



POLYKETONE

A NEXT GENERATION
SUSTAINABLE NYLON
ALTERNATIVE

INTRODUCTION

TODAY'S PRESENTERS



Dr. John Swanson

Technology Manager
Specialty Engineered Materials
Avient



Jeremy Gray

Application Development and
Technical Service Engineer
Specialty Engineered Materials
Avient



DISCUSSION TOPICS

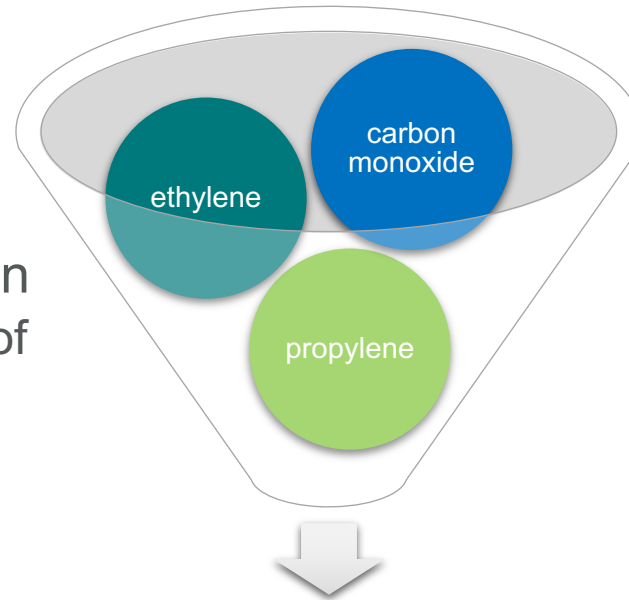
- Market dynamics
- Polyketone overview
- Material performance
- Application challenges
- Avient solutions

MARKET DYNAMICS

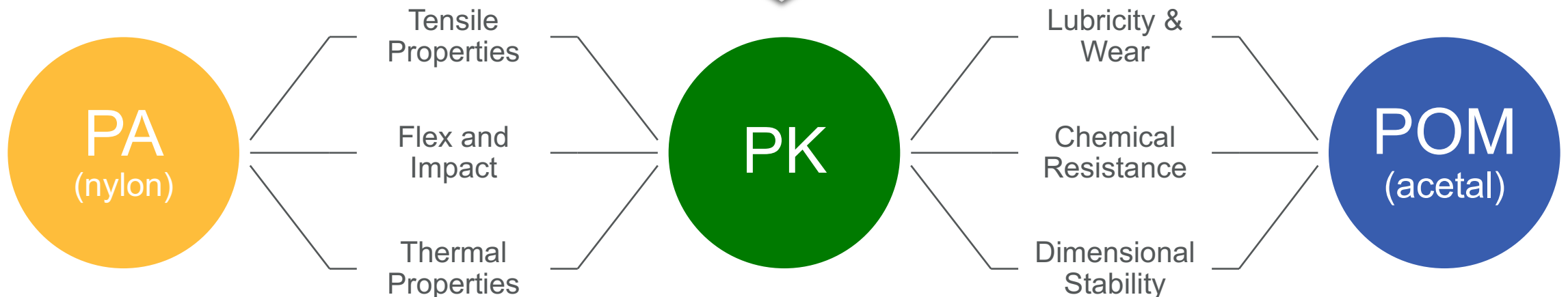


WHAT IS POLYKETONE (PK)?

BACKGROUND

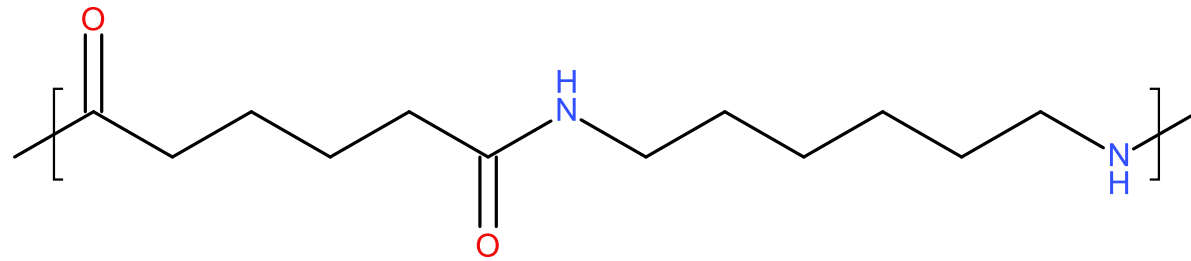


An “eco-conscious” engineering resin
Semi-crystalline, alternating copolymer of **carbon monoxide** and **ethylene**, some **propylene** (1-10%)

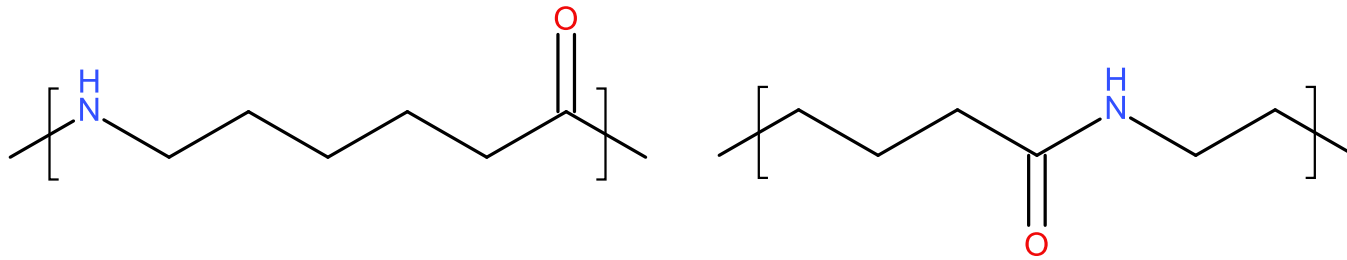


WHAT IS POLYKETONE (PK)?

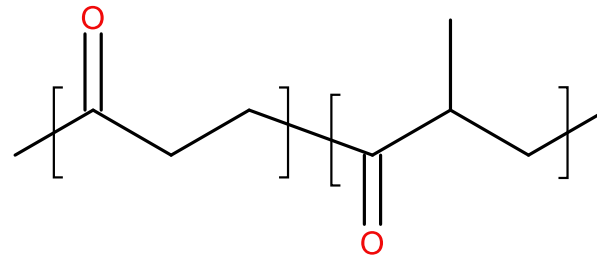
STRUCTURAL SIMILARITIES



PA66 (Nylon 66)



