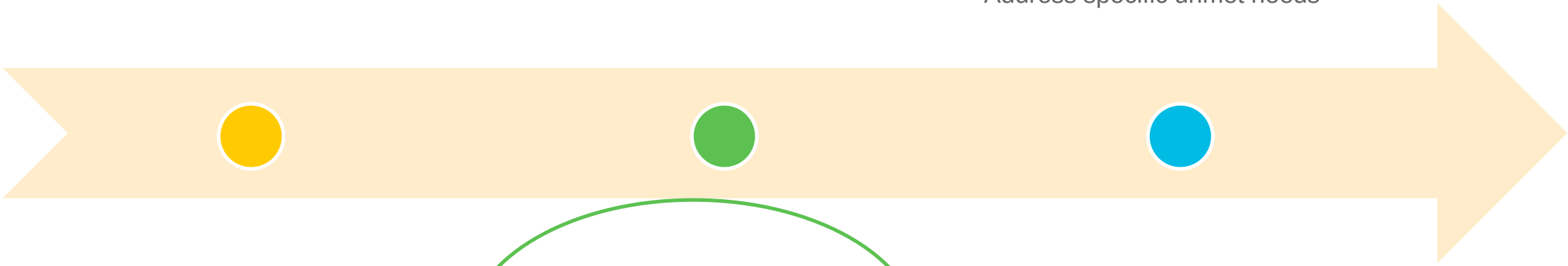
## Application translations

- New applications for existing products

**Next-generation products**

## Differentiate

- Transformational products
- Enable differentiated performance
- Address specific unmet needs



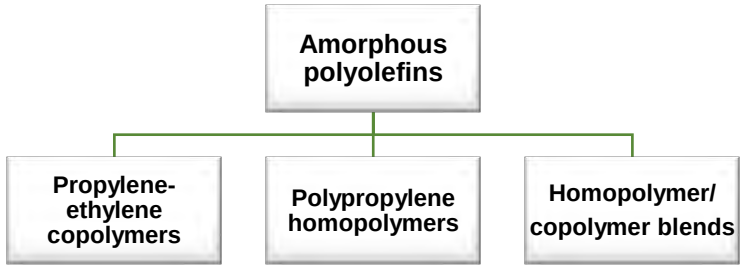
## Broaden the portfolio

- New products
- Expand the design space
- Increase formulation flexibility

**Aerafin 35**

# Amorphous polyolefins

*Driving growth for Eastman adhesives*




## Eastman amorphous polyolefins

- Soft, flexible
- Broadly compatible with numerous elastomers, polymers, and aliphatic tackifying resins
- Low color, good heat stability, low molecular weight, low odor, and excellent thermal and UV stability
- Wide viscosity range
- Exhibit excellent water and moisture resistance with broad temperature service range
- Consistent in quality
- Common applications—roofing, HMAs, packaging, nonwovens, road-marking paint, and product assembly

# Innovating with Aerafin

*Hot-melt adhesives finally have the polymer they need.*


Hygiene


Mattresses


Woodworking


Packaging


Sealants


Carpets


Automotive

High-strength copolymers from ethylene and propylene with exceptional balance of tensile strength and elongation

## Formulation flexibility

- Good adhesion
- Enhanced tensile strength vs. Eastoflex APOs
- Low $T_g$ allows formulation flexibility and low-temperature performance
- Compatibility with hydrocarbon tackifier resins

## Application robustness

- Excellent thermal stability
- Excellent sprayability
- Clean running and low-temperature processability
- Low softening point; easy to melt

## For end users

- Low odor
- Low substances of interest (SOI)

# Expanded product portfolio for formulation flexibility

| Aerafin | $T_g$ (°C) | Softening point (°C) | Viscosity @ 190°C (mPa·s) | Needle penetration (dmm) | Physical form | Tensile strength (MPa) | Elongation (%) |
|---|---|---|---|---|---|---|---|
| Aerafin 180 | –38 | 120 | 18,000 | 20 | Pellets | 1.9 | 263 |
| Aerafin 17 | –38 | 125 | 1,500 | 20 | Pellets | 2.3 | 18 |
| **Aerafin 35** | **–40** | **120** | **3,300** | **14** | **Pellets** | **2.7** | **40** |

