

2019 MRC Conference

***MANUFACTURING WITH RECYCLED MATERIALS:
WHAT EVERYONE NEEDS TO KNOW***

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Sales Manager

Cascade Engineering



- 1 About Cascade Engineering**
- 2 Manufacturing Capabilities**
- 3 Recycled Material Challenges**
- 4 Overcoming the Challenges**
- 5 Questions?**

Background



Cascade Engineering:

- Founded in 1973 by Fred Keller
- Headquartered in Grand Rapids, MI
- Annual Revenue \$380 million
- 1,800 employees in 14 facilities worldwide
- 9 Business Units

MARKETS

- Automotive
- Commercial Truck & Bus
- Compounded Polymers
- Field Services
- Office Seating
- Material Handling
- RFID Systems
- Solid Waste & Recycling



Cascade Engineering Learning Community:
First LEED Certified Platinum Building in the state of MI.

Triple Bottom Line



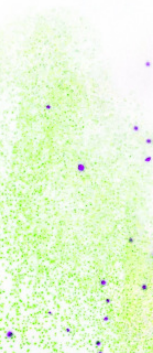
We are a Triple Bottom Line company. Our success is not only defined by monetary gain but also on the positive impact we make on society and the environment.

Since 2003 we have produced our annual TBL report that quantifies our progress in these three key areas:

People – Social Capital

Planet – Environmental Responsibility

Profit – Financial Impact



Certified “B” Corp



One of the largest certified “B Corporations” in the world. Using the power of business to positively impact social and environmental change.

- Independent auditing processes
 - Measures performance financially, socially, and environmentally
 - Reinforces TBL strategy
 - Provides a benchmark for like-minded companies
-
- #1 Patagonia
 - #2 Cascade Engineering



PEOPLE **USING**
BUSINESS
..... AS A
FORCE **FOR** GOOD

Global Footprint



North American Facilities

1. Grand Rapids, Michigan
2. Montpelier, Ohio
3. Mount Airy, North Carolina
4. Grand Prairie, Texas
5. Brownsville, Texas

European Facility

6. Budapest, Hungary



Business Units



**AUTOMOTIVE
AMERICAS**



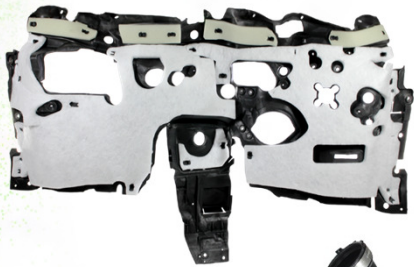
**AUTOMOTIVE
EUROPE**



**INNOVATIVE PLASTIC
TECHNOLOGIES**



**CK
TECHNOLOGIES**



Business Units



**CASCADE CART
SOLUTIONS &
FIELD SERVICE
MANAGEMENT**



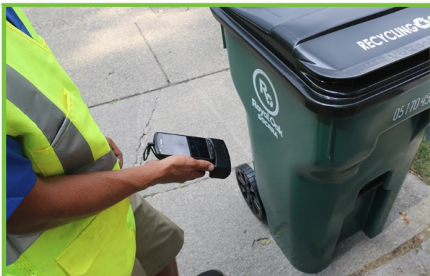
**NOBLE
POLYMERS**



**DECADE
PRODUCTS**



**XTREME
RFID**



Cascade Customers



tedrive

HAWORTH®

Knoll



Amway



HONDA
The Power of Dreams



TRISTONE

FORD PERFORMANCE



A PACCAR COMPANY



KOHLER



Johnson Controls



TEKLAS
KAUÇUK SANAYİ ve TİCARET A.Ş.

