



**THERMOPLASTIC ELASTOMERS • STRUCTURAL • WEAR
CONDUCTIVE • COLOR • FLAME RETARDANT**

High Performance Plastics for Pumps and Fluid Handling Applications

***Joel Bell, Ph.D.,
International Technology Manager***



RTP Company Corporate Headquarters • 580 East Front Street • Winona, Minnesota 55987 USA
website: www.rtpcompany.com • email: rtp@rtpcompany.com • Wiman Corporation • +1 320-259-2554

TELEPHONE:

U.S.A.	SOUTH AMERICA	MEXICO	EUROPE	SINGAPORE	CHINA
+1 507-454-6900	+55 11 4193-8772	+52 81 8134-0403	+33 380-253-000	+65 6863-6580	+86 512-6283-8383



- Overview of RTP Company
- Pump Types/Applications
- High Performance Pump Compounds
- Key Technologies
 - Very Long Fiber Reinforcement
 - Wear & Friction Resistance
 - Static & ESD Control
 - Flame Retardant
- Case Studies
- Additional Information
- Questions





RTP Company Profile

YOUR GLOBAL COMPOUNDER OF CUSTOM ENGINEERED THERMOPLASTICS

- RTP Company is an independent, privately owned custom compounder
- Global manufacturing and engineering support
- Worldwide sales representation/distribution
- Established in 1982
- 1000+ employees
- \$400+ million annual sales



- **High-Tech Specialty Compounder**
 - 60+ engineering resins
 - 100+ modifiers
- **Annual Production**
 - 6000+ commercial products
 - 1750+ new products each year



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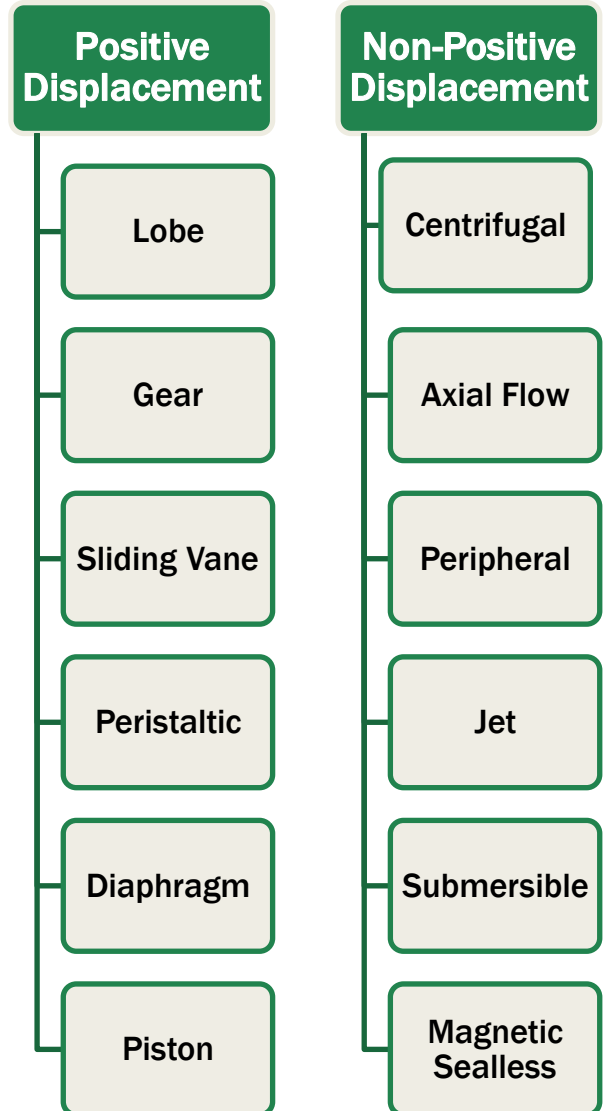
- Are you currently utilizing plastics in your pump products or plan to in the next 12 months?
 - Yes
 - No



Pumps Types

- **Products pumped**

- Water
- Chemicals
- Fertilizers
- Fuels
- Petroleum products
- Paints and Inks
- Medicine



- **Engineered plastic compounds**

- Pump Housings
- Propellers
- Impellers
- Diffusers
- Rotors and Vanes
- Housing Liners
- Gears and Lobes
- Seals
- Containment Shells
- Bushings
- Valves



- **What is your main motivation for using or considering plastics?**
 - Cost benefits vs metal
 - Manufacturability
 - Chemical/corrosion resistance
 - Lightweight



Advantages

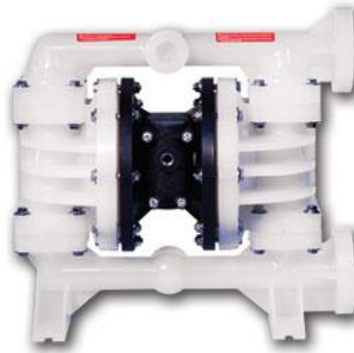
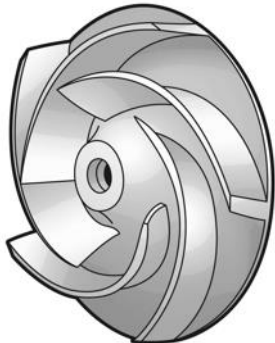
- Chemical Resistance
- Light Weight
- Manufacturability
- Cost

Limitations

- Flammability
- Wear
- Strength/Impact
- Conductivity
- Continuous Use Temp.

Considerations

- Products Pumped
- Operating Temp.
- Conditions of Use
- Regulatory Constraints
- Economics



- What is your biggest challenge to implementing plastics in your pump designs?
 - Flammability
 - Strength/Impact
 - Wear resistance
 - Conductivity
 - Temperature requirements
 - Chemical resistance



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Resin

- PP
- Nylons
- PBT
- PPS
- Fluoropolymers
- PEEK
- Urethane
- Acetal
- PPA

Reinforcement

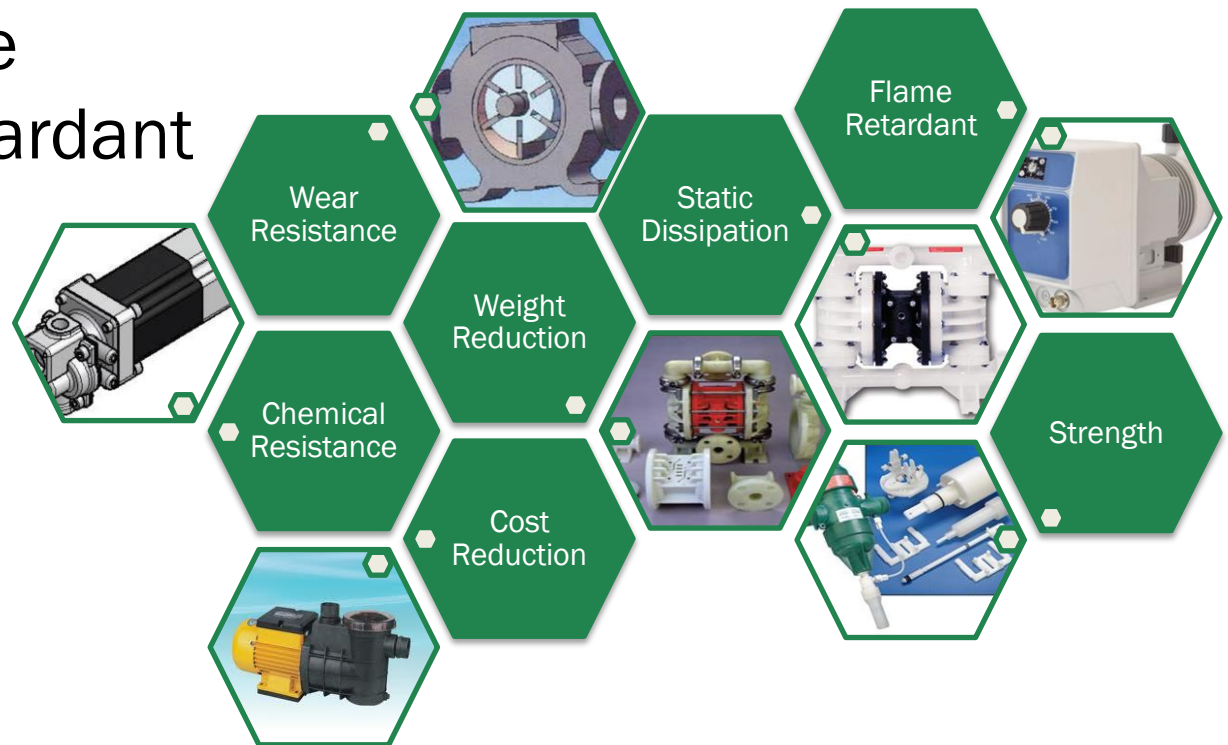
- Short Glass
- Long Glass
- Carbon Fiber

Additive

- Graphite
- PTFE
- Silicone
- PFPE
- Aramid Fiber
- Ceramic
- Flame Retardant
- Carbon Black