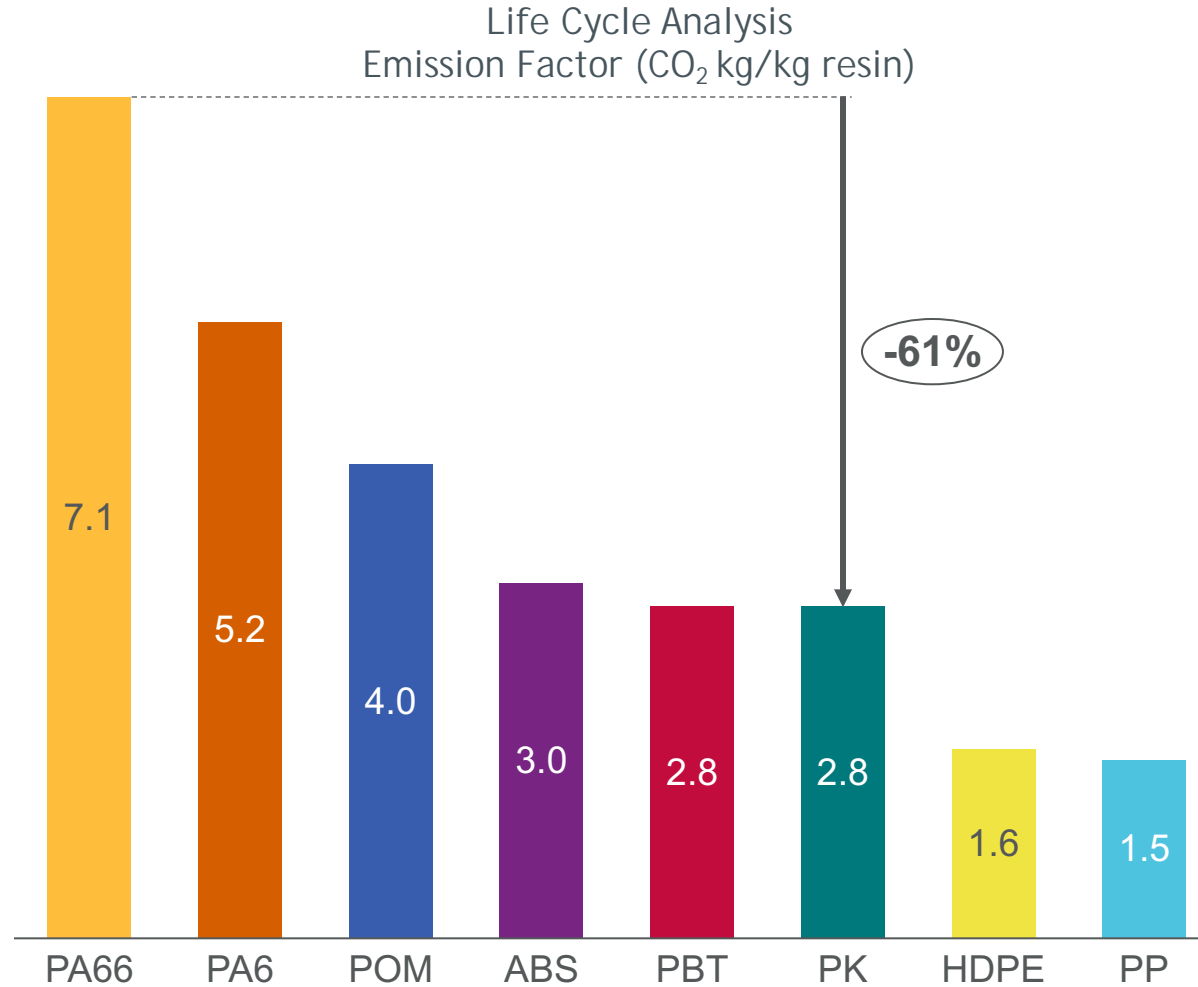
PA6 (Nylon 6)



PK (Aliphatic Polyketone)