DAIMLER



faurecia



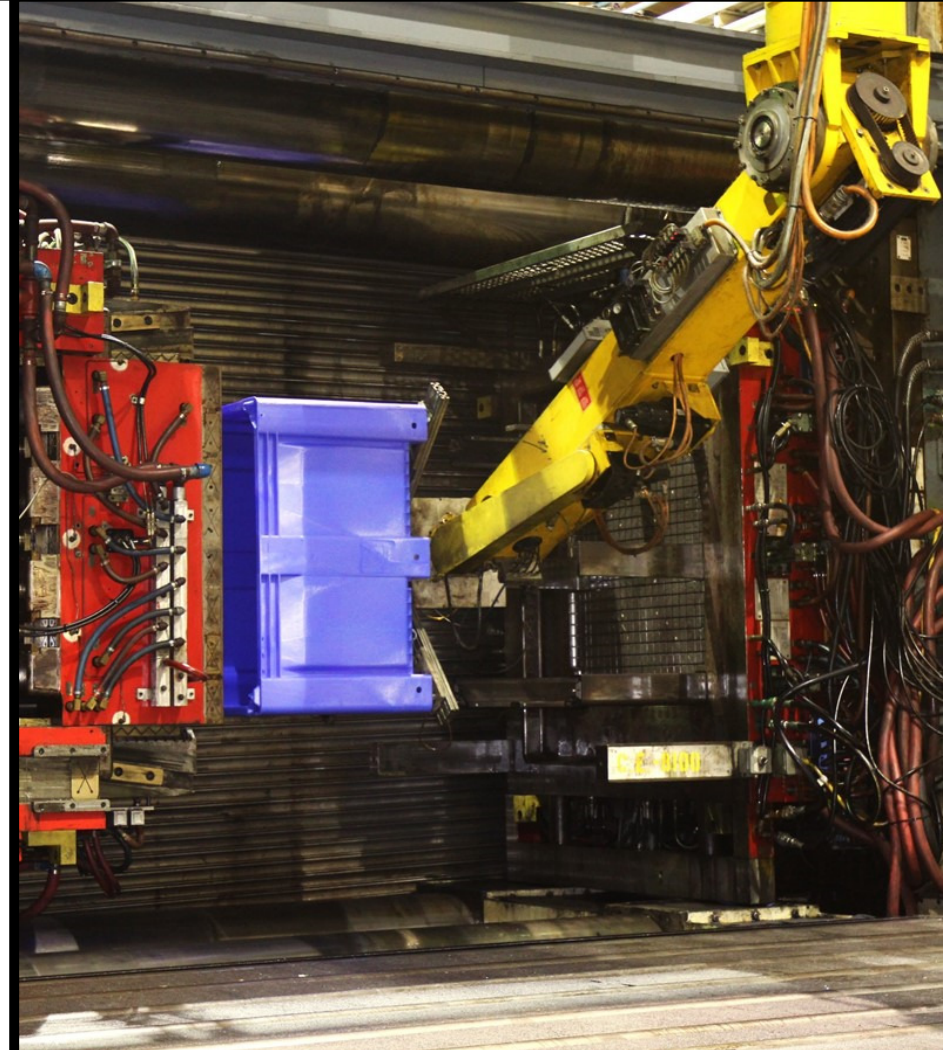
Cascade Engineering Manufacturing Capabilities

Products // Processes // Markets

Injection Molding



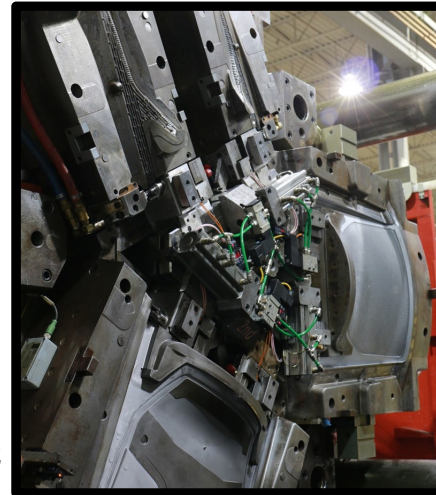
- Cascade has 11 manufacturing plants
- 1 million sq. ft. of building space
- 115 injection molding machines ranging in size from 50 ton to 9000 ton.
- Cascade Buursma Plant houses the largest injection molding press in North America (9000 ton machine)
- Primary focus on large tonnage injection molding (1500+ tons)
- Molded parts with complex geometries, high quality finishes, and structural requirements
- Full range of material capability from highly engineered plastics to 100% recycled polymers



Additional Molding Capabilities



- **3D Suction Blow Molding**
 - Innovative designs enable light-weighting and simplified plant operations, resulting in cost reduction and reduced manual labor
- **Multi-Shot Molding**
 - Injecting two or more materials sequentially into a mold at different times and locations to form multi-material/colored parts
 - Combination of materials allow products to have unique design and functional features
- **Co-Injection & Gas Assist**
- **Non-VOC Decorative Films & Coatings**
 - In addition to conventional paint finishing, non-VOC options offer a more sustainable solution, not only environmentally but also from a cost perspective.