- **Key Technologies**

- Structural
- Wear
- Conductive
- Flame Retardant
- Elastomer
- Color



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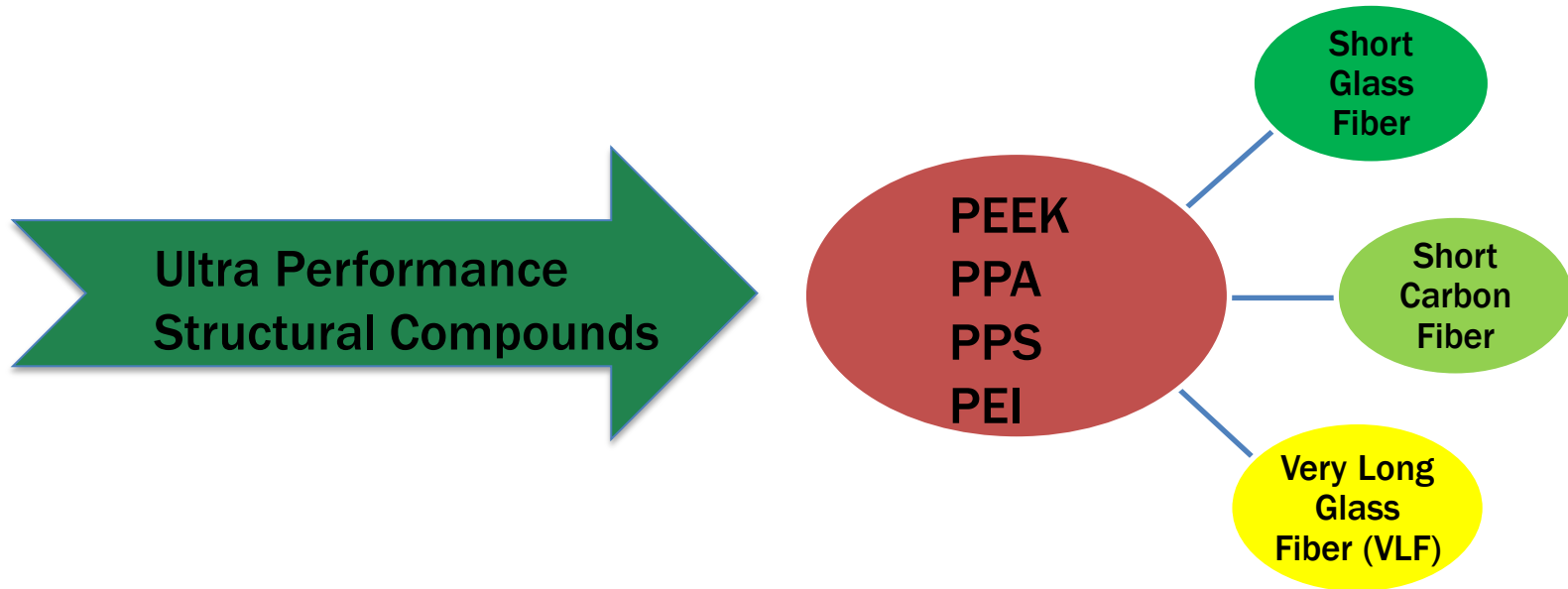


- **Filled**
 - Talc
 - Minerals
 - Ceramics
 - Nanoclay
- **Fiber Reinforced**
 - Glass fiber
 - Carbon fiber
 - Natural fibers
- **Density Modified**
 - Lightweight
 - High gravity
- **Impact Modification**

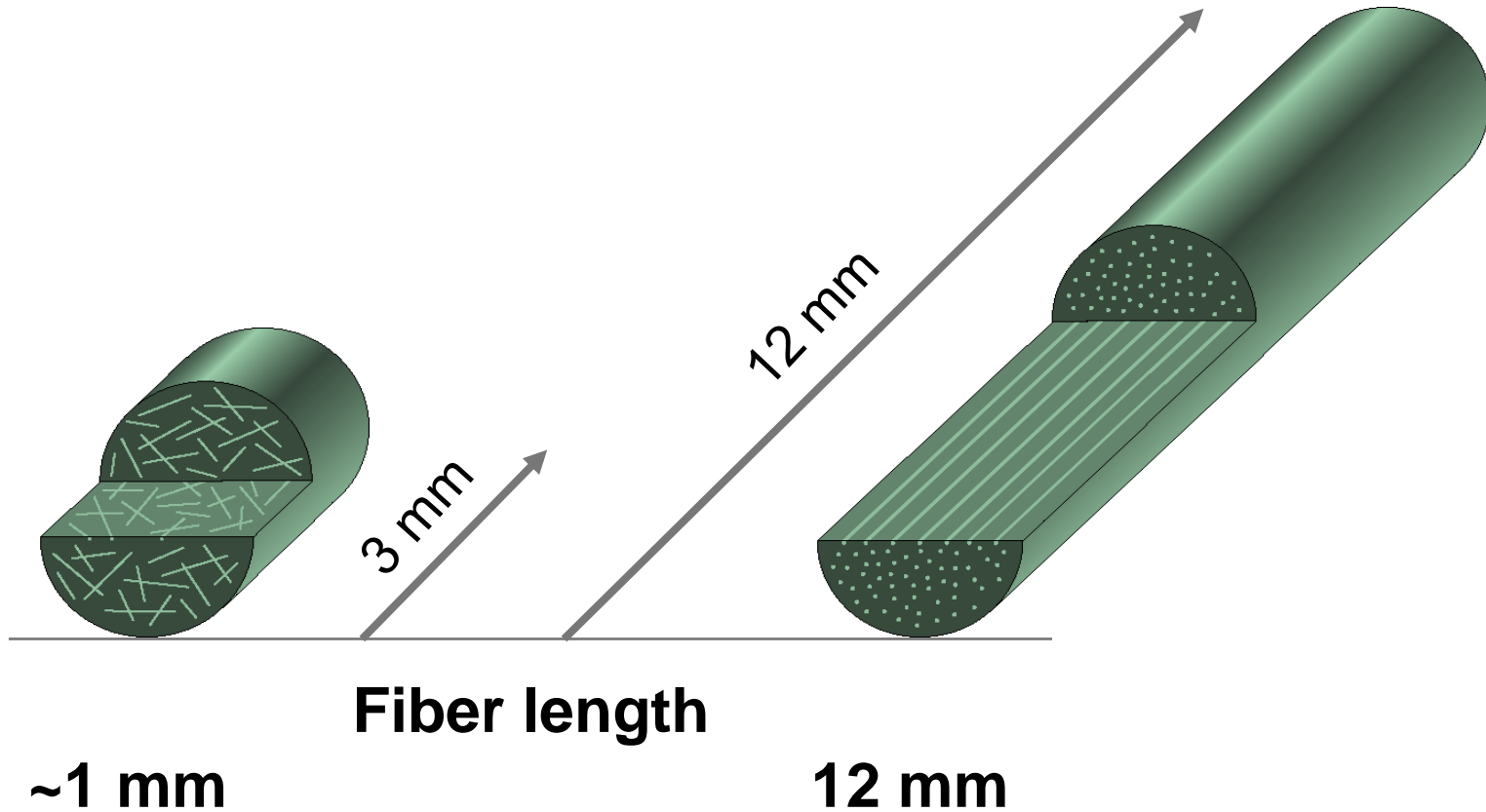


Ultra Performance Structural Products?

