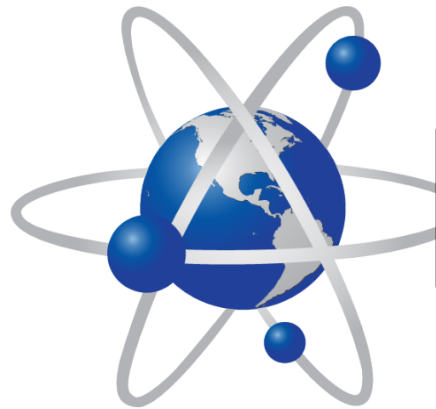


Plastics News

CRAIN



PolySource

Resin • Solutions • Delivered

**Polyketone- Cost Efficient Option in
this Tight Supply Environment**

Cliff Watkins & Jeremy Bland
PolySource LLC



Polyketone – Cost Efficient Options in this Tight Supply Environment

Plastics News

Presented By: Cliff Watkins & Jeremy Bland

Polyketone – *Cost Efficient Option in this Tight Supply Environment*



- 39-year plastics industry veteran
- Past owner of TP Composites- bought by Techmer PM in 2013
- PhD Chemistry
- 14 years with PPG Fiber Glass

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- 22-year plastics industry veteran
- Pittsburg State University-Plastics
- Process Engineering Expertise
- Six Sigma Black Belt

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Protecting Your Business & Your Customer's Business



Insufficient Cargo Ship Capacity

COVID Shutdowns

Force Majeure

Booming Asia Demand

Extended Lead Times

Lengthy US Port Delays

Short Staffed

Allocation

Weather

Price Increases



What's your issue today??

Protecting Your Business & Your Customer's Business



Global Logistics Chaos

It's Like Déjà vu All Over Again!



Back in 2018, we reviewed these memorable events

- Chronic shortages of ULTEM, the past 10 years
- Evonik plant explosion, PA12 global mess
- SABIC SAP conversion, “the mother of all messes”
- Nine (9) Force Majeures in 8 months in Nylon 66, global shortage

“He who forgets history, is doomed to repeat it.”
- George Santayana



In-house capabilities and the support of Our Partnered Suppliers!

In Just 3 Years, We're Scrambling Again



To 2021.....

- Force Majeure declarations from Ascend, Celanese, Covestro, Dupont...
- The “world” is sold out on everything



Except aliphatic Polyketone or POK

The 2021 Supply Outlook



US Domestic Resin Production

- Polyolefins
- Polycarbonate
- Polyamides
- Polyacetal
- Styrenics
- *Weather Issues*
- *COVID Shutdowns*
- *Short Staffed*
- *Demand Exceeding Supply*



**Lead times remaining very long through the Summer (>12 weeks)
Sales Control, Allocation, and Suppliers Not Accepting New Customers**

The 2021 Supply Outlook



Asia Imports

- Polyolefins
 - Polycarbonate
 - Polyamides
 - Polyacetal
 - Styrenics
 - Polyesters
- *Booming Demand in Asia*
 - *Insufficient Cargo Ship Capacity*
 - *Shipping Container Shortages*
 - *> 16 Week LT*
 - *Lengthy US Port Delays*



The 2021 Supply Outlook



- The global pandemic has completely [insert expletive] the plastics industry
- The power grid failure in TX was like kicking someone [insert unpleasant visual]