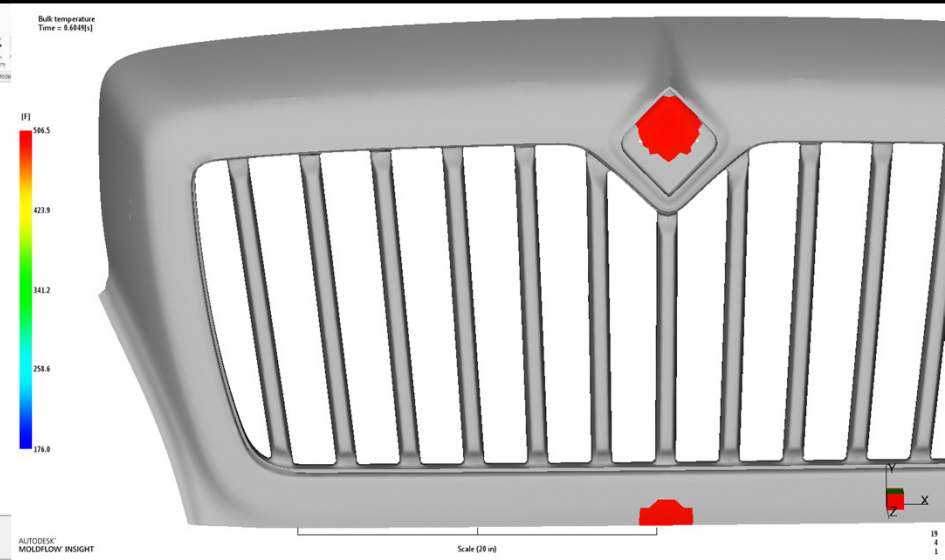
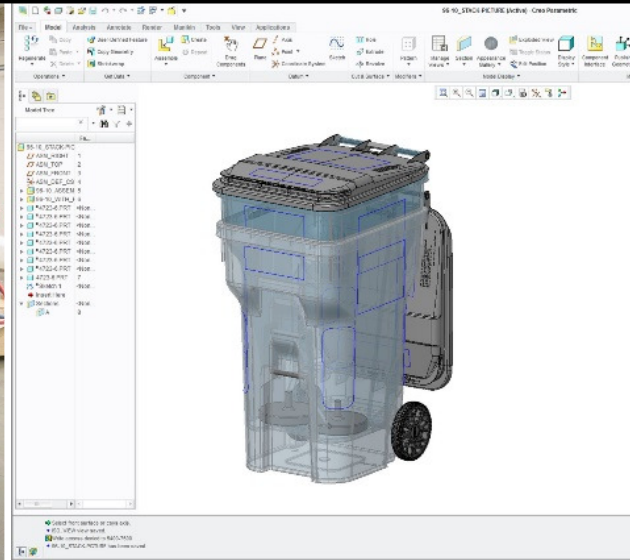
Challenges Manufacturing with Recycled Materials

Processability // Performance // Aesthetics-Customer Requirements // Cost

Part & Mold Design



- Part Design
 - Wall Thicknesses
 - Thinner Part Design
 - Inconsistent Wall Thicknesses and Transitions
- Mold Design
 - Mold Designs typically with 100 virgin
 - Gate/Drop Design
 - Moldflow 100% Virgin



Processability



- Recycled Materials
 - Increase scrap %
 - Reduce cycle times
 - Lower machine efficiency/uptime
- Consistency of Material Properties
 - MFI – Melt Flow Index (how the material flows)
 - Density
- Contaminants
 - Metal/Wood – Damage to very expensive equipment
 - Wear and tear on equipment



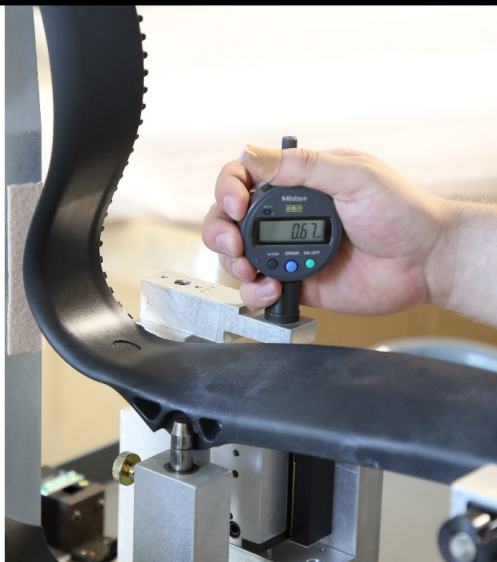
MOLDING DEFECTS

Molding Defects	Alternative name	Descriptions	Causes
Burn Marks	Air Burn/ Gas Burn	Localized burnt zone (often in the yellow/brown tones)	Tool lacks venting, injection speed is too high
Flash	Burrs	Excess material in thin layer exceeding normal part geometry	Tool damage, too much injection speed/material injected
Color Streaks		Localized change of color	Master batch isn't mixing properly, or the material has run out and it's starting to come through as natural only
Flow marks		Directionally "off tone" wavy lines or patterns	Injection speeds too slow (the plastic has cooled down too much during injection, injection speeds must be set as fast as you can get away with at all times)
Short shot	Non-Fill / Short mold	Partial part	Lack of material, injection speeds too slow