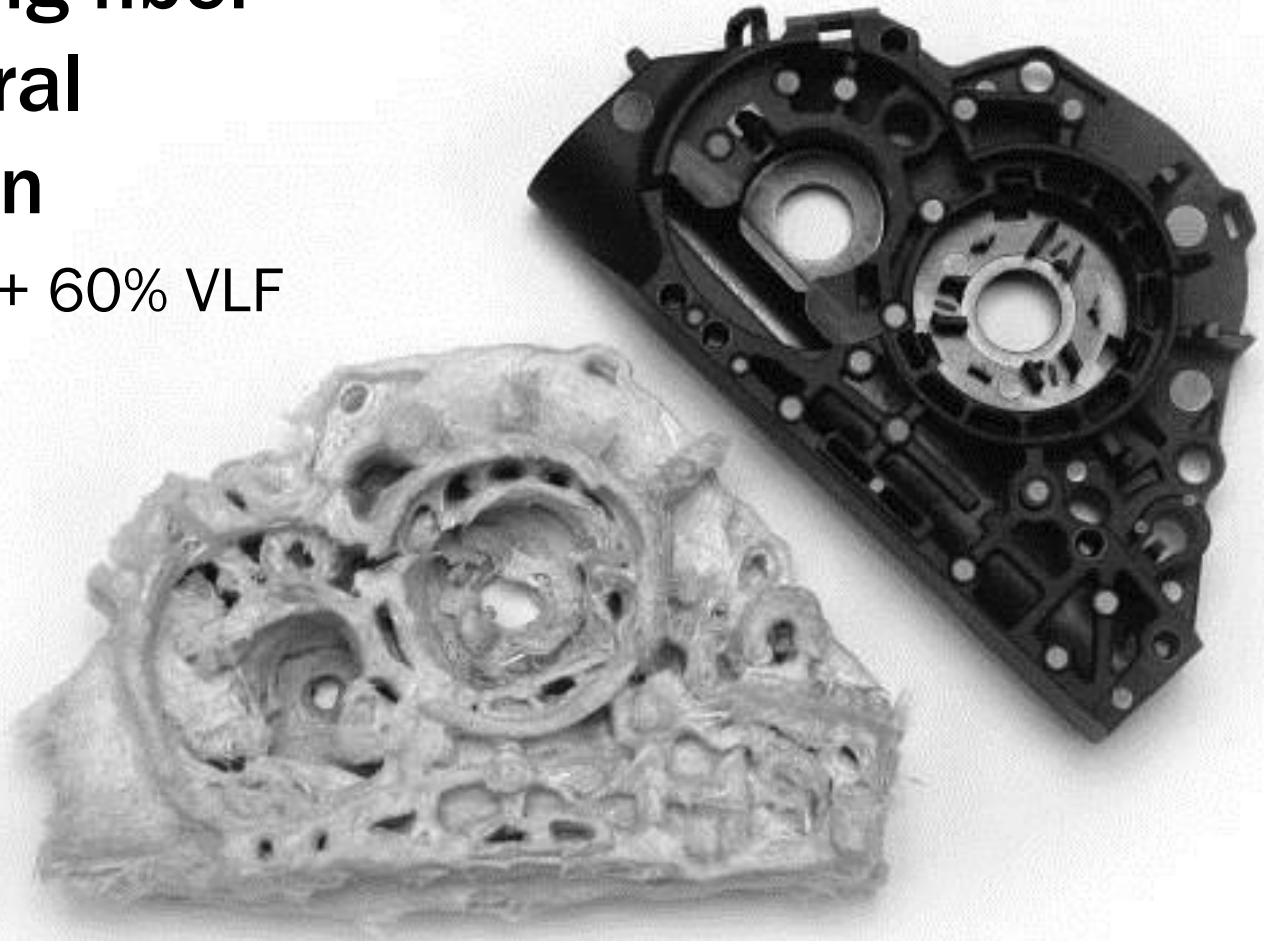
YOUR GLOBAL COMPOUNDER OF CUSTOM ENGINEERED THERMOPLASTICS



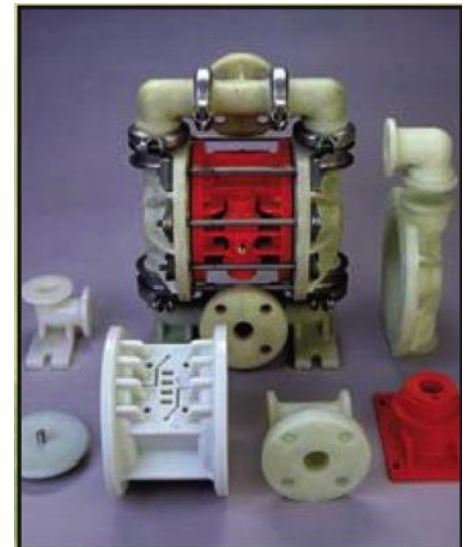
1. 10-35% improvement to the High Temperature product portfolio that is already the highest performing in the industry!
2. PPA and PPS w/CF products that exceed the tensile and flexural properties of competitive products by 30-40%
3. 40%CF PEEK product that competes with Victrex 90 HMF 40
4. VLF products have 3-4 times the impact of short glass products