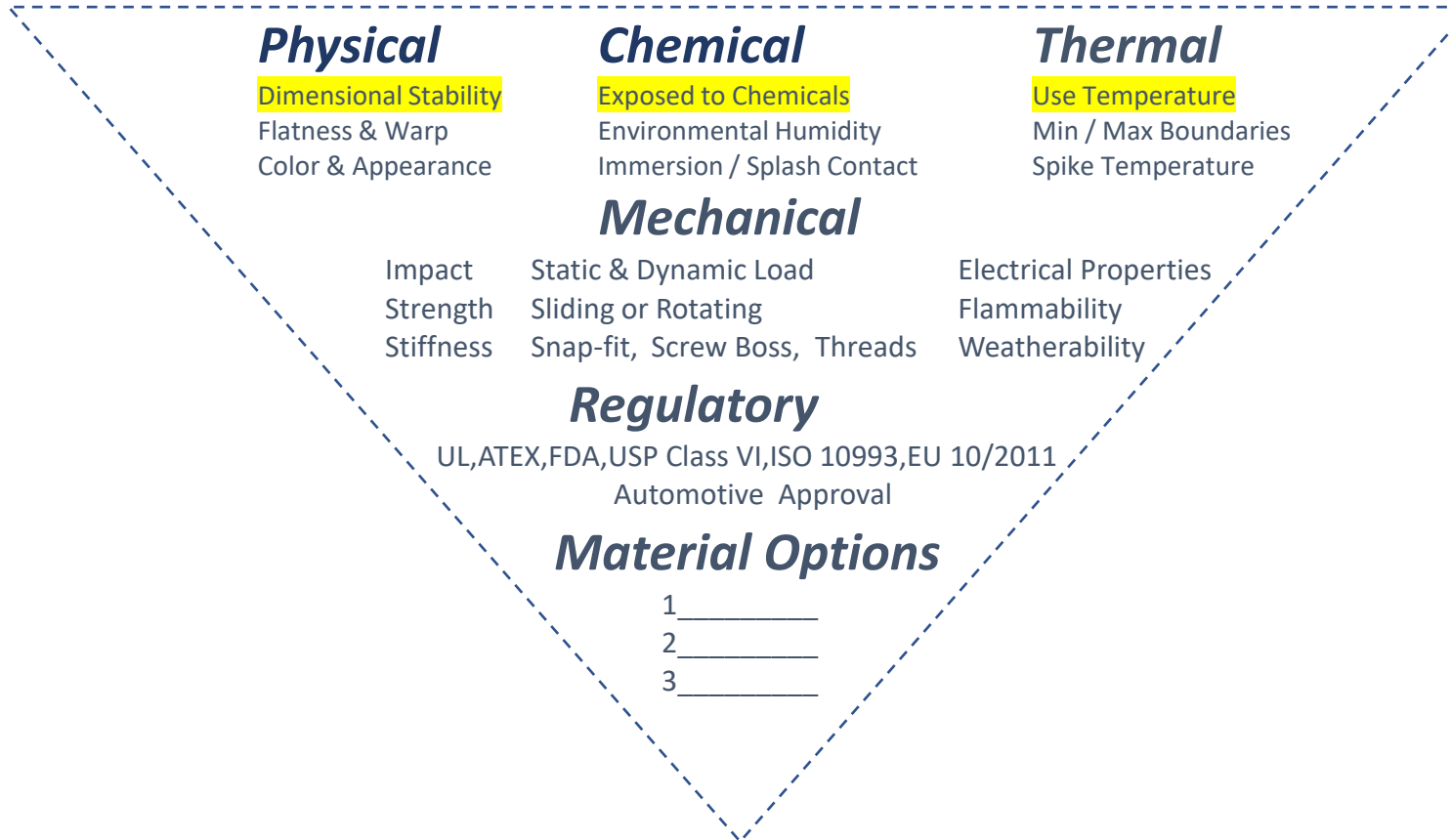
What are your Resin Options?

1. What resin or compound are you using now?
2. Use the Design Funnel to uncover the key requirements or “Critical to Quality” [CTQ’s]
3. Will your customer invest time and money to approve a material change?



Polyketone is readily available is a STRONG option for MANY applications

The PolySource Design Funnel



A lot of upfront questions to generate answers... That lead to the best material options

Processing POK in Existing Equipment



POK is a Semi-Crystalline Resin

- Unfilled – high mold shrinkage like POM
- Reinforced POK – Shrinks like Zytel 70G or Valox 420
- Comparable thermal resistance to PA612

POK has

- Excellent chemical resistance
- Excellent low coefficient of friction
- Very good mechanical properties
- FDA, NSF, and USP Class VI
- Supply is plentiful



POK has already replaced these 'classic' resins in many applications

How to think about POK as a supply option?