- Higher tensile strength
- Good elongation at lower viscosity

# Aerafin 35 property comparison with competitive materials

| Physical property | Aerafin 35 | Vestoplast® 703 | Vestoplast® 704 | Vestoplast® EP V2103 | Vestoplast® EP V2094 | REXtac 2730 | REXtac 2732 | REXtac 2535 |
|---|---|---|---|---|---|---|---|---|
| Ring and ball softening point (°C) | **120** | 124 | 105 | 103 | 94 | 110 | 121 | 132 |
| Viscosity @ 190°C (mPa·s) | **3,300** | 2,700 | 3,500 | 2,500 | 2,500 | 3,000 | 3,000 | 3,500 |
| Density @ 23°C (g/cm$^3$) | **0.86** | 0.87 | 0.87 | 0.86 | 0.86 | NA | NA | NA |
| Needle penetration | **14** | 12 | 23 | 12 | 20 | 30 | 22 | 45 |
| $T_g$ (°C) | **–40** | –28 | –36 | –33 | –38 | –23 | –22 | –37 |
| Tensile strength (MPa) | **2.7** | **1.8** | **0.7** | 2 | 1 | 0.61 | 0.59 | **0.2** |
| Elongation at break (%) | **40** | **32** | **83** | 40 | 70 | NA | NA | **87** |
| Open time (s) | **18–20** | **10–12** | **20–25** | 5 min | >10 min | 300 | 120 | 60 |

Higher tensile strength than competitive materials

Longer open time than Vestoplast® 703

Better elongation than Vestoplast® 703

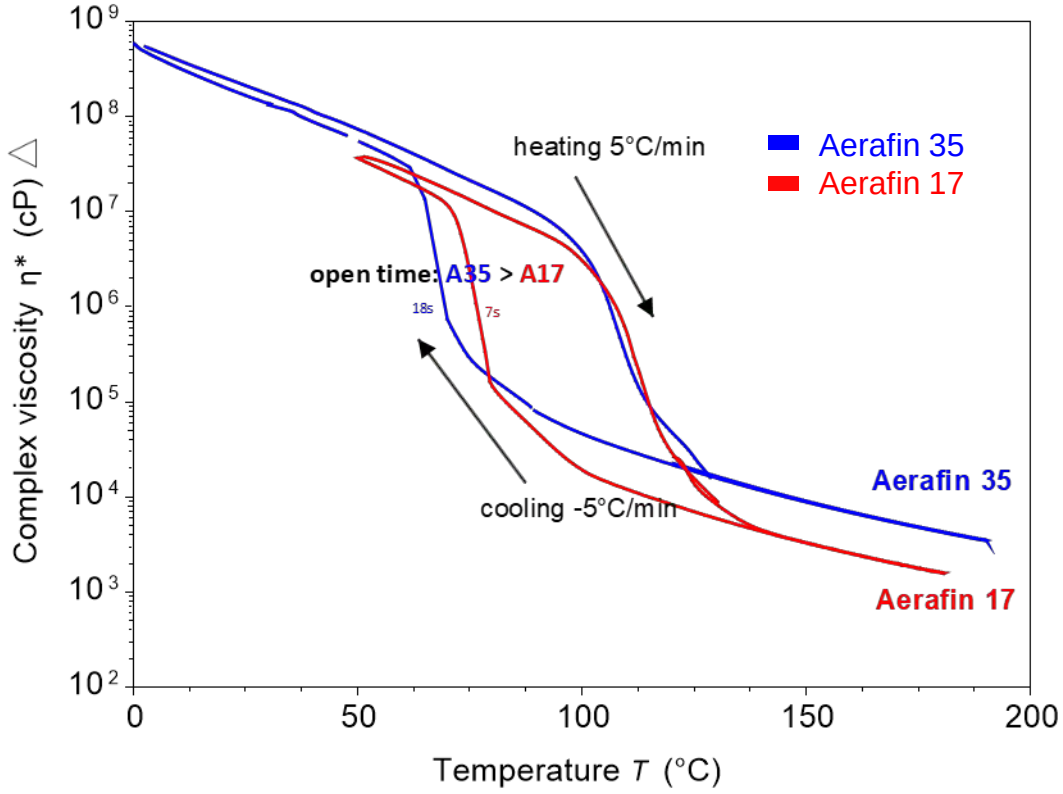
Eastman data in **bold.** Other data pulled from public resources. NA = data not available.