SUSTAINABILITY

CO₂ EMISSIONS IN PRODUCTION

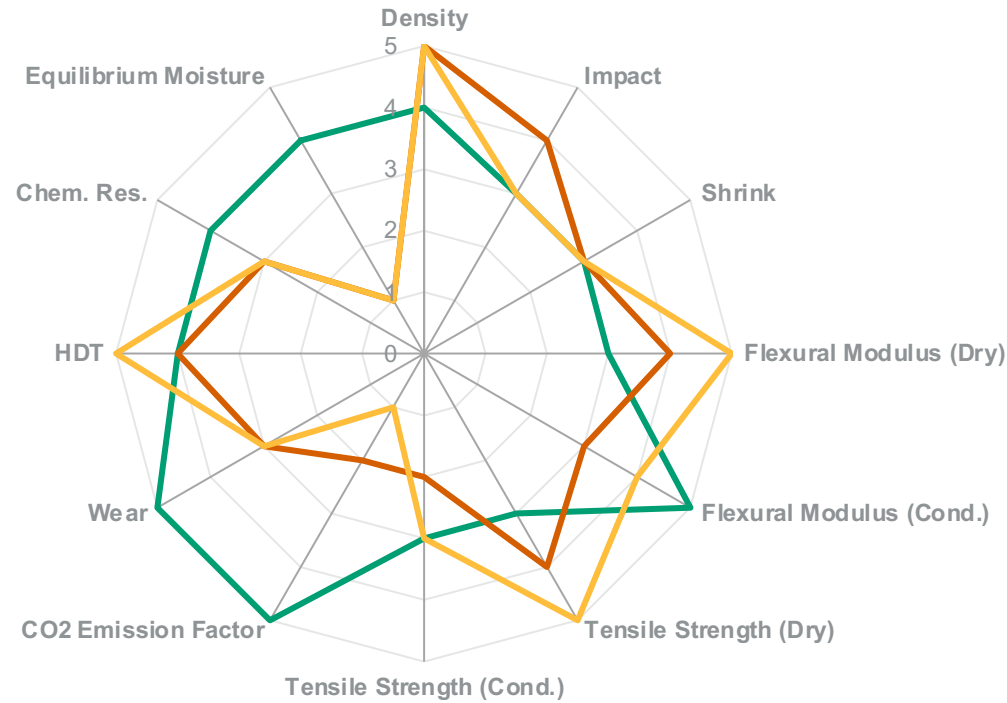


PROPERTY SUMMARY

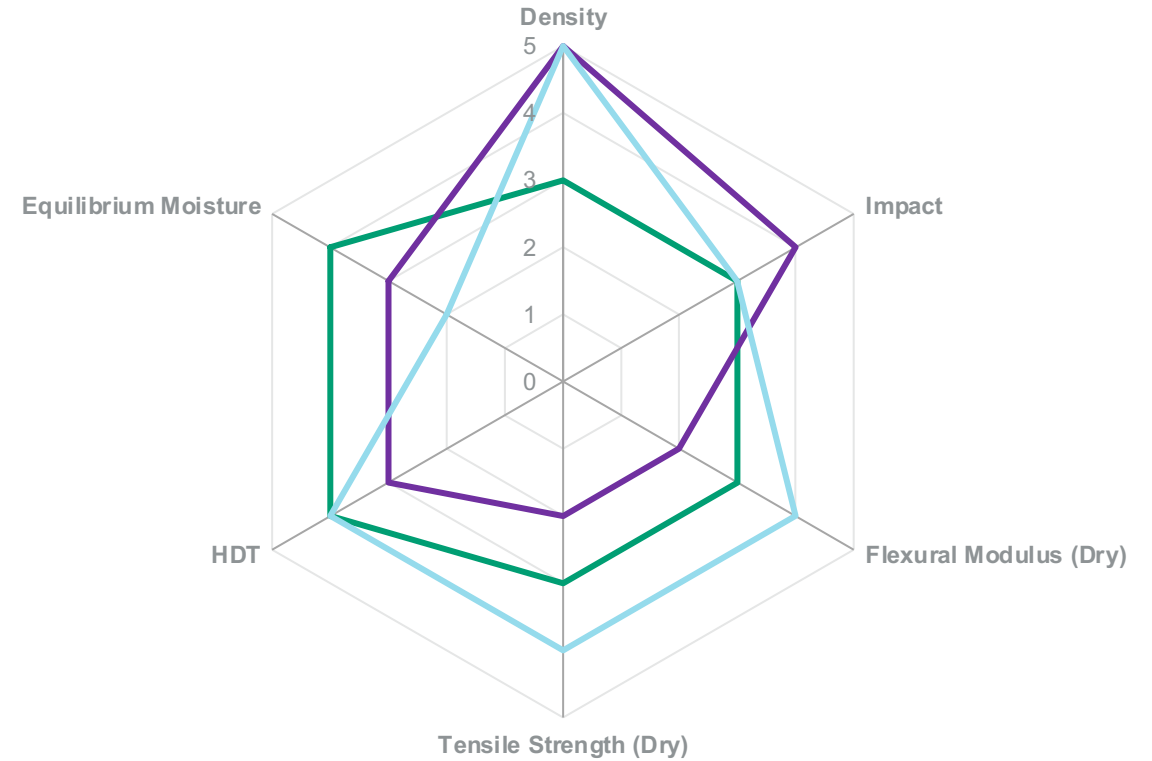
POLYKETONE VERSUS NYLON

1: Poor 3: Good 5: Excellent

PK-GF PA6-GF PA66-GF

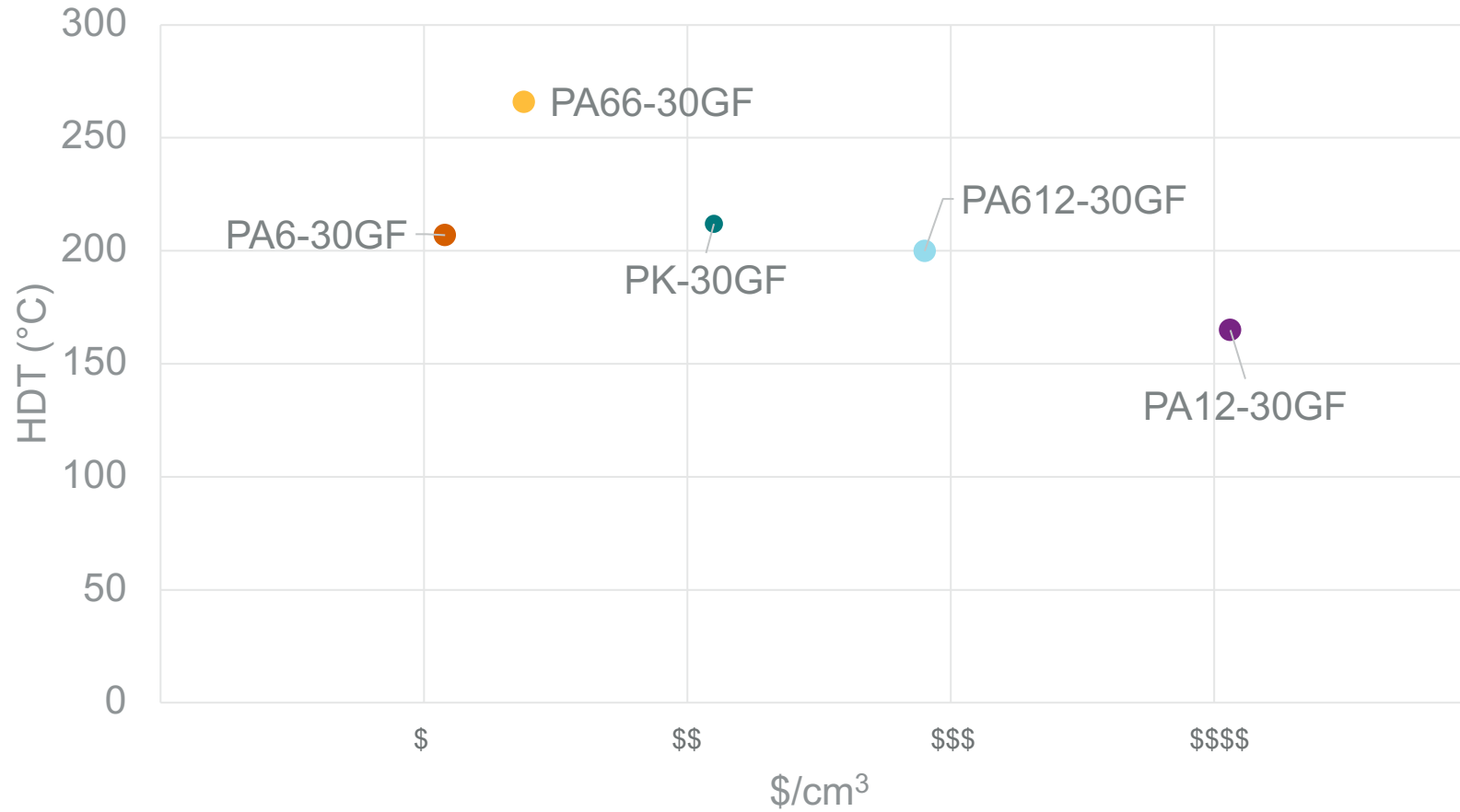


PK-GF PA12-GF PA612-GF



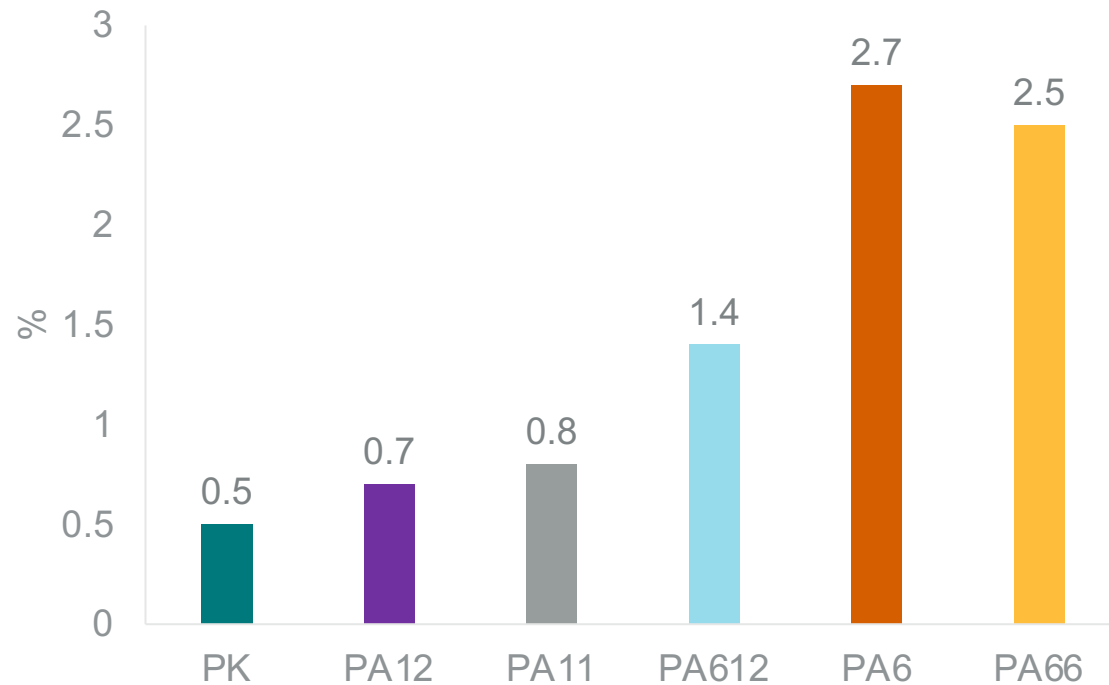
PRICE FOR PERFORMANCE