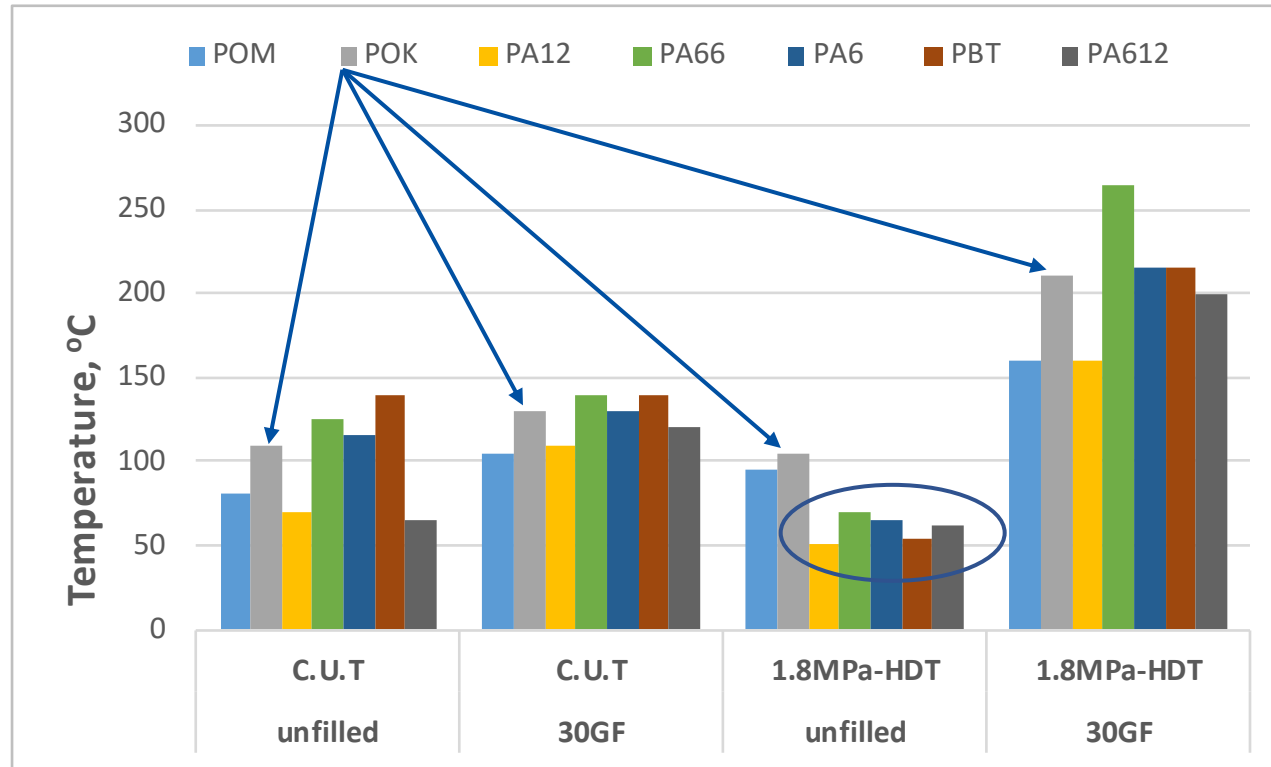


- ***Screws n' Barrel***, GP screws work great, typical metal alloys
- ***Cold Runner & Hot Manifolds***, 20% regrind, hot drops, valve gating
- ***Barrel & Melt Temps***, Broad range, good residence time window
- ***Drying***, 2-3 hours, not hygroscopic
- ***Mold and Shrinkage***, fast cycling, releases well, predictable shrinkage