Part Performance



- PCR in most cases negatively impacts product performance.
 - Material has heat history/property degradation
 - Bonding of the material (virgin/PCR)



Part Performance – HDPE/Carts



- HDPE
 - ALL HDPE IS NOT THE SAME
 - In the beginning we sampled all recycled HDPE
 - Realized we needed to drastically narrow our scope
 - Carts
 - 5-6 melt
 - .94 - .95 density
 - PP adds to HDPE change physical properties
 - PP will help with stiffness but will negatively affect the impact strength
 - CE does not use recycled HDPE materials that include PP in the production of carts as carts will not meet the 10 year warranty period.
 - LDPE negatively impacts stiffness
- Carts – Move to automated collection
 - Abusive environment
 - Performance requirements evolve with industry



Aesthetics / Customer Requirements



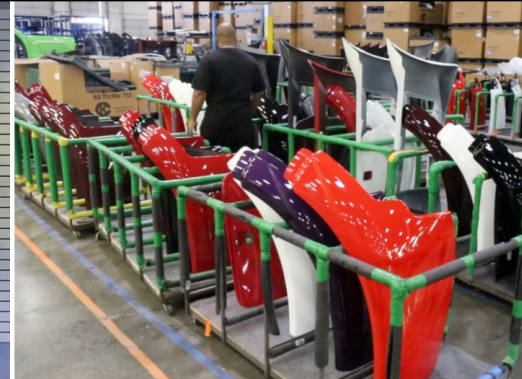
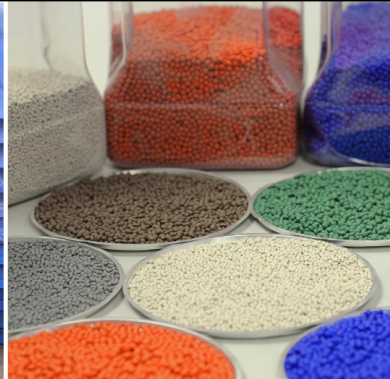
- OEM's have restrictions on PCR/Recycled Content usage
 - Painted parts
 - Aesthetic parts
 - Concerns about performance and impacts on branding
- Structural Parts / Engineering Grade Resins
 - Not recyclable



Aesthetics // Color



- OEM's have strict guidelines on color
 - Branding
 - Marketing
 - Need to match other compatible products (side chairs, ect)
 - Very low tolerance for color shifting
- **BLACK**
 - Many recycled materials are **BLACK** where customer requirements call for custom colored products.



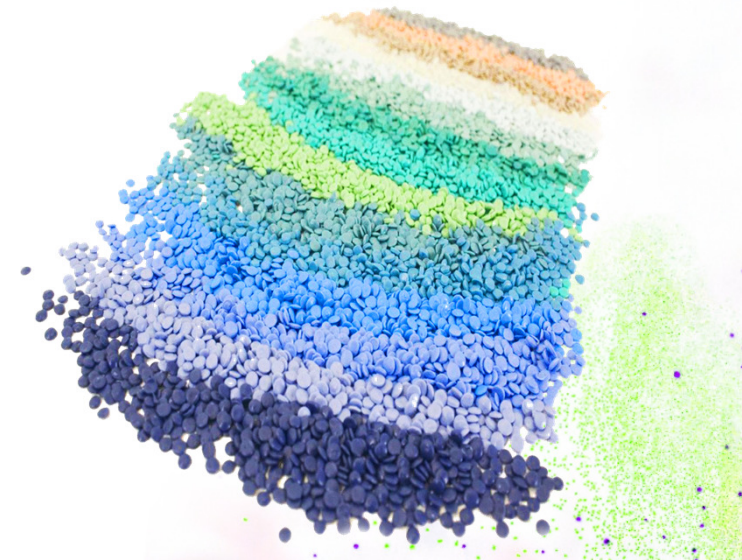


Current Market – High Supply due to new infrastructure

Recycled Pelletized	\$0.05 - \$0.08	/lb less than virgin
Regrind	\$0.08 - \$0.12	/lb less than virgin
Wide-Spec	\$0.125 - \$0.15	/lb less than virgin

Recycled Content \neq Cost Savings

- “Wide Spec”
 - Manufacturers using high amounts of ‘wide-spec’ material as recycled content
 - Properties often meets the specification of virgin resin
 - Readily available in the marketplace
 - Cheaper than recycled materials
 - Pelletized (ready for manufacture)
- Variance in cost from virgin to PCR at times do not justify the performance and/or scrap losses
 - Operational efficiency
 - Machine uptime
 - Scrap