VOLUMETRIC PRICE COMPARISON TO NYLONS

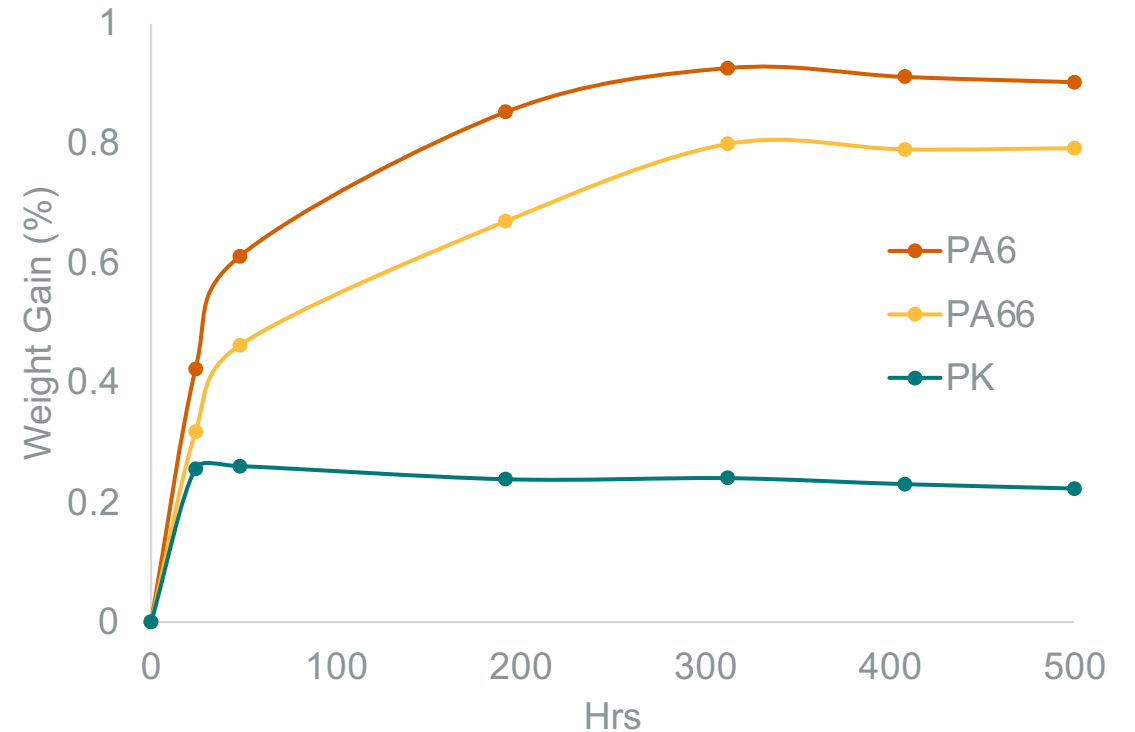


MOISTURE UPTAKE COMPARISON

Equilibrium Moisture @ 50% RH
Unfilled Resin



Environmental Chamber @ 62% RH 70°C
30% Glass Fiber



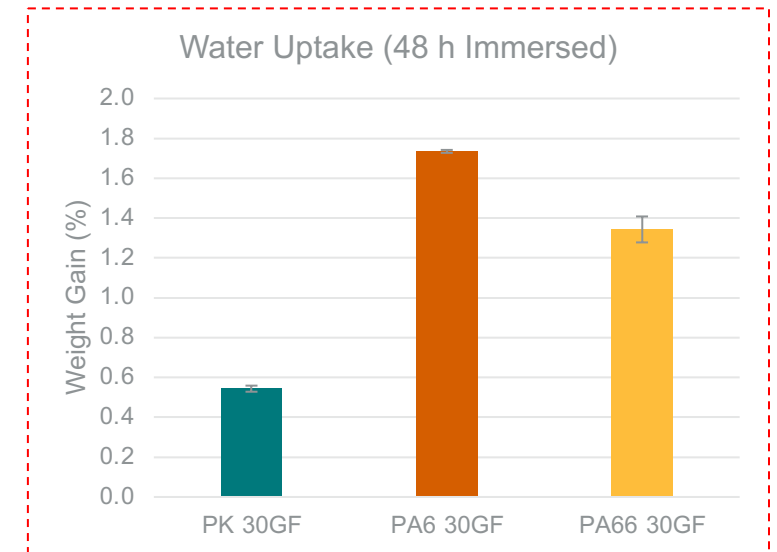
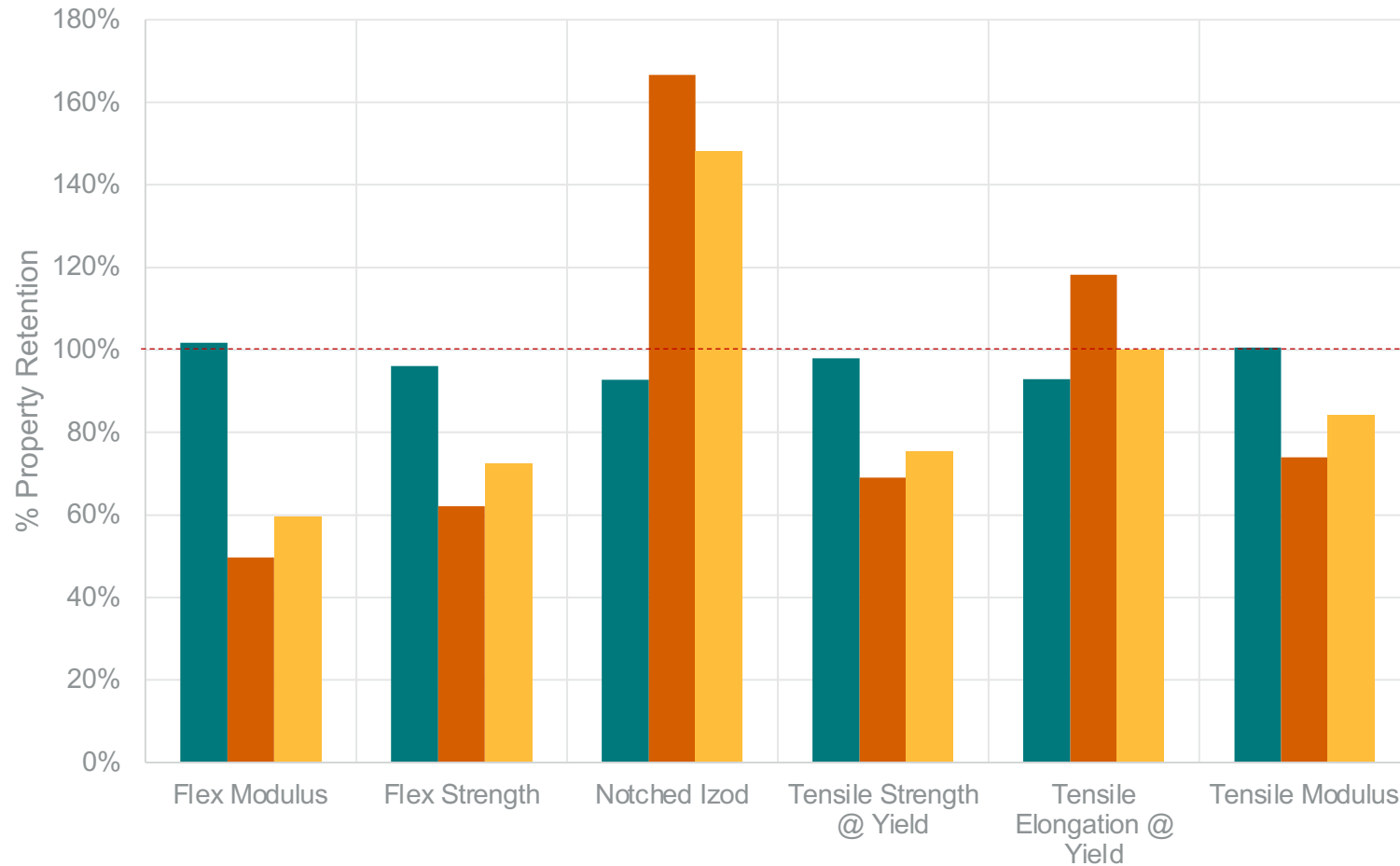
Palmer, Robert J. "Polyamides, plastics." Kirk-Othmer Encyclopedia of Chemical Technology (2000).