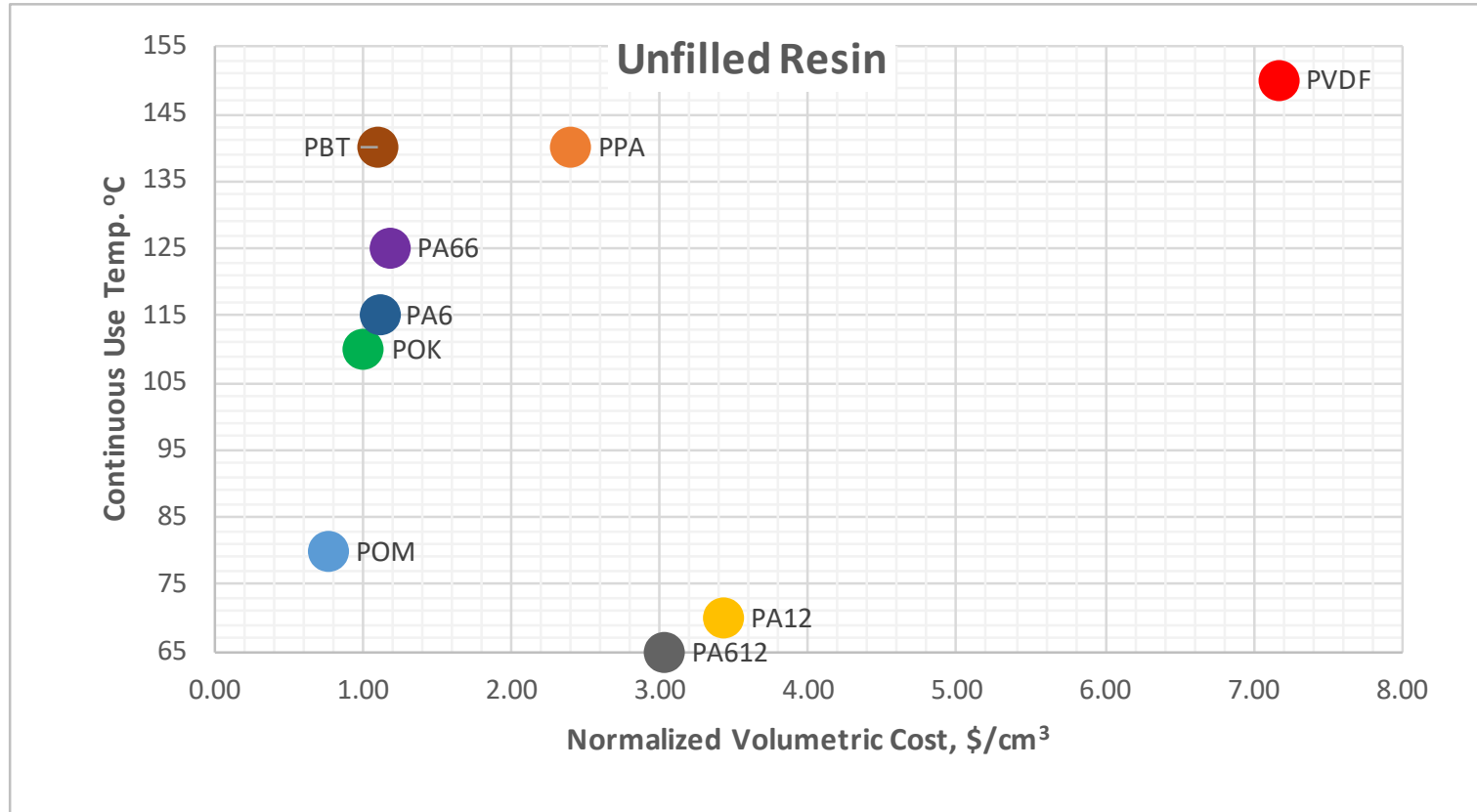
You don't need to change your molds!