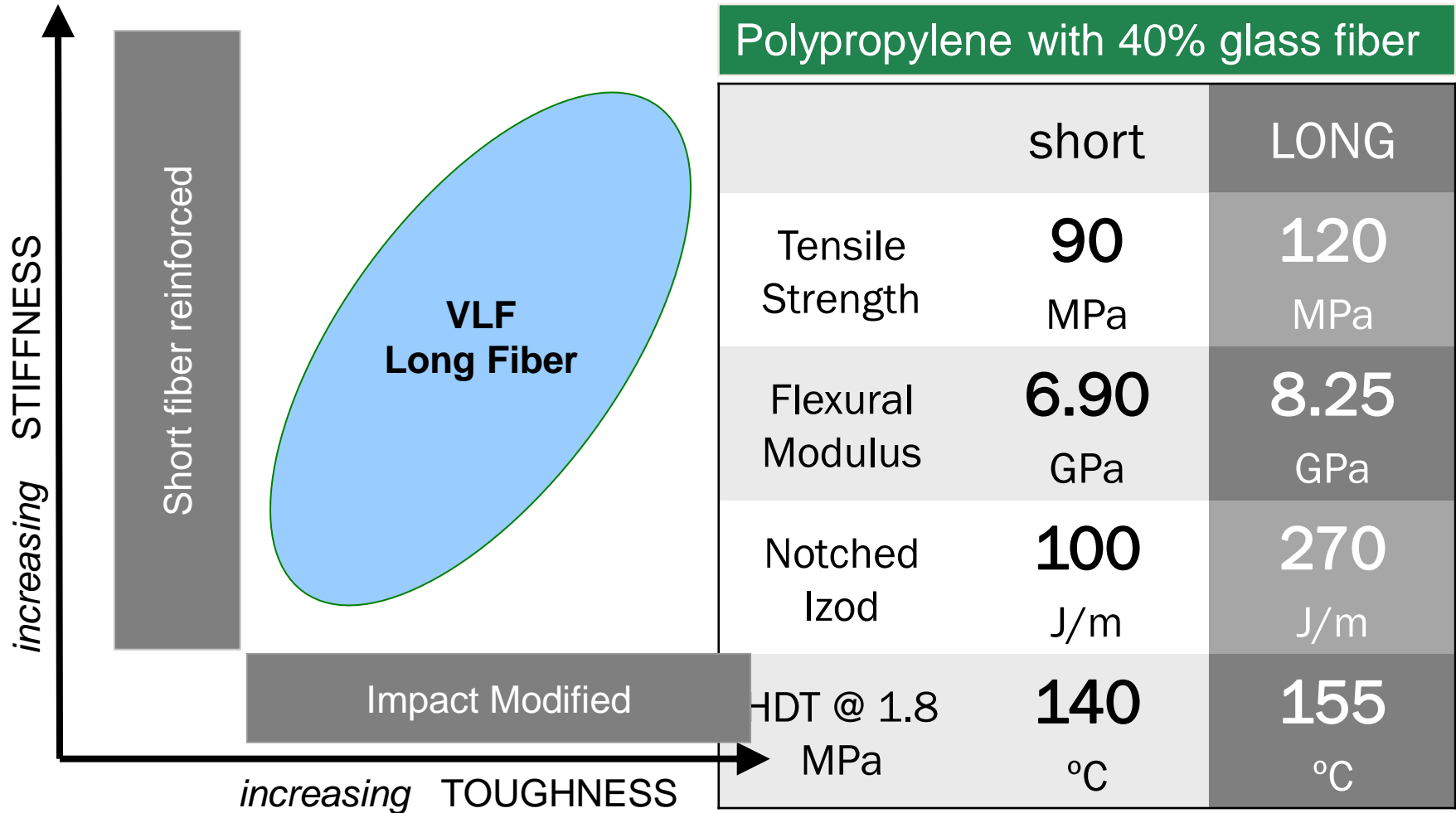


- Very long fiber structural skeleton
 - PA 66 + 60% VLF

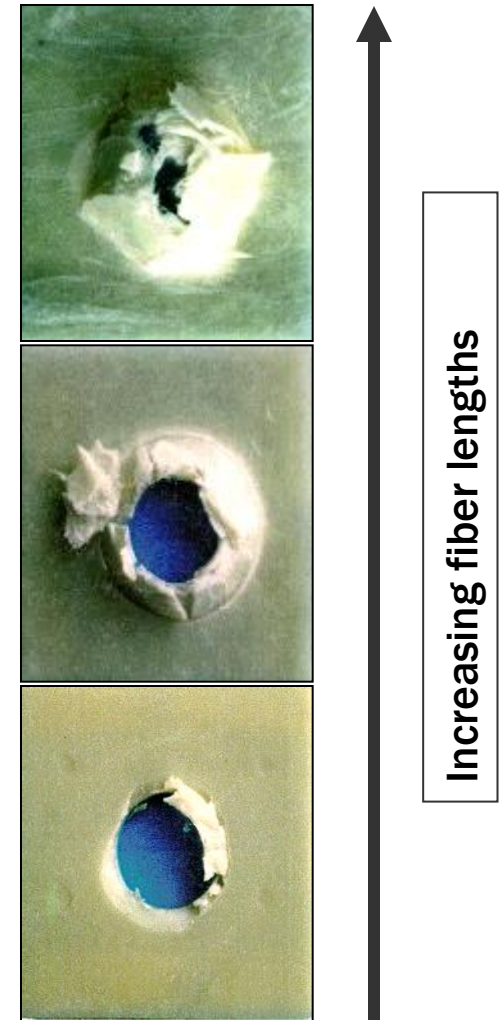
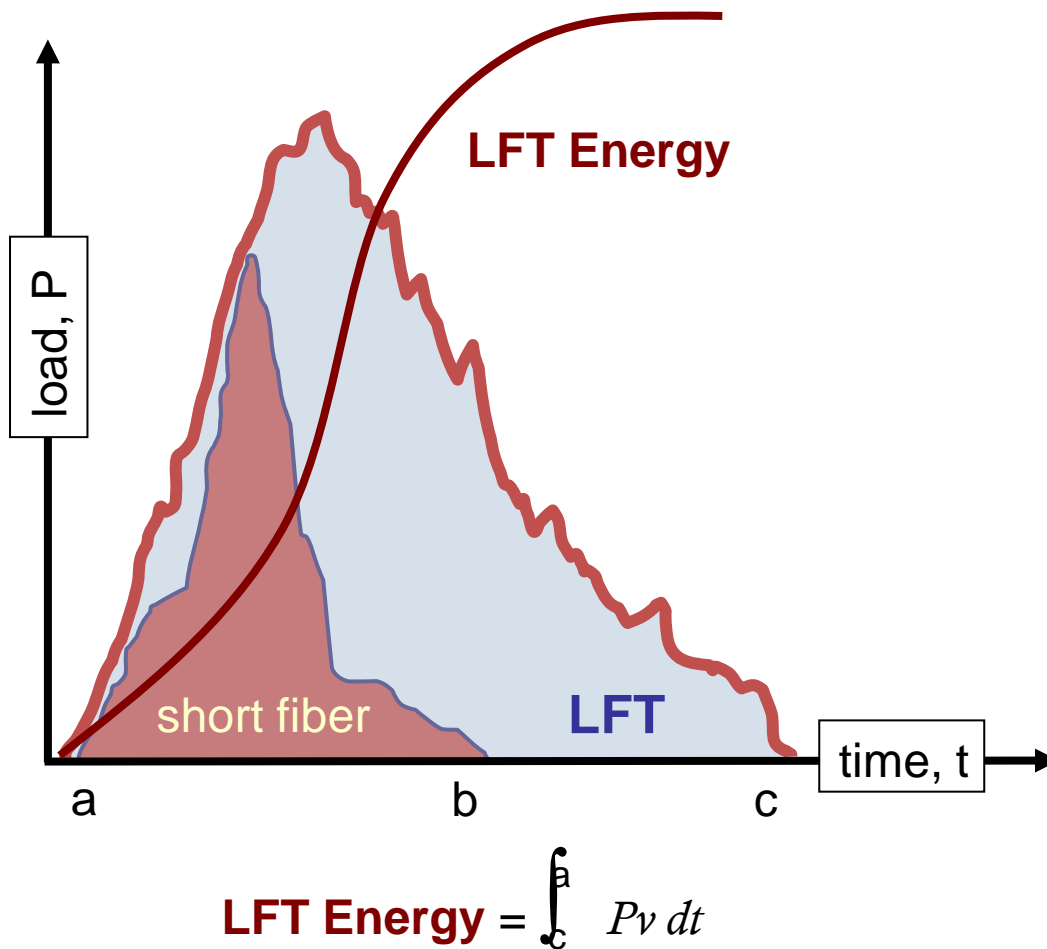


- **In both hot and cold environments**
 - Stiff and tough!
 - Extremely high impact resistance
 - Dimensional stability and warp resistance
 - Retain stiffness as temperature increases
 - Excellent creep resistance
 - Lightweight vs metal



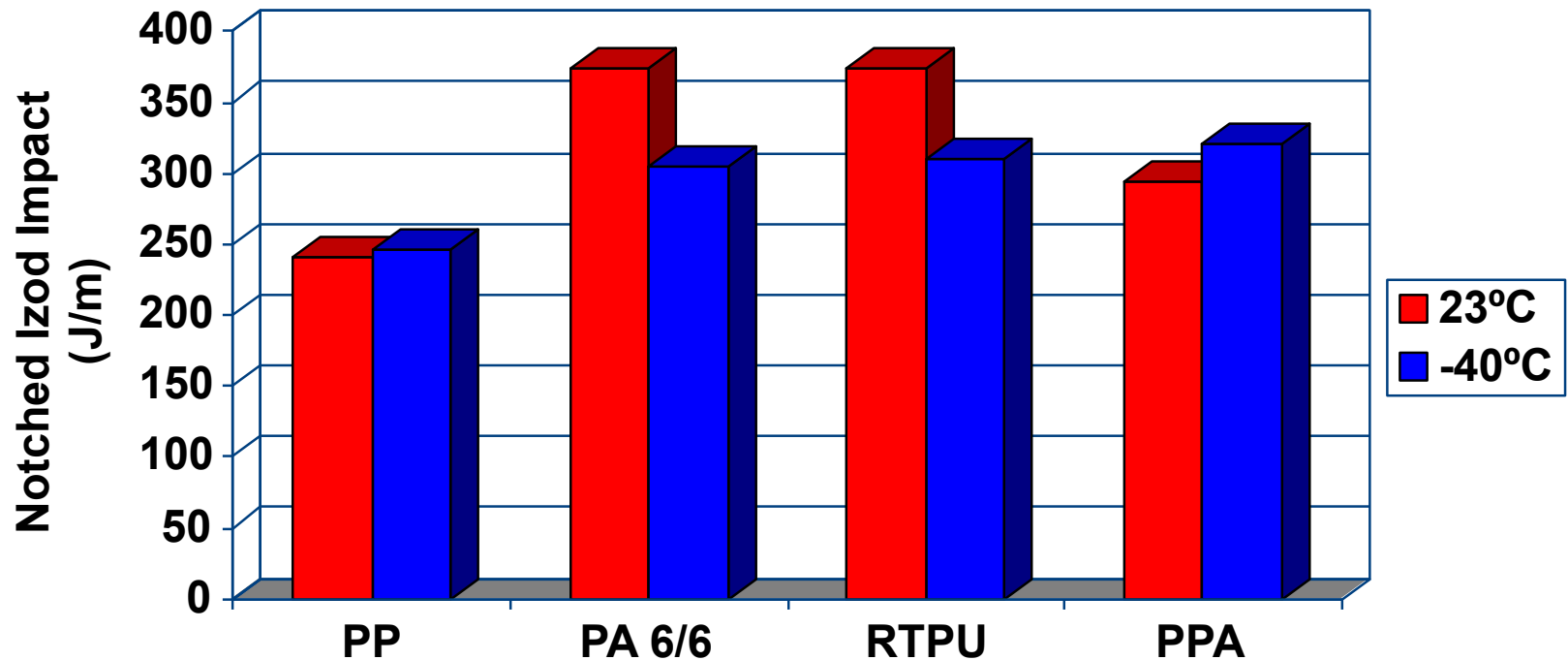


Impact energy absorption



VLF Parts Maintain Durability at Low Temp

50% VLF



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Additive technologies

PTFE



Silicone



PFPE



Graphite Powder



MoS₂



Fibers



PTFE – Polytetrafluoroethylene (5-20%)

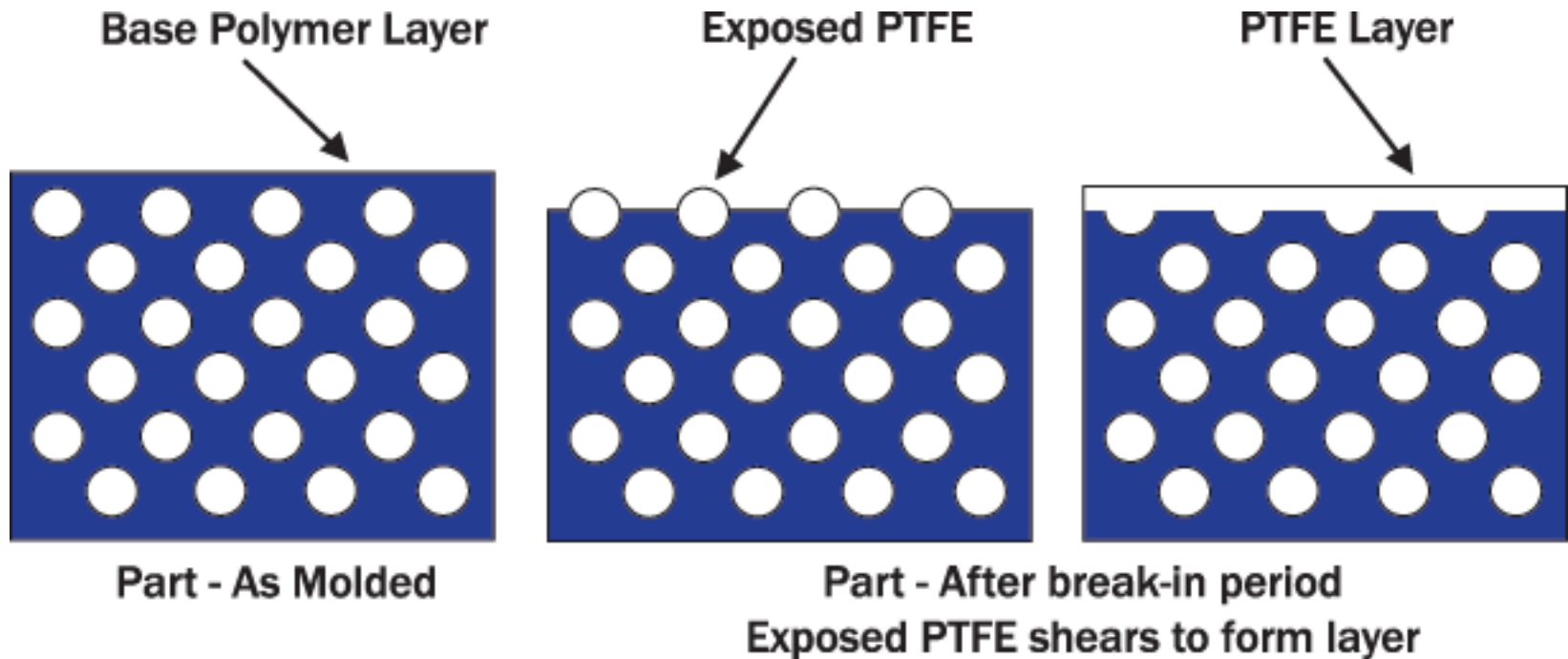
- Workhorse additive – solid white powder
- Homogeneously distributed throughout the polymer matrix
- Forms a lubricious layer at polymer surface – requires a “Break-in” period
- Compatible with nearly all thermoplastic resins