MOISTURE CONDITIONING COMPARISON

GLASS-FILLED PK PROPERTIES DO NOT CHANGE WHEN CONDITIONED

Dry As Molded compared to Equilibrium Moisture @ 50% RH

■ PK 30GF ■ PA6 30GF ■ PA66 30GF



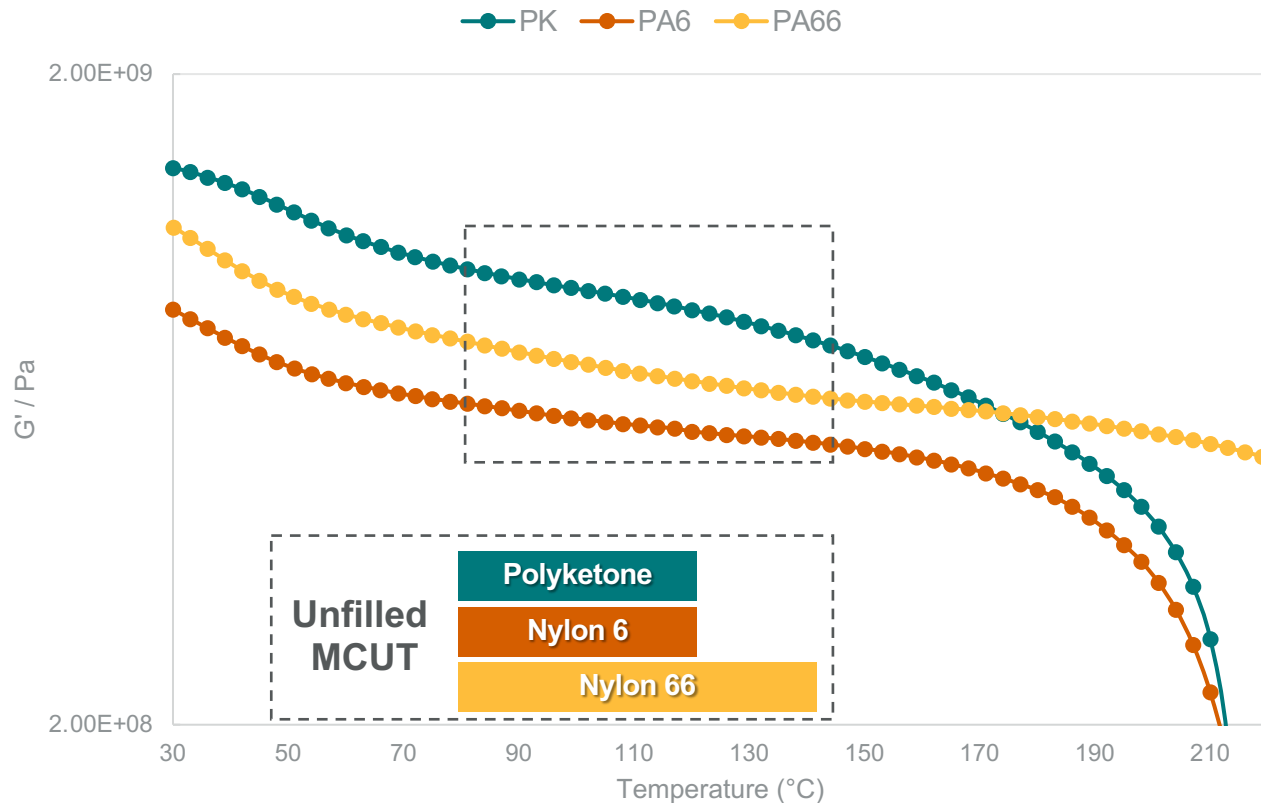
PK VERSUS SPECIALTY NYLONS

GLASS-FILLED PK PROPERTIES ARE SIMILAR TO SPECIALTY NYLONS



THERMAL COMPARISON

Storage Modulus vs Temperature (30% GF)



- Samples at Equilibrium Moisture
- Max. Continuous Use Temp (MCUT)
- Unfilled PK MCUT: ~110-115 °C similar to PA6
- Similar to PA6 with incorporation of GF

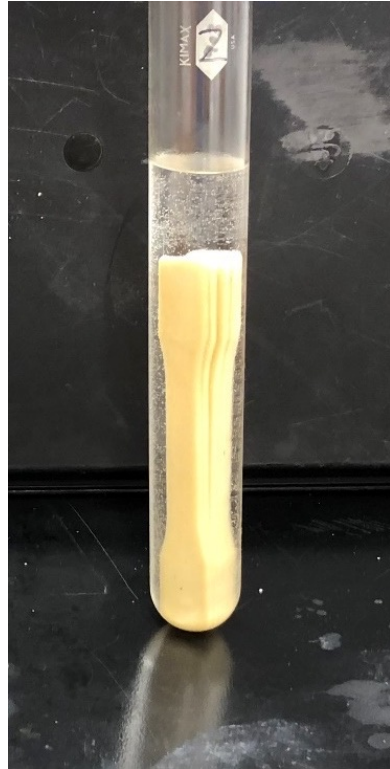
Temperature dependent torsion DMA. 90 s thermal soak-time at each temperature increment prior to performing the measurement