The Short Path, For Today's Discussion



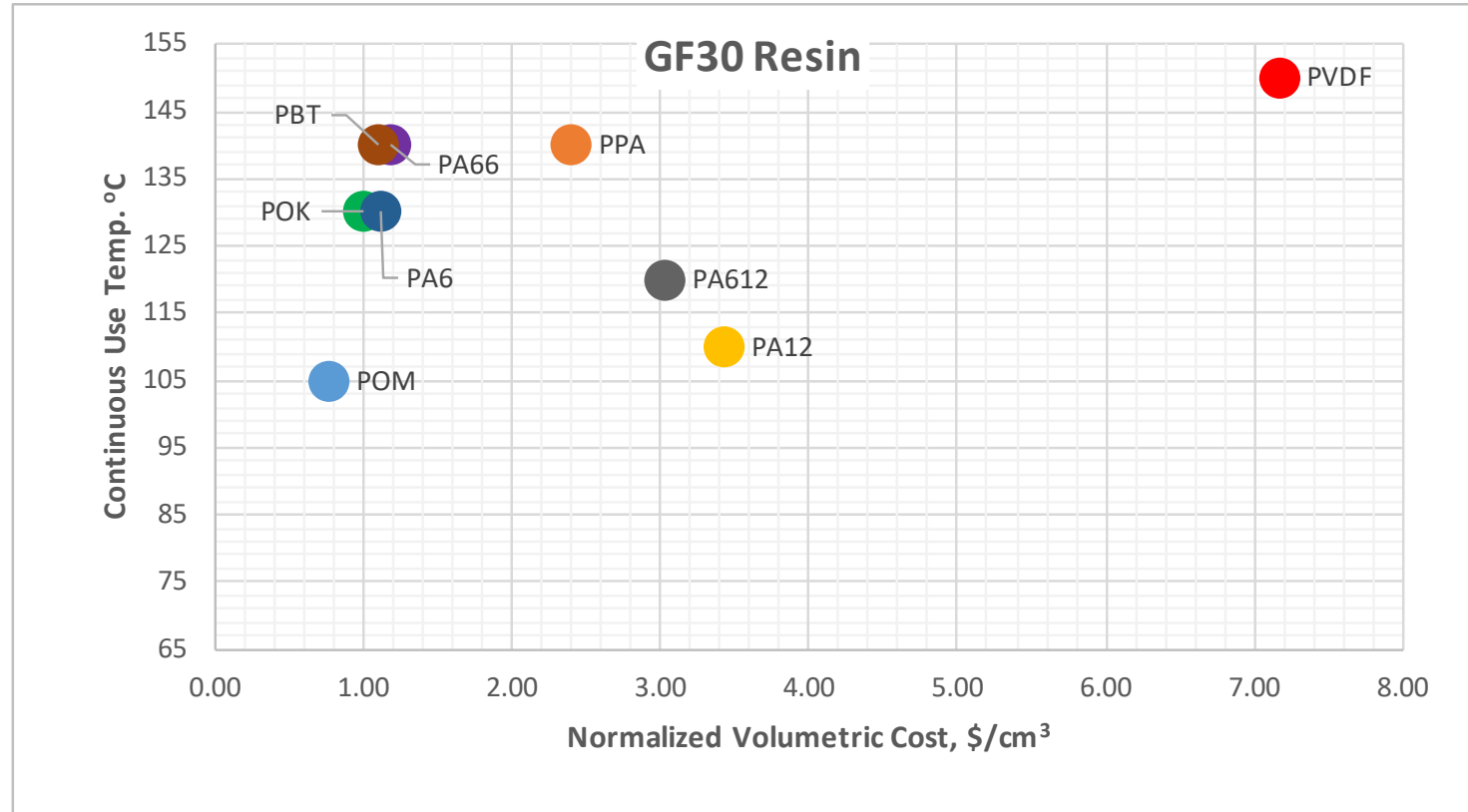
It's all about thermals, mechanicals, and mold shrinkage

“Bang for the Buck”



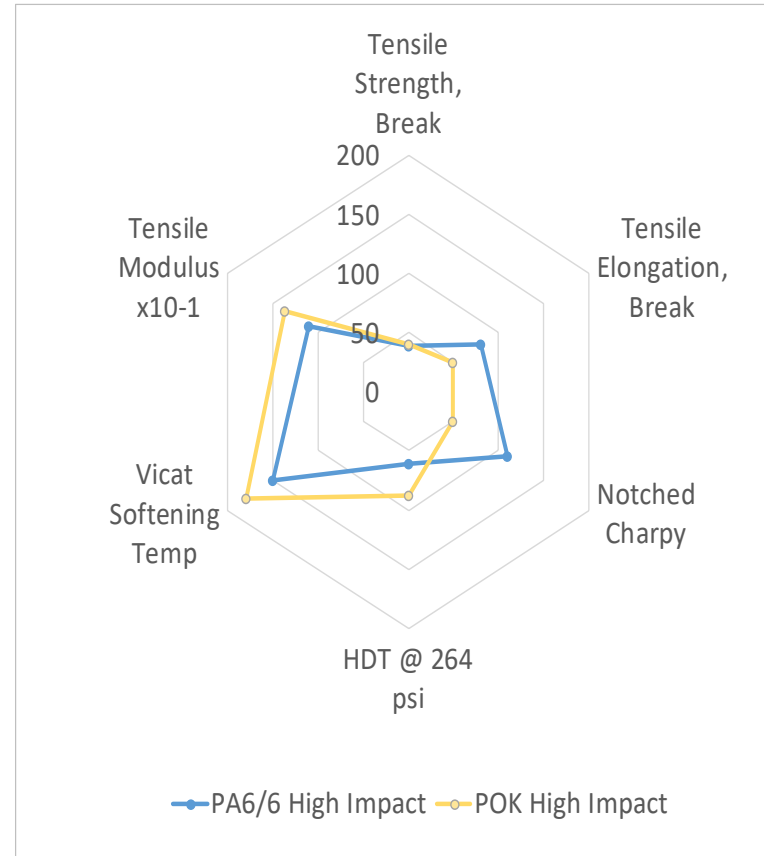
Continuous use temperature is very different than HDT

“Bang for the Buck”



Continuous use temperature is very different than HDT

Some High Impact Options too!