Limitations

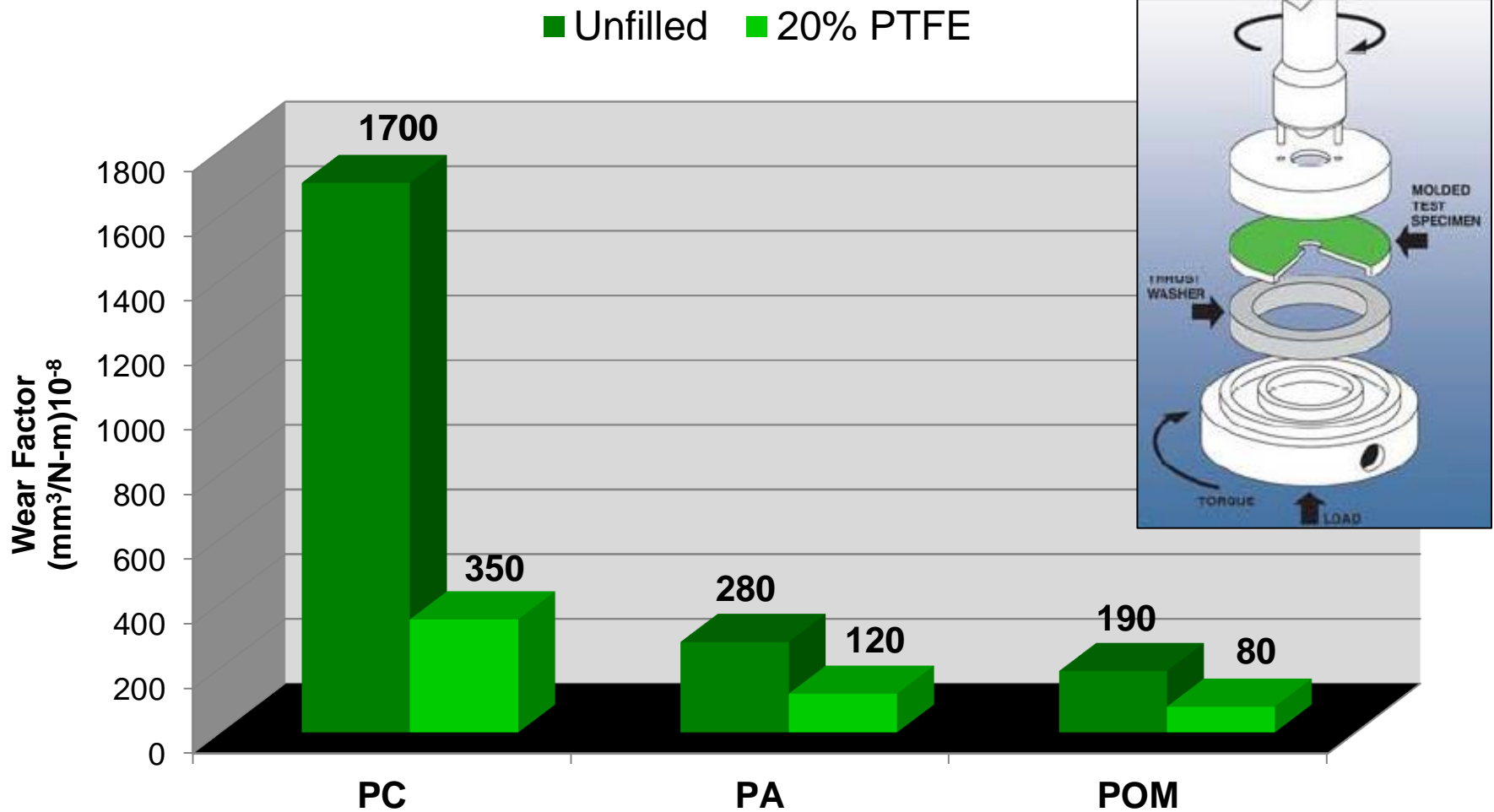
- Fluorine content
- Die plate-out
- Relatively high loadings
- Becoming very expensive

PTFE Wear Mechanism



Wear & Friction Resistance

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Wear Factor per ASTM D3702 against steel; PV=70 (kPa m/sec)

Silicone – Polydimethylsiloxane (1-3%)

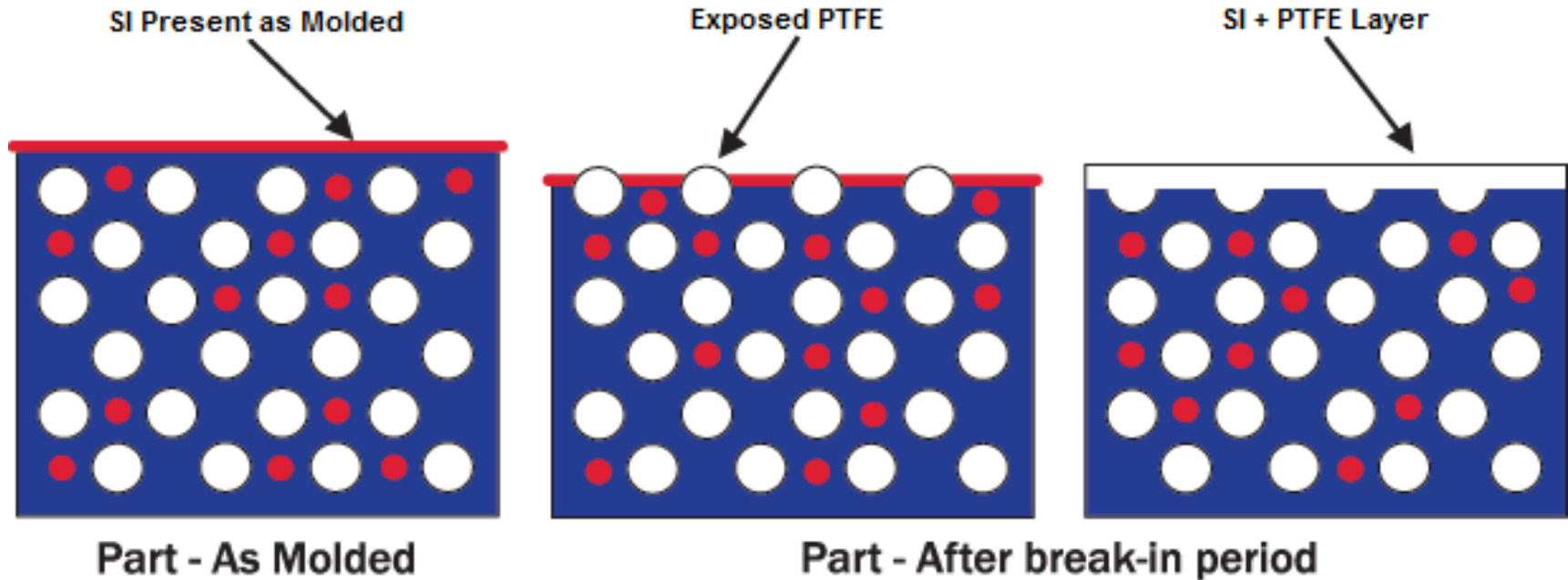
- Boundary lubricant which migrates to the surface over time
- Migration rate is viscosity dependent
- Excellent friction reducer
- Best in high speed/low load applications
- Used with PTFE to eliminate “Break-in” period



Limitations

- **Limited use in decorated parts**
 - Poor adhesion of paint or print inks
- **Bad for electrical applications**
 - Can foul contacts

Silicone Wear Mechanism



PFPE – Perfluoropolyether Oil (< 1%)