CONCENTRATED ACID

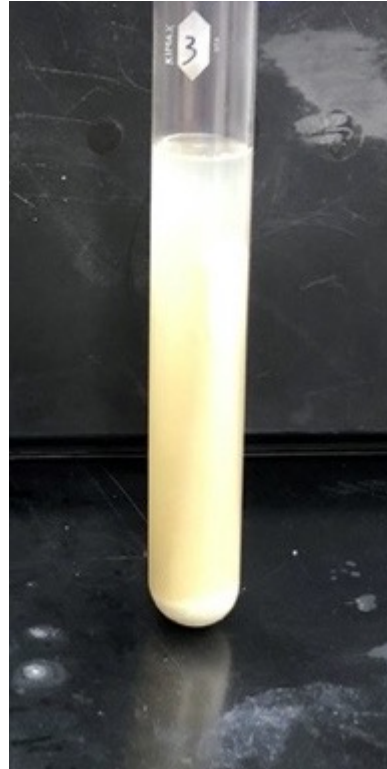
30% H₂SO₄, 24 HRS, 23 °C



PK 20GF



PK 40GF



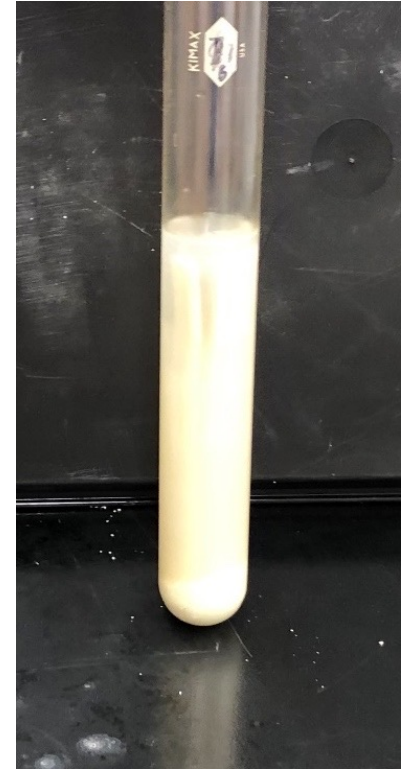
PA6 20GF



PA6 40GF



PA66 20GF



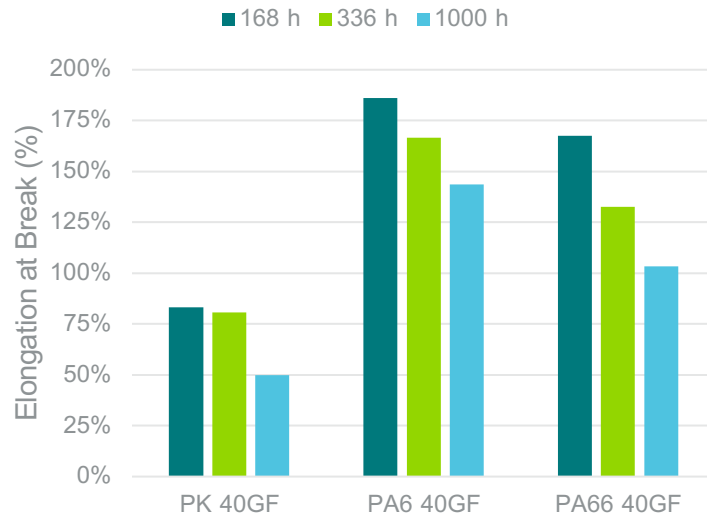
PA66 40GF

Nylon samples were almost completely dissolved after one day, while the PK bars are still visible.

LONG-TERM CHEMICAL RESISTANCE

40% GLASS-FILLED RESIN

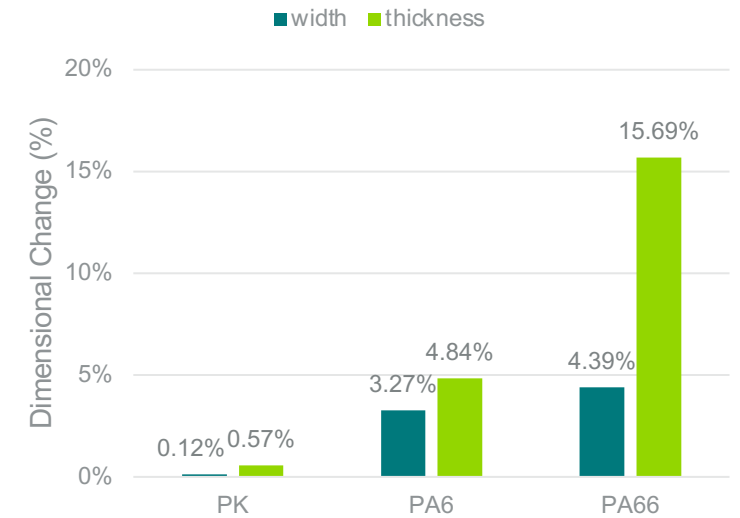
Water/EG (120 °C / 248 °F)