We have developed some brand-new high impact POK grades to help even 'super tough' supply issues

The *INTEGRA*[™] POK Toolbox



<i><u>Impact Strength & Stiffness</u></i>	<i><u>Lubricated</u></i>	<i><u>Specialties</u></i>
Glass Fiber	PTFE	X-Ray &/or Metal Detection
Carbon Fiber	Silicone	Medical
Minerals & Glass Beads	p-Aramid	Thermal &/or Electrical Conductivity
High Impact	MoS ₂ (moly)	Anti-Counterfeiting
FR	Graphite	Laser Marking



INTEGRA[™] POK resins and compounds for molding and extrusion

Successful POK Replacements vs “Classic Resins”



- **PA6**, Seed Firmer, Ag Market
- **PA6 IM**, Conveyor Buckets, Material Handling Market
- **POM IM**, Conveyor Sorting Shoe, Material Handling Market
- **PA66**, Wear Bushing, RV Market
- **PA612 IM**, Spiral Chain link, Material Handling Market
- **POM**, Seed Singulator, Ag Market



All 6 examples were SUCCESSFUL in EXISTING TOOLING with POK grades we STOCK!!

Package Handling Sorter



Issue:

Lead time on the DELRIN 100P extended to “we don’t know when we can ship your order.”

CTQs:

- Similar mold shrink to 100P
- Low friction
- Resistant to greases and lube oils

Time to Approve:

- 1 week for mold trial
- 1 week to measure fit and dimensions
- 4 weeks beta site field test



INTEGRA™ POK 9070

1st order shipped in 6 weeks, 10% savings to the customer, savings in their end market, PRICELESS

Commercial Planter, Seed Firmer

Issue:

High viscosity PA6 absorbs moisture causing loss in part modulus, failures, and customer complaints

CTQs:

- Similar mold shrink to Ultramid B4
- High ultimate strain (excellent toughness)
- Abrasive resistant to sandy soil
- 2-year UV resistance (in black)

Time to Approve:

- 1 week for mold trial
- 1 week to measure fit and dimensions
- 2-month beta site field tests



INTEGRA™ POK 9070, black with UV, Customer complaints reduced to near ZERO!

Bucket Conveyor

Issue:

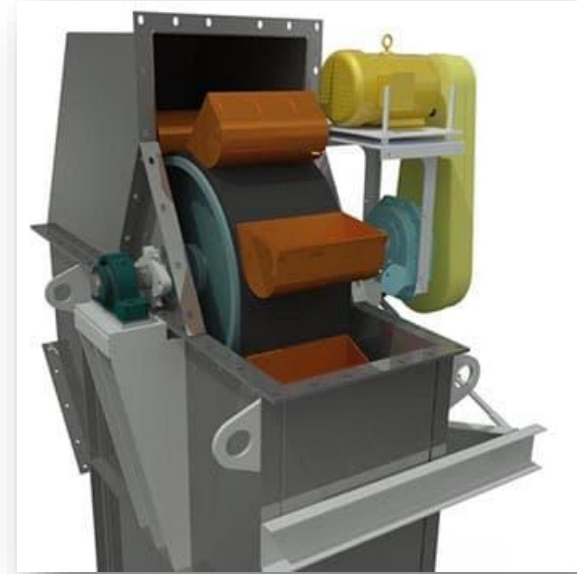
High impact PA6, very high priced and lengthy lead time

CTQs:

- Similar mold shrink to current material
- Excellent drop impact toughness
- Abrasion resistant and low COF
- Food contact compliant

Time to Approve:

- 1 week for mold trial
- 1 week to measure fit and dimensions



**INTEGRA™ POK 9060 FC1,
BIG cost savings to the customer, ENHANCED abrasion resistance &
GAINED 2 NEW end markets with food contact!**

Spiral Conveyor

Issue:

High impact PA612, very high priced and lengthy lead time

CTQs:

- Similar mold shrink to current material
- High ultimate strain (excellent toughness)
- Abrasion resistant and low COF dry sliding
- Adhesion with over-molded TPR 2nd Shot

Time to Approve:

- 1 week for mold trial
- 1 week to measure fit and dimensions
- 1 week for 2 shot over-mold trial and peel strength
- 1 month beta field test



Polyketone is readily available, is a strong option for many applications

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What's Your Issue(s) ???