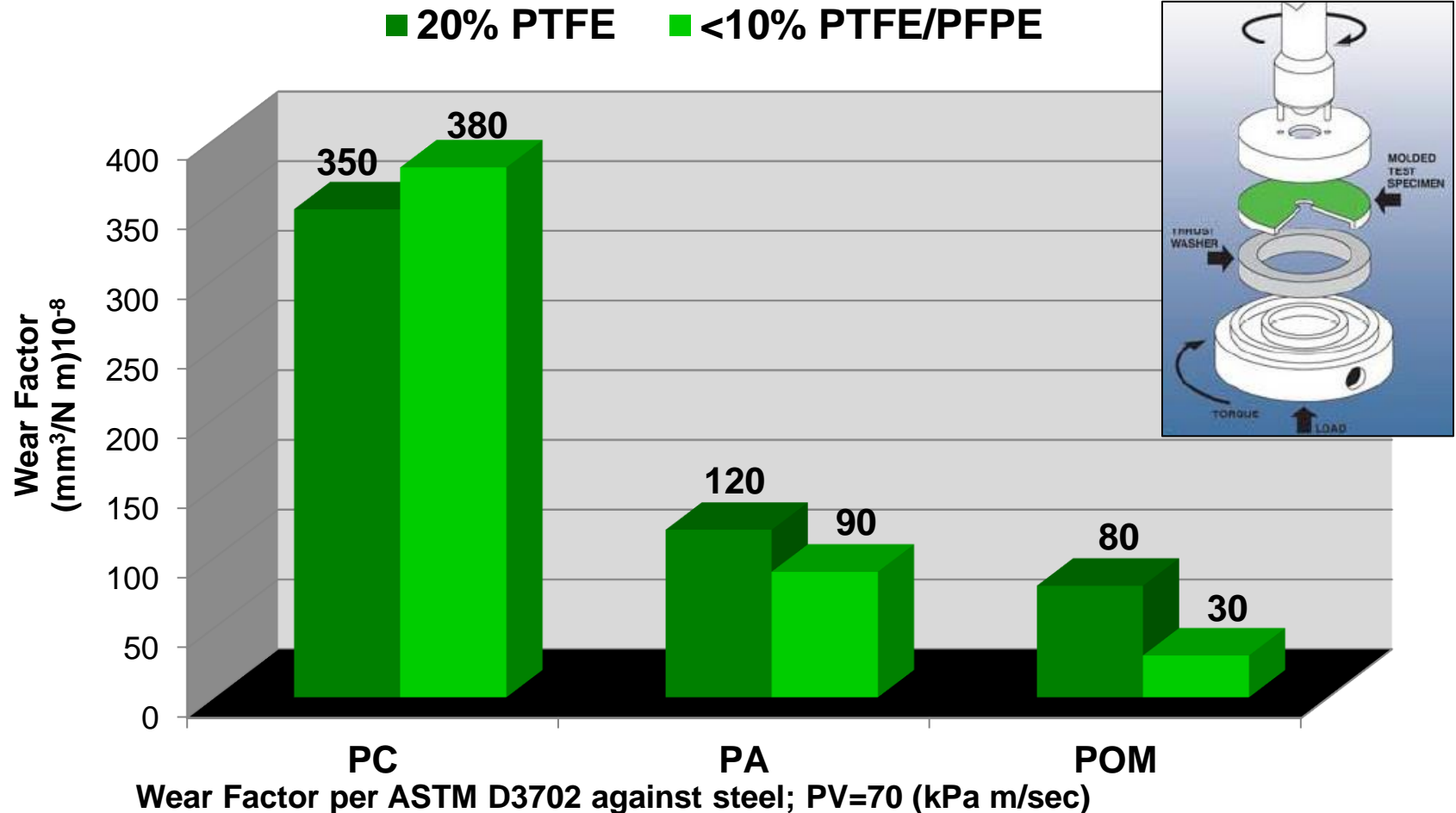
- Thermally stable up to PEEK processing temps
- Differentiates RTP Company from others
- Physical properties maintained
- Minimized die plate-out
- Synergy with PTFE
- Specific gravity benefits
- Improved fatigue resistance



Limitations

- Limited effectiveness in amorphous resins
- Needs PTFE “kick” to deliver optimum friction reduction

PFPE Allows For A Reduction In PTFE Loadings



Graphite Powder (5-30%)

- Aqueous environments
- Excellent temperature resistance
- Black color



Molybdenum Disulfide - MoS₂ (1-5%)

- Nucleating agent in nylons: creates harder surface
- High affinity to metal
 - Smoother mating surface = lower wear

Limitations

- Limited use
- Dark color limits colorability
- Sloughing type additives



Reinforcing Fibers

Glass Fiber



- Improved bearing capabilities/wear resistance
- Very abrasive

Carbon Fiber



- Higher bearing capabilities
- Excellent thermal resistance
- Conductive
- Less abrasive

Aramid Fiber



- Little strength improvement
- Very gentle to mating surface

**Fibers protect the polymer,
but may be abrasive against the mating material**



Glass



Carbon



Aramid

Aluminum Contact Surface

“Ultra” Wear Compounds

- **Demand for materials to withstand extreme conditions**
 - Typical PV = 70 to 350 (kPa m/sec)
 - What about 350+
 - High temperature
 - Chemical environments
- **RTP Company has investigated high temperature resins and wear additive combinations to compete in these environments**



Ultra Wear Advantages

Injection Moldable

- Vespel® (TPI) and Rulon® (PTFE) available in stock shapes only
- Torlon® (PAI) requires extensive post curing

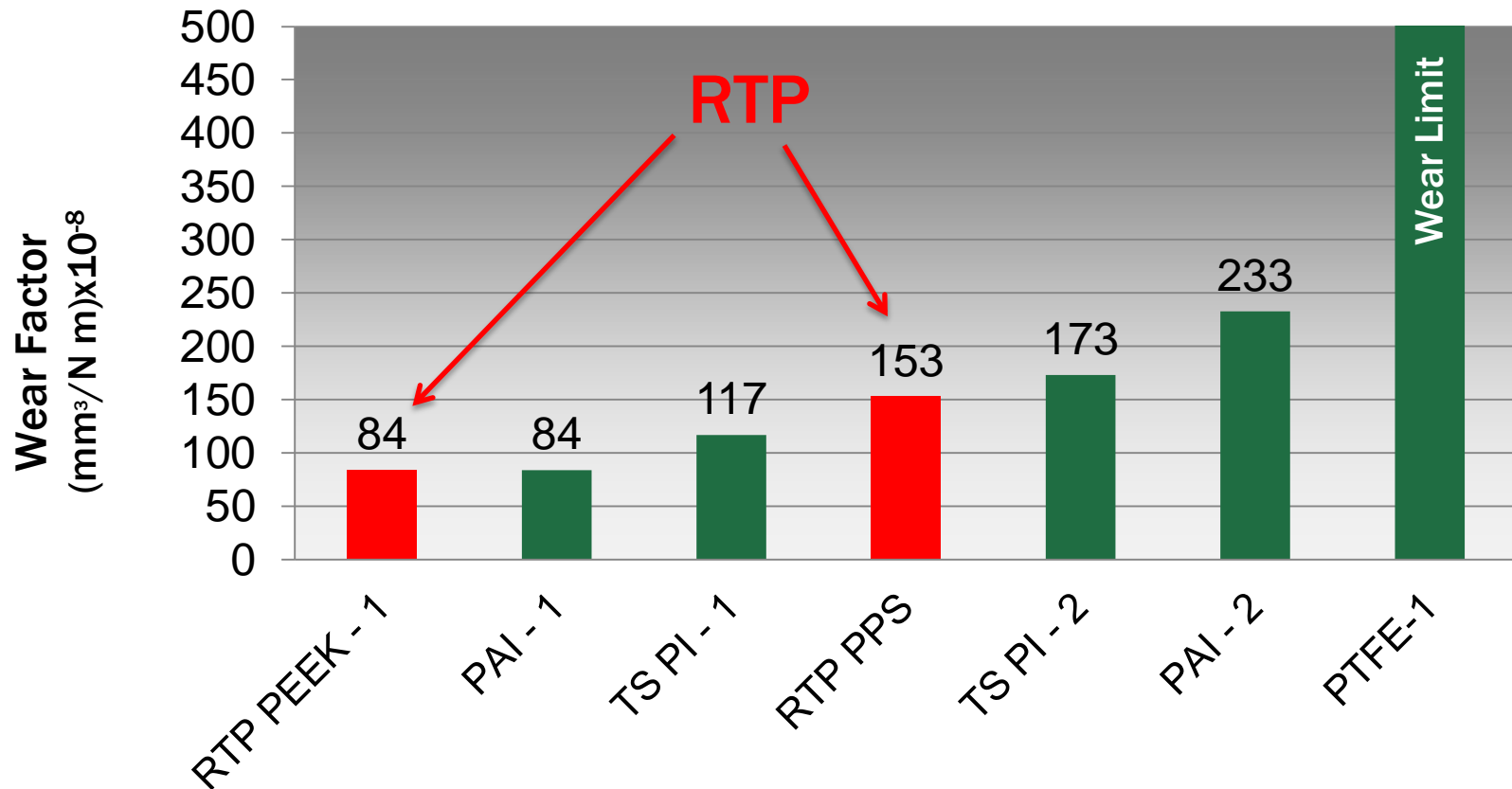
Outstanding Wear

- At high PV combinations of 1750 + (kPa m/s)
- At room and elevated temps (204°C)

High Strength

- Stiffer and stronger than Rulon® (PTFE)
- Similar strength and notched izod impact vs Torlon® (PAI) and Vespel® (TPI)

“Ultra” Wear Data (Elevated Temperature)