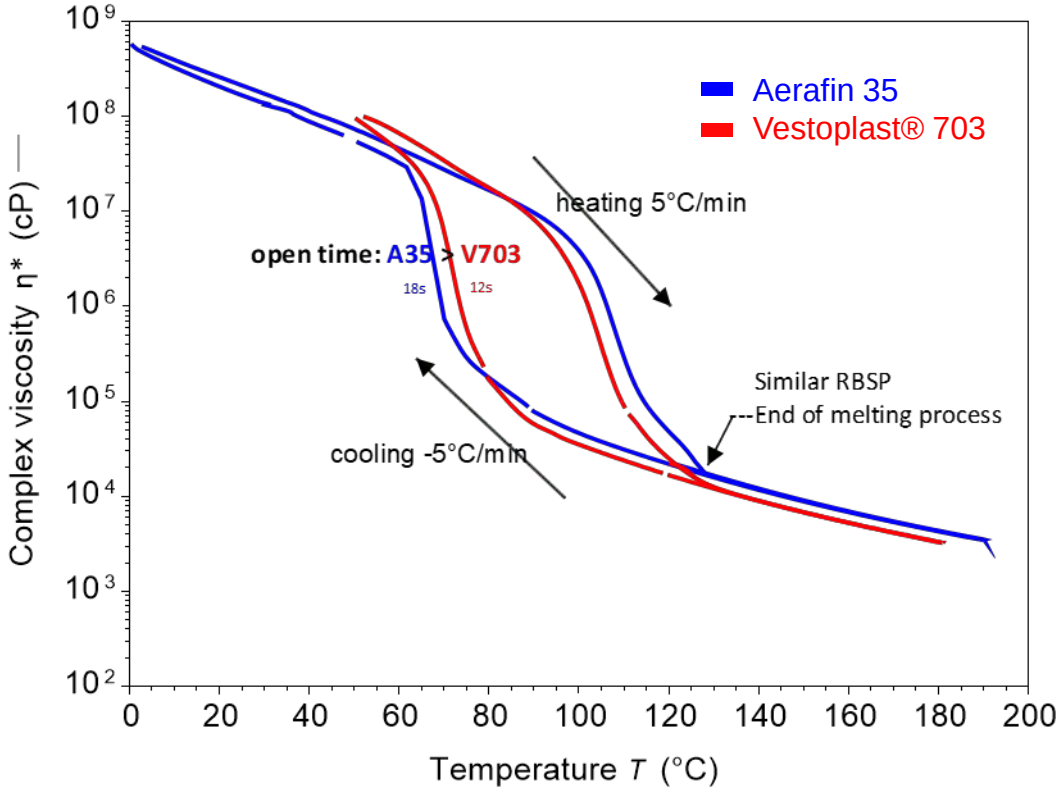
Tensile test: Tensile strength and elongation at break were determined by Eastman internal method based according to ASTM D412 die C. APO samples were compression molded into a 1-mm thickness film; then, dumbbell test specimens were prepared by die cutting following ASTM-D412. All testing was performed in a temperature- and humidity-controlled (CTH) room. Tensile strength at break was calculated by the force magnitude at break divided by cross-sectional area of unstrained specimen. Elongation at break was calculated by extended distance at break recorded and normalized by original normal gage length 62.5 mm within tensile grips.

Open time: Determination of open time in the lab was done by Eastman internal method based on ASTM D4497-10. The melt (180℃) is applied as a film of 127 µm (5 mil) using hot drawdown bar on a kraft paper. Strips of kraft paper are pressed into the film by 1-kg weighted block at certain intervals (depending on open time). Thirty minutes after the last strip is applied, a 90-degree peel is carried out by hand to see which of the last strips applied can be lifted off without pulling out the paper fibers (50% fiber tear). The time at which this strip was applied is noted.

# Comparison of DMA curves

Aerafin 35: Longer open time + Easier to melt than Aerafin 17 and has the same melt temperature as Vestoplast® 703




**Test conditions**

25-mm parallel plate; 5°C/min; frequency 10 Hz

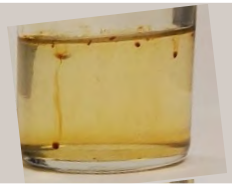
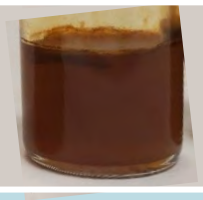
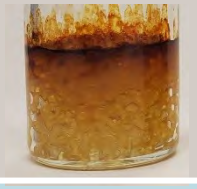
# Thermal stability of pure polymers at 160°C

| | Aerafin 35 | mPE | b-APO (propene-rich) | b-APO |
|---|---|---|---|---|
| Initial |  |  |  |  |
| 24 hr |  |  |  |  |
| 48 hr |  |  |  |  |
| 72 hr |  |  |  |  |