Polyketone (POK) Resource Available



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BEST PLACES TO WORK
2017

Plastics News
BEST PLACES TO WORK
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2017

Plastics News
BEST PLACES TO WORK
2019

DATA SHEETS

www.PolySource.net

Today's Presentation has been added to our Webpage



POKETONE (Polyketone) What is it?

Unique engineering plastic, the polymer of which backbone consists of only Carbons.

Highly crystalline with compact crystal structure.

Excellent impact resistance, abrasion resistance, chemical resistance, fuel resistance, and gas barrier properties.

- Manufactured in Seoul, South Korea by Hyosung** – Currently 110 Million lbs. per year of capacity with capacity authorization to double the output per year by 2020.
- Competing Resins:** All Nylons, PBT, POM (Acetal)
- Performance:**
 - High Impact Strength – Impact/Fatigue (2X of POM)
 - Excellent Chemical Resistance – Automotive Fluids, Hydrocarbon Solvents, Salts
 - Excellent Wear Resistance – Wear and Friction better than POM
 - Exceptional Barrier Properties – Gasoline, Diesel (2X of PA12)
 - Good Flame Retardancy – Only half of flame retardant is necessary to meet UL V-0 Rating
 - Stable Dimensions – After 24 hours and in Moisture Environments

	PP	POM	POK	PA6	PA66	PBT
Glass Transition Temp, T _g , °C	-35	-30	15	47	50	66
Crystalline Melting Pt, T _m , °C	168	177	210	223	275	223
HDT, 66 psi (0.45 MPa), °C	104	156	205	160	200	154
HDT, 264 psi (1.8 MPa), °C	82	101	105	54	70	54
Specific Gravity	0.9	1.41	1.24	1.14	1.14	1.31
Moisture Absorption, 24hr/23 °C	0.05	0.2	0.3	1.2	1.2	0.25
Dimensional Change, 24hr/23 °C H ₂ O	0.0	0.0	0.2	3.0	2.7	0.0
Mold Shrinkage, in/in	0.012	0.020	0.020	0.016	0.018	0.018

- Markets:**
 - Automotive – Radiator End Tanks, Junction Box, Clip Holders, Cable Box, Fuel Tank Fuel Doors, Fuel Line, Connector, Wheel Cover
 - Electrical/Electronics – Electrical Switch, Gears, Connectors, CDU Stacker, Refrigerator Door Closer
 - Appliance – Water Meter, Water Filtration System, Pump Housings, and Water Filters
 - Industrial – Rail Fastening System, Conveyor Belts, Cosmetic Containers, Industrial Wheels, Helmet components, Cable Ties, Oil Seal, Pipe and Tubing
 - Medical – Equipment Housings
- Injection Molders Benefits: Easy Mold Ability**
 - Short Cycle Times – Low Clamp-force Requirements
 - Easy Drying – (Not Sensitive to Humidity) – Superior Flow Ability

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POLYKETONE (ALIPHATIC)

Polyketone is a semi-crystalline polymer that combines: the higher heat performance of polyamide 6 and 6/6, the fuel resistance of nylon 11 and 12, the low moisture absorption of PBT, and the exceptional wear & friction performance of POM. When it comes to injection molding, polyketone holds a significant benefit over traditional materials such as nylons, acetal and polyester for cycle time, ease of drying, no off gassing and no need to rely on moisture for toughness. Polyketone exhibits similar mold shrinkage to these resins allowing for existing molds to be used.

FEATURES

Wear Resistant, Good Dimensional Stability, High Strength, Low Viscosity, Food Contact Acceptable, Chemical Resistant, High Viscosity, Drinking Water Contact Acceptable, Pleasing Surface Appearance, Flame Retardant

USES

Automotive Applications, Engineering Parts, Industrial Applications, Electrical/Electronic Applications, Gears, Bearings, Connectors, Food Packaging, Cosmetic Packaging, Packaging

TRADE NAMES

- ColorFast PK (Americhem)
- InStruc (Americhem)

- HiFill PK (Techmer Polymer Modifiers)
- INTEGRA PK (PolySource, LLC)

- Hyosung Polyketone (Hyosung Corporation)

QUICK GUIDE

POLYKETONE (POK) – Quick Guide

www.PolySource.net

Thank You for Joining the Discussion Today!!



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