Wear per ASTM D-3702 against Steel at 204° C (400°F); PV = 1750 kPa m/sec

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Anti-Static Compounds

- All-polymeric
- PermaStat®
- Prevents accumulation of static charge

Static Dissipative Compounds

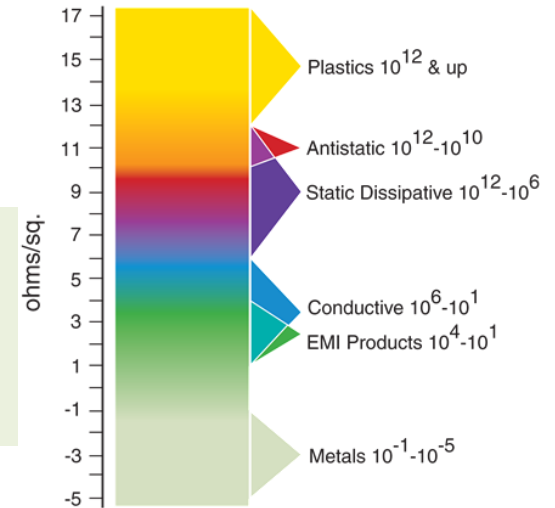
- PermaStat® Plus
- Fully colorable
- Controlled dissipation of static charge

Conductive Compounds

- Carbon fiber
- Carbon powders (ESD-C)
- Carbon nanotubes
- Near instantaneous charge decay

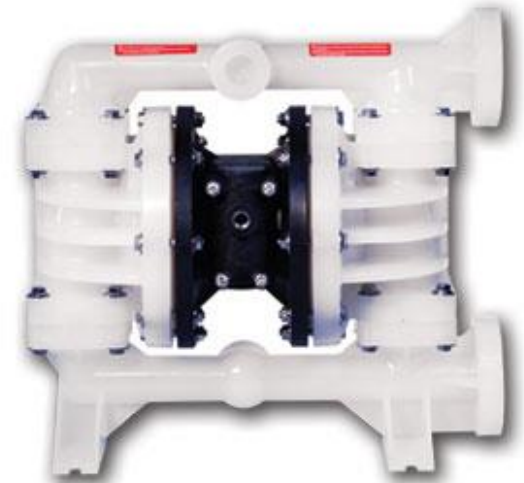
EMI/RFI Shielding Compounds

- Stainless steel fibers
- Nickel coated carbon fibers
- Absorb /reflect electromagnetic energy



What is ATEX?

- **ATmosphere EXplosive**
 - Potentially explosive environments
- **Began as a European Union directive**
 - Now seen in in Americas and Asia
- **Standards**
 - Several depending on the type of equipment
 - EN 50014
 - IEC 60079
 - UL 60079
 - FM 3610



ATEX Testing

- Actual requirements dictated by operating environment
- All tests are on actual parts
- Tests could include
 - Surface resistance (almost always included)
 - RTI (Relative Thermal Index)
 - Chemical resistance
 - Impact (low temperature)
 - UV
 - High humidity aging testing
 - Flame Retardance
- Need to fully identify all requirements for proper material selection

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- **Broad Technology Platform**
 - Halogen-free technology
 - Halogenated technology
- **Technology for over 30+ thermoplastic systems**
- **Meet flammability performance specifications**
- **Obtain regulatory compliance**
 - UL
 - RoHS/REACH Compliant
- **Global support**





Key Technologies-Flame Retardant

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Flammable

- Polyolefins
- Nylons
- Polycarbonate
- Polyesters
- Styrenics
- TPE's

Inherently Flame Resistant

- Polysulfones
- Polyphenylene Sulfide
- Polyetheretherketone
- Polyetherimide
- Fluoropolymers

Flammable resins can be tailored with additives to impart the needed UL ratings...

UL94 V-0, V-2, 5VA

UL746 RTI, f1, electrical ratings (CTI, HWI, etc.)



Key Technologies-Flame Retardant

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Multi-Functional Flame Retardant Products

- **FR Solution to meet compliance... PLUS**
 - Reinforced options
 - Increase Modulus/Strength
 - Thinning of wall sections or carry additional loads
 - Additional functionalized stabilization
 - Increase resistance to UV, Heat, Chemical Resistance, Hydrolytic Stability
 - Increased durability and safety
 - Impact modification, added lubricity, ESD protection
 - Added Aesthetics
 - Color, transparency/diffusion

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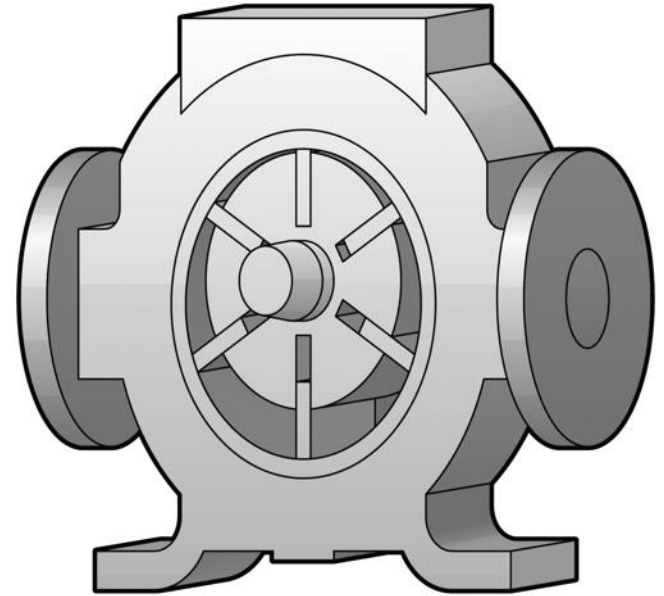


Application: Positive displacement transfer pump

Problem: Pump must be light weight and capable of moving hydrocarbons and other chemicals.

Solution: Impeller: RTP 1300 Series PPS with carbon fiber, PTFE, and PFPE; Wiper Blade: RTP 2200 Series PEEK compound with PTFE

Benefit: High strength, excellent chemical and fuel resistance, superior wear and abrasion

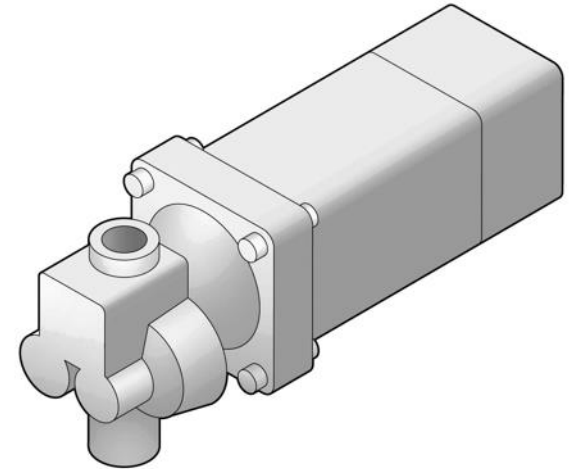


Application: Gears in a micro pump for use in food and industrial applications. Used to transfer clean liquids at pressures up to 250 psi and flows up to 11 gallons/minute

Problem: Pump requires chemically resistant materials capable of moving a wide variety of fluids. Need high wear materials but can not utilize glass fiber

Solution: RTP 2200 Series PEEK with carbon fiber, aramid fiber, and PTFE

Benefit: Excellent chemical resistance, high strength, wear resistant, lower abrasion than glass versus mating materials

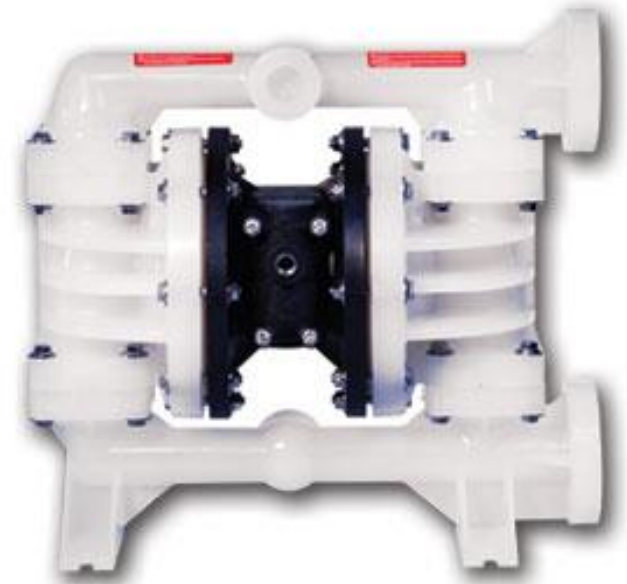


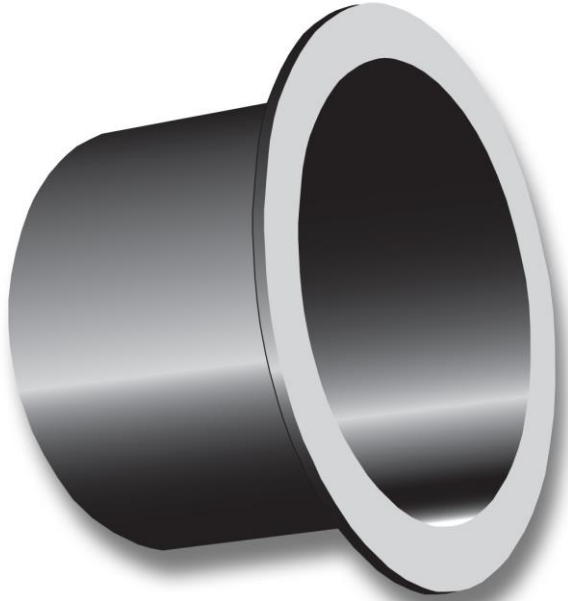
Application: Housing for an air operated diaphragm pump used to move a variety of liquids in mining operations