Aerafin 35 has excellent thermal stability. After 72 hours at 160°C, it:

- Is clear
- Has no char
- Has no phasing
- Has no gel formation
- Has no flocculation

# Thermal stability of pure polymers at 180°C

| | Aerafin 35 | mPE | SEBS | b-APO (propene-rich) | b-APO | SBS | SIS |
|---|---|---|---|---|---|---|---|
| Initial |  |  |  |  |  |  |  |
| 24 hr |  |  |  |  |  |  |  |
| 48 hr |  |  |  |  |  |  |  |
| 72 hr |  |  |  |  |  |  |  |
| Comments | Slight char after 48 hours | Slight char after 24 hours | Gel on surface after 24 hours | Cloudy and slight char after 48 hours | Slight char after 24 hours | Char after 24 hours | Char after 24 hours |

# Excellent sprayability

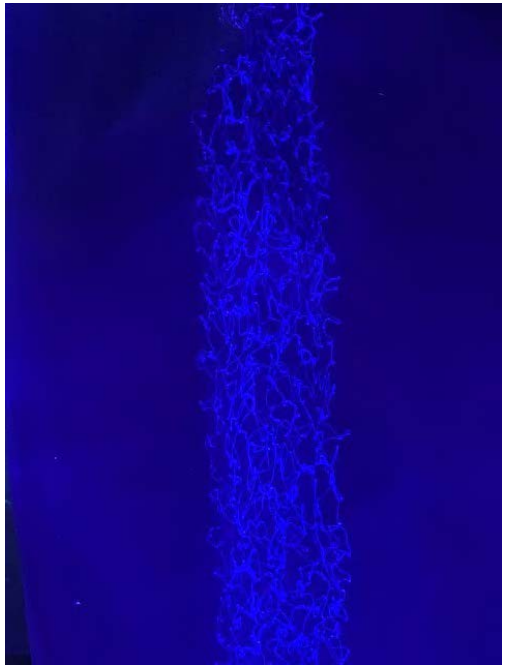
Spiral glue gun at 180°C

Aerafin 35
pure polymer

Spiral glue gun at 180°C

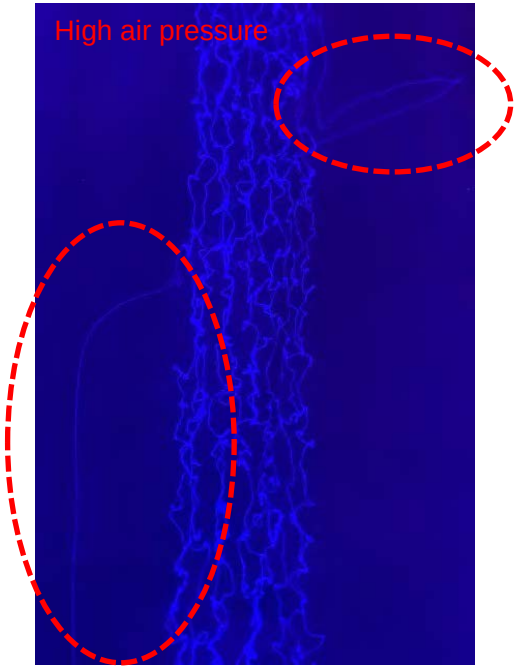
b-APO pure
polymer

Nordson Signature nozzle
using Catbridge coater
(150°C)



Aerafin 35
formulated adhesive

Nordson Signature nozzle
using Catbridge coater
(150°C)