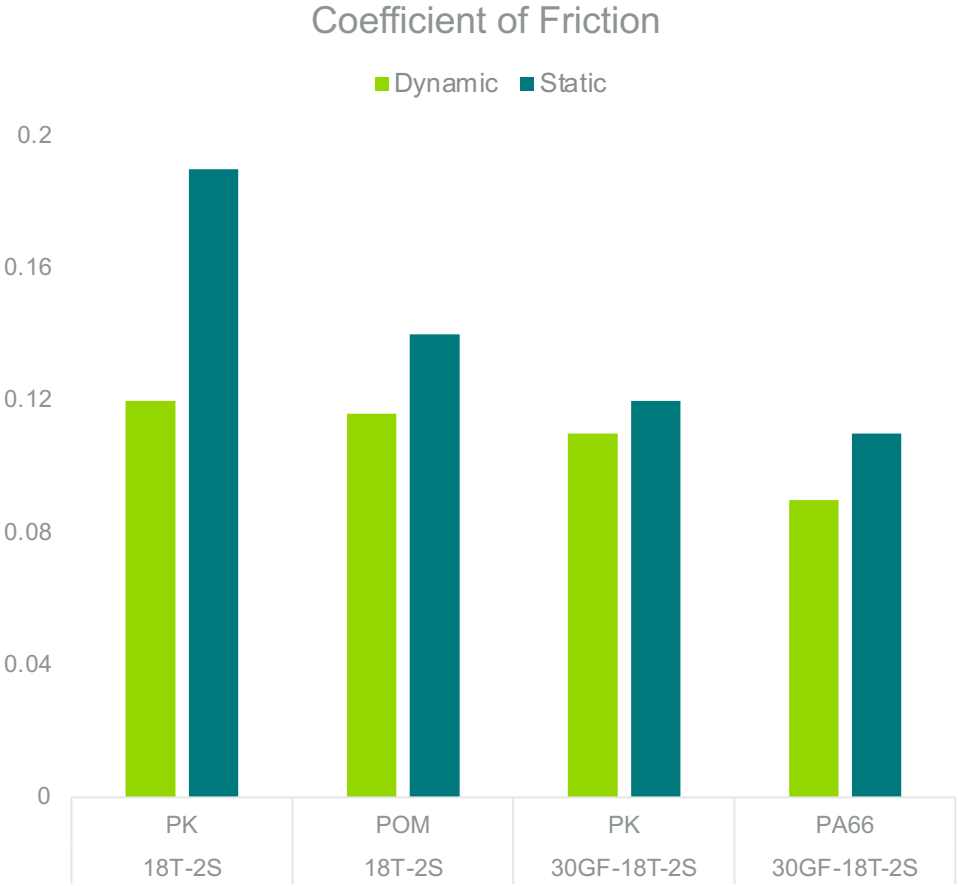
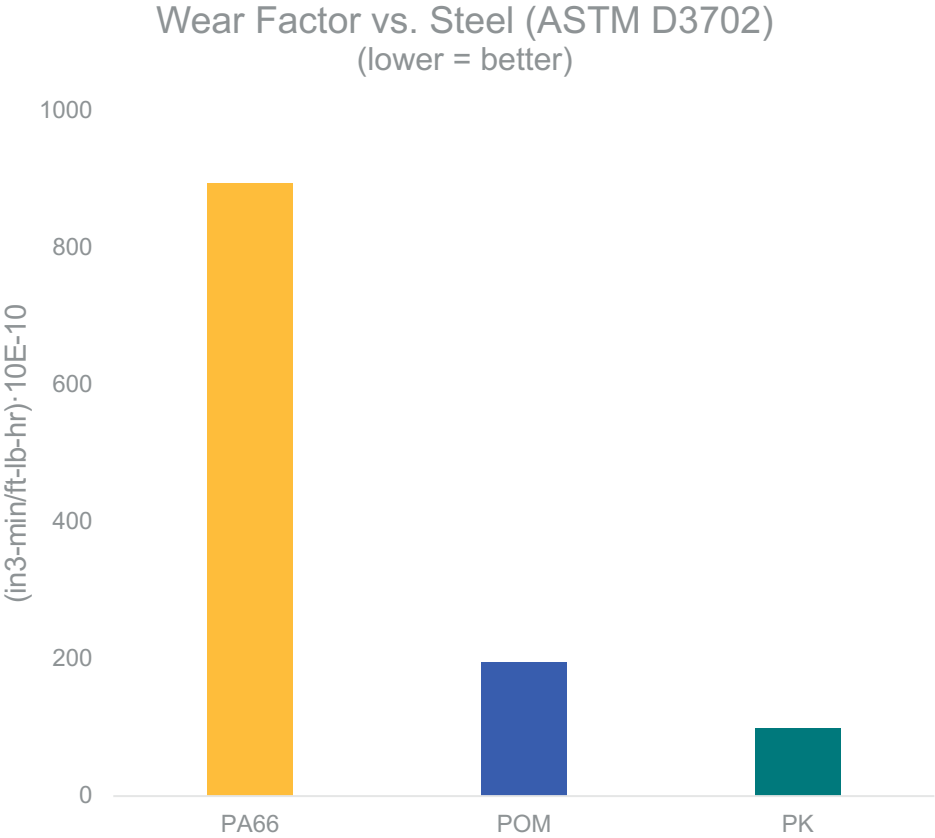
Water/EG (1000 h, 120 °C / 248 °F)



Water/EG (1000 h, 120 °C / 248 °F)