Problem: Pump must be lightweight, chemically resistant, and ATEX compliant for use in explosive atmospheres

Solution: RTP 100 Series glass reinforced PP with conductive carbon powder

Benefit: High strength, low weight versus metal, good chemical resistance, static dissipative





Application: Containment shell for seal less centrifugal pump

Problem: Pump must be capable of pumping a wide range of chemicals and fuels. Containments shell must have outstanding chemical resistance with high strength and impact properties

Solution: RTP 3200 Series carbon fiber reinforced ETFE

Benefit: High strength, high impact, low weight versus metal, outstanding chemical resistance versus a wide range of chemicals and fuels

Application: Control housing for metering pump

Problem: Housing must be durable and flame retardant (non-hal)

Solution: RTP 100 Series flame retardant glass reinforced PP

Benefit: Non halogenated flame retardant, good durability and chemical resistance, excellent colorability, moldability, cost effective, overmoldable



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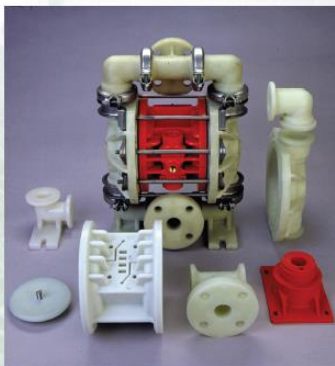


Specialty Compounds for Pumps & Fluid Handling

Technical Brief

Thermoplastic Compounds

- Excellent chemical and corrosion resistance
- Reduce weight
- Improved abrasion and wear properties
- Reduce static buildup (ATEX)
- Reduce manufacturing costs
- Extend product life



The chemical resistance of an RTP Company glass fiber/polypropylene compound provides security against corrosion for parts used in fluid handling pumps. The pump is lightweight, weighing 18 pounds. Metal versions of the same pump weigh up to 42 pounds. There are no secondary finishing operations needed.

Customized Thermoplastic Solutions

Fluid handling pumps are a common piece of industrial equipment, second only to electric motors. The market has enjoyed steady growth over the last decade, since many industries rely on pumps to move water, acids, lubricants, solvents, chemicals, and fuels.

Metals have been the traditional choice of pump manufacturers for housing, impellers, seals, and other elements.

However, the desire for improved manufacturing efficiencies has led designers to thermoplastic compounds as excellent candidates to replace metals or unfilled resins.

Plastic compounds offer a combination of physical strength, wear resistance, self-lubrication, and cost effectiveness (both material and processing costs).

They are superior to metals in corrosive environments, and they are chemically resistant. Smooth surfaces for better wear performance are achieved without secondary operations.

Choosing the right thermoplastic for your pump application depends on several factors, which can vary significantly, such as pressure, temperature, and speed. Additionally, the corrosive nature of many chemicals, the abrasive characteristics of liquids or slurries, the degree of contamination that can be tolerated, and projected uses for the pump must also be considered.

Products from RTP Company are available and supported worldwide through our global facilities that provide technical support from design through finished part production.

Choose RTP Company Specialty compounds for:

- | | | |
|----------------------|-------------------------------|-----------------------|
| • Pump Housings | • Rotors and Vanes | • Diffusers |
| • Propellers | • Housing Liners | • Bushings |
| • Impellers | • Seals | • Flow Control Valves |
| • Containment Shells | • Rotary Pump Lobes and Gears | |

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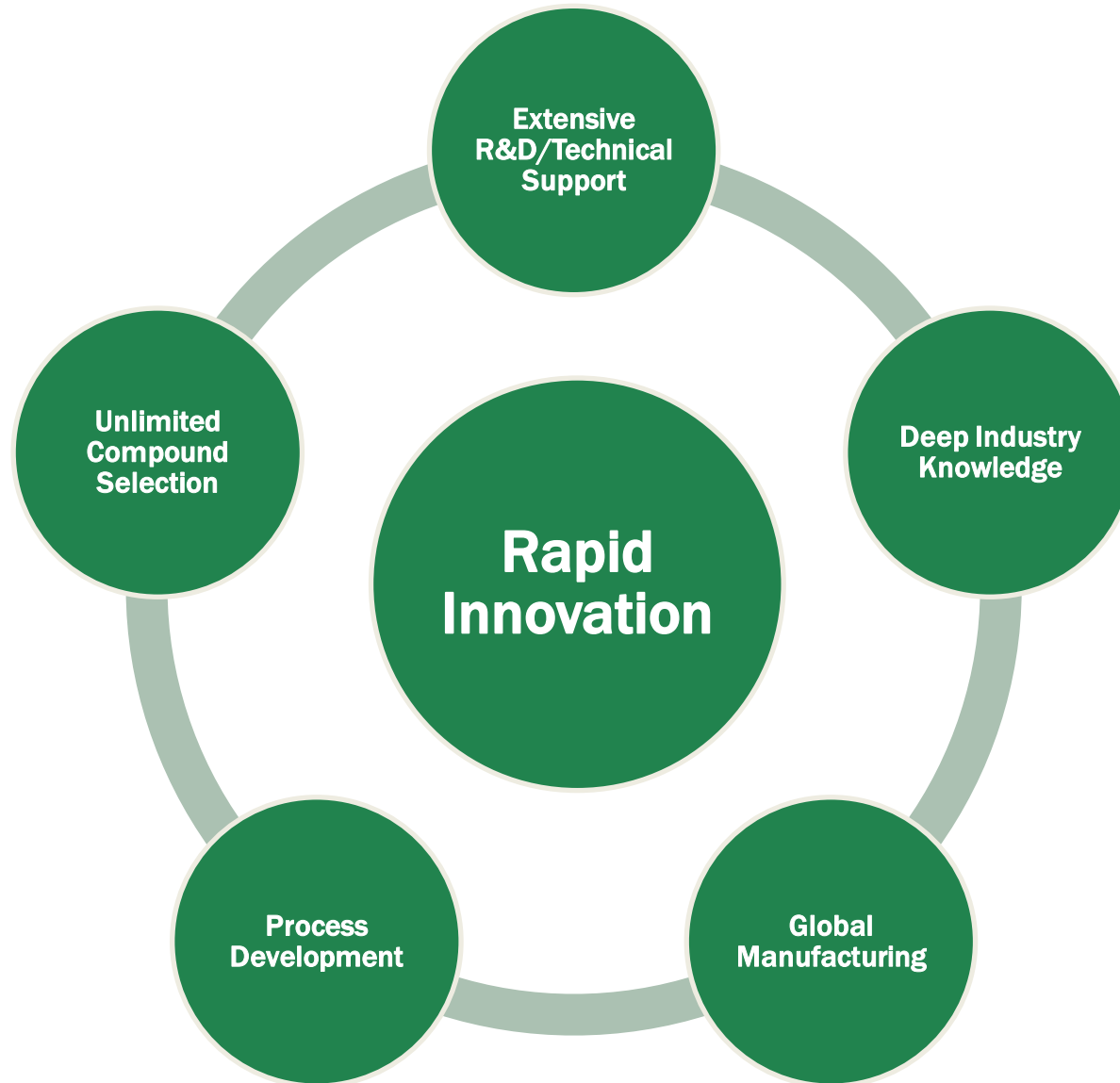
- Specialty Compounds for Pumps Tech Brief
- Download from RTP website
 - www.rtpcompany.com
- Request email copy at end of webinar
- Available Translations
 - English
 - German
 - Japanese
 - Chinese



Additional Information

YOUR GLOBAL COMPOUNDER OF CUSTOM ENGINEERED THERMOPLASTICS

- **In-depth recorded webinars on RTP Company product technologies featured in this presentation**
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 - Static & ESD Control
 - Flame Retardant
- **View on-demand: www.rtpcompany.com**





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Questions?

*Dr. Joel Bell, Ph.D.
International Technology Mgr.
jbell@rtpcompany.com
507-474-5378*

*Will Taber
Market Mgr. – Industrial
wtaber@rtpcompany.com
816-591-7181*



RTP Company Corporate Headquarters • 580 East Front Street • Winona, Minnesota 55987 USA
website: www.rtpcompany.com • email: rtp@rtpcompany.com • Wiman Corporation • +1 320-259-2554

TELEPHONE:

U.S.A.	SOUTH AMERICA	MEXICO	EUROPE	SINGAPORE	CHINA
+1 507-454-6900	+55 11 4193-8772	+52 81 8134-0403	+33 380-253-000	+65 6863-6580	+86 512-6283-8383





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- Color
- Conductive
- Flame Retardant
- Structural
- Wear Resistant

Visit www.rtpcompany.com for a material tailored to meet your precise needs

- Custom Solutions
- 60+ Resins
- Independent & Unbiased
- Local Support
- Worldwide Manufacturing

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U.S.A.
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SOUTH AMERICA
+55 11 4193-8772

MEXICO
+52 81 8134-0403

EUROPE
+33 380-253-000

SINGAPORE
+65 6863-6580

CHINA
+86 512-6283-8383