b-APO
formulated adhesive

# Adhesion

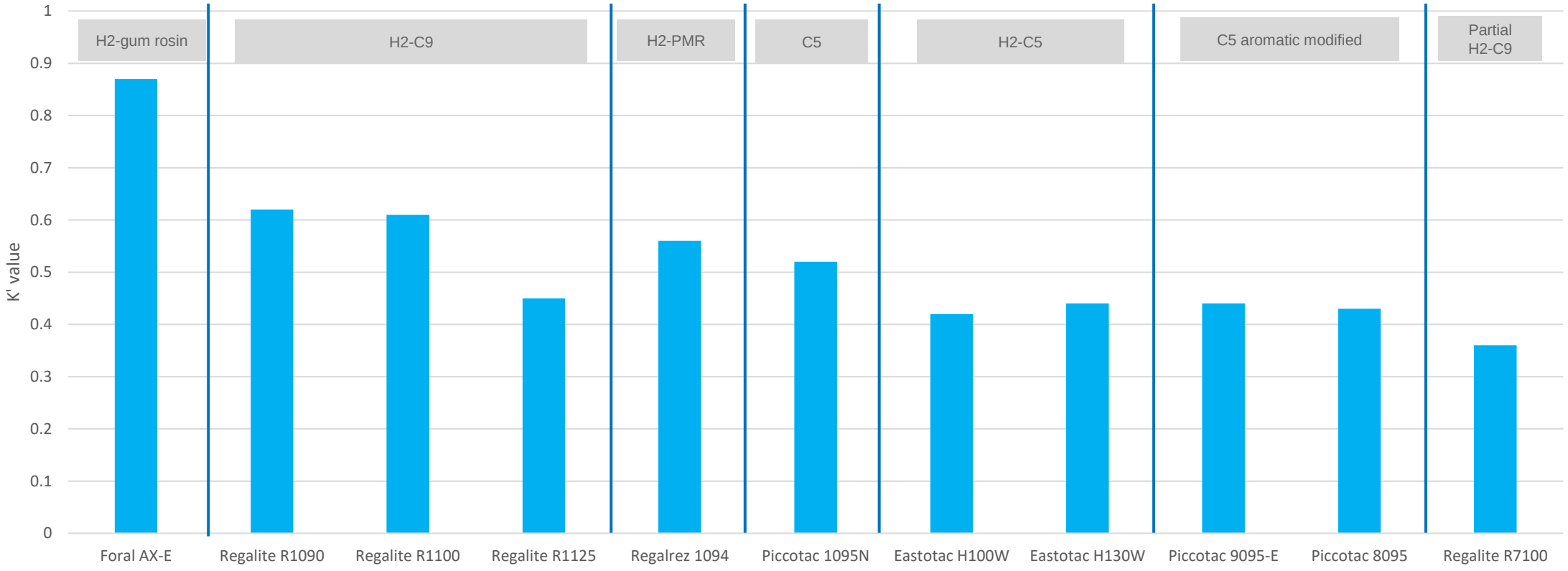
| Substrates/sample ID | Aerafin 35 | Aerafin 35/tackifier blend (70/30) | | | | |
|---|---|---|---|---|---|---|
| | | Aromatic modified C5 | C5 | H2-C9 | H2-C5 | H2-gum rosin |
| Al/Al | - | + | +++ | ++ | + | + |
| Wood/wood birch | ++++ | ++++ | ++++ | +++ | +++ | +++ |
| PP/PP | +++++ | ++++ | ++++ | +++ | +++ | +++ |
| PVC/PVC | + | +++ | +++ | +++ | +++ | ++ |
| ABS/ABS | - | +++ | +++ | +++ | +++ | ++ |
| HDPE/HDPE | ++ | +++ | +++ | +++ | +++ | +++ |
| LDPE/LDPE | + | ++ | ++ | ++ | ++ | ++ |
| PC/PC | - | +++ | +++ | ++ | ++ | ++ |
| SS/SS | - | +++ | +++ | +++ | ++ | ++ |
| Cardboard/cardboard | SF | SF | SF | SF | SF | SF |

Great adhesion on wood, PP, and corrugated cardboard

Improved adhesion on other substrates when adding tackifier

Adhesion test: This adhesion test is based on 70/30 polymer/tackifier blends. A fixed amount of the blend was coated on the different substrates (1-in. wide) and adhered using a fixed pressure and time. The joint substrates were conditioned overnight, and the substrates were pulled apart using Instron on the next day. The force to pull each specimen apart was recorded. Higher force means better adhesion. The force value is converted to a + and – sign ratings. 5+ means highest force (great adhesion) and – sign means low/no force (no adhesion). SF means substrate failure.

# Compatibility—K' value of resin blends with Aerafin 35




**Compatibility trend**

H2-gum rosin **>** Fully H2-C9 **>** H2-PMR **>** C5 **>** H2-C5 **=** C5 aromatic modified **>** Partial H2-C9

**Compatibility test:** K' value is calculated using the $T_g$ data (DSC) of P/T blends of 75/25, 50/50, and 25/75 ratio. This is a relative factor that compares Gordon-Taylor (blends) and Fox (ideal miscibility) equations; K' = 1 means full compatibility; the higher K' value, the more compatible.

# Disclaimer

Properties of Aerafin 35 reported in the TDS are considered typical of the described first batch of commercial material. Eastman makes no representation that the material in any particular shipment will conform exactly to the values given. Typical values may change after more batches are produced in our commercial plant.

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