WEAR & FRICTION RESISTANCE

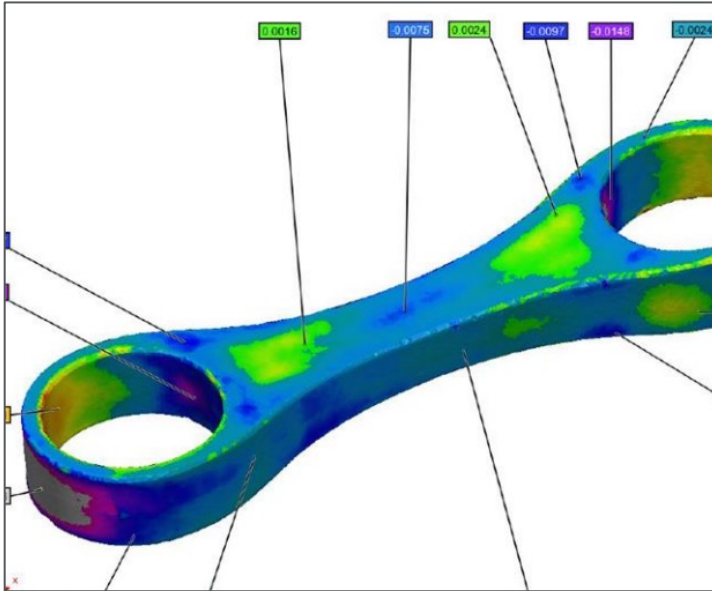


PK HIGH IMPACT (HI) VERSUS PA66 HI

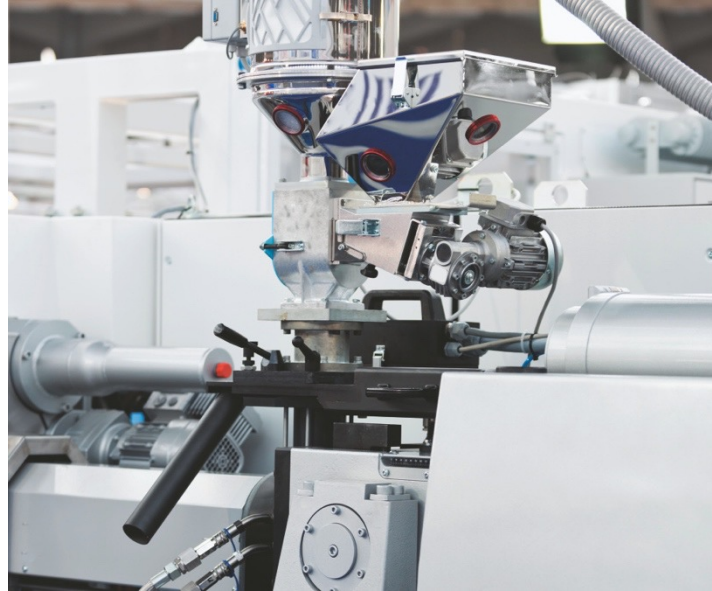
PK HI HAS IMPROVED ELONGATION PROPERTIES AND LOWER MOISTURE UPTAKE THAN PA66 HI



APPLICATION CHALLENGES



MOLD SHRINK



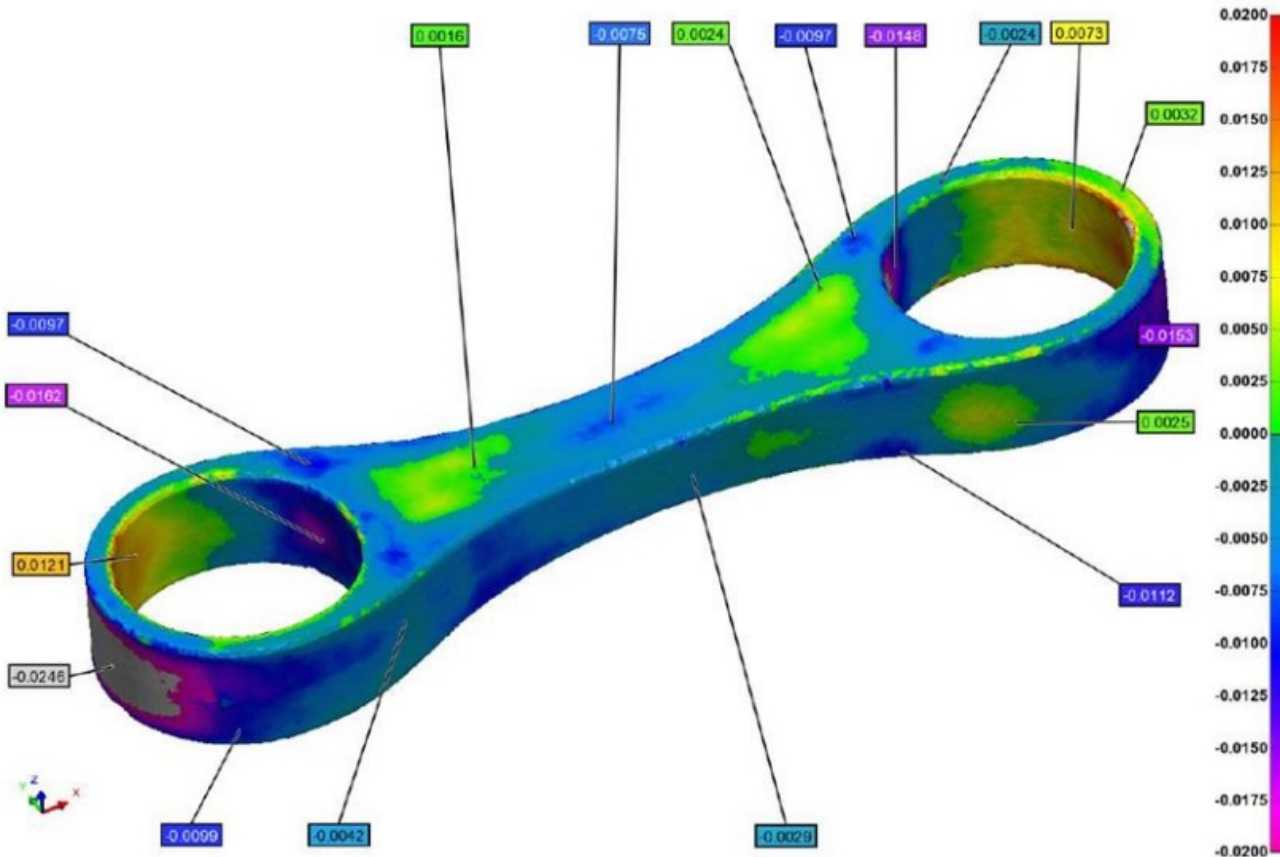
PROCESSABILITY



COLORABILITY

MOLD STUDY

DATA & DIMENSIONAL ANALYSIS



- PK shrinks and changes dimensions less than PA6 in the connector rod geometry
- Certain in-mold features, such as cores, help to control shrinkage and aid in keeping dimensions between the two resins similar
- Length and part surface height consistently remain slightly larger in PK molded parts
- Glass-filled PK pulls away from the mold surface at a lower magnitude than glass-filled PA6

A photograph of industrial machinery, likely a plastic extrusion or injection molding machine. It features a large hopper at the top, a complex extruder or injection head in the middle, and various pipes and mechanical components. The machine is primarily white and blue. The background is slightly blurred, showing more of the factory environment.

PROCESSING

Drying

- Absorbs moisture in an ambient environment with no impact to material properties
 - No splay, no drooling, no change in injection pressure

Processing

- Heat sensitivity, shear exposure, cavity characteristics
- Not as hydroscopic as a nylon

Post-Molding Behavior

- PK will have very little if any post-mold property shift compared to nylon solutions
- PK will not need to be conditioned post-molding

COLOR TECHNOLOGY



SPECIALTY POLYKETONES AT AVIENT

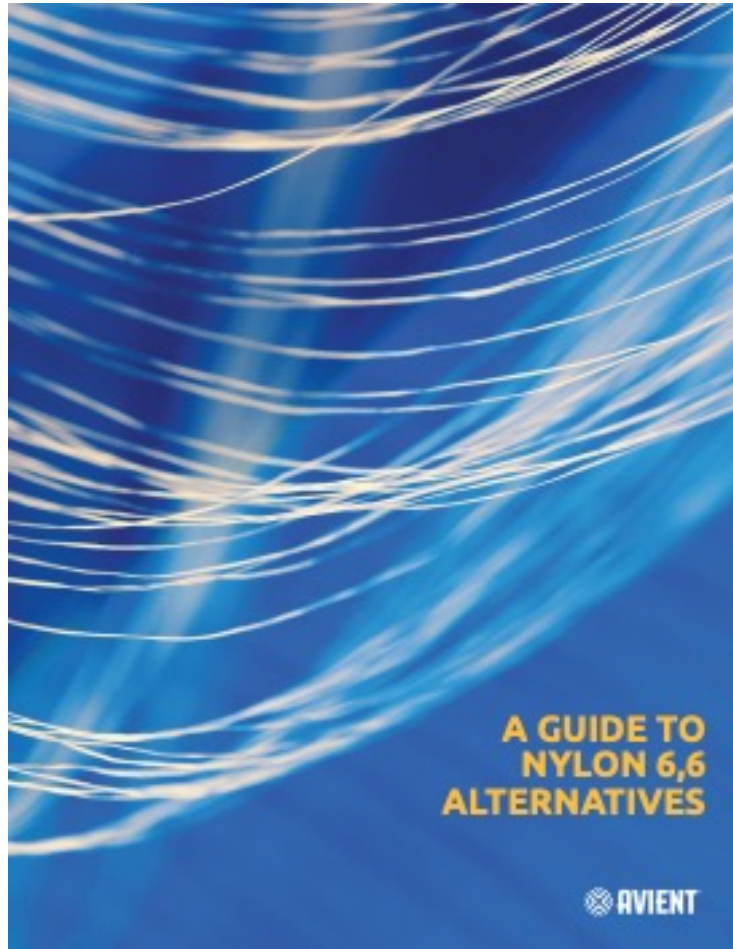
FUNCTIONAL PROPERTIES FOR BROAD INDUSTRY NEEDS



Automotive, Healthcare, Consumer & Sporting Goods, Industrial, Electrical & Electronics

ADDITIONAL AVIENT SOLUTIONS

HELPING TO SOLVE YOUR TOUGHEST MATERIAL CHALLENGES



8 WAYS WE HELP CUSTOMERS BE MORE SUSTAINABLE



Lightweighting



Bio-polymers



Reduced
Energy Use



Eco-conscious



VOC
Reduction



Sustainable
Infrastructure



Recycle
Solutions



Human Health
& Safety

SUMMARY

- Nylon supply is cyclical & sustainability commitments are a challenge to meet
- Polyketone-based formulations can help
 - Perform well against nylons and acetals
 - More stable supply than nylon
 - Lower CO₂ footprint
 - Excellent chemical resistance
 - Low moisture uptake
 - Good wear resistance

THANK YOU

John Swanson

John.Swanson@Avient.com

Jeremy Gray

Jeremy.Gray@Avient.com

www.avient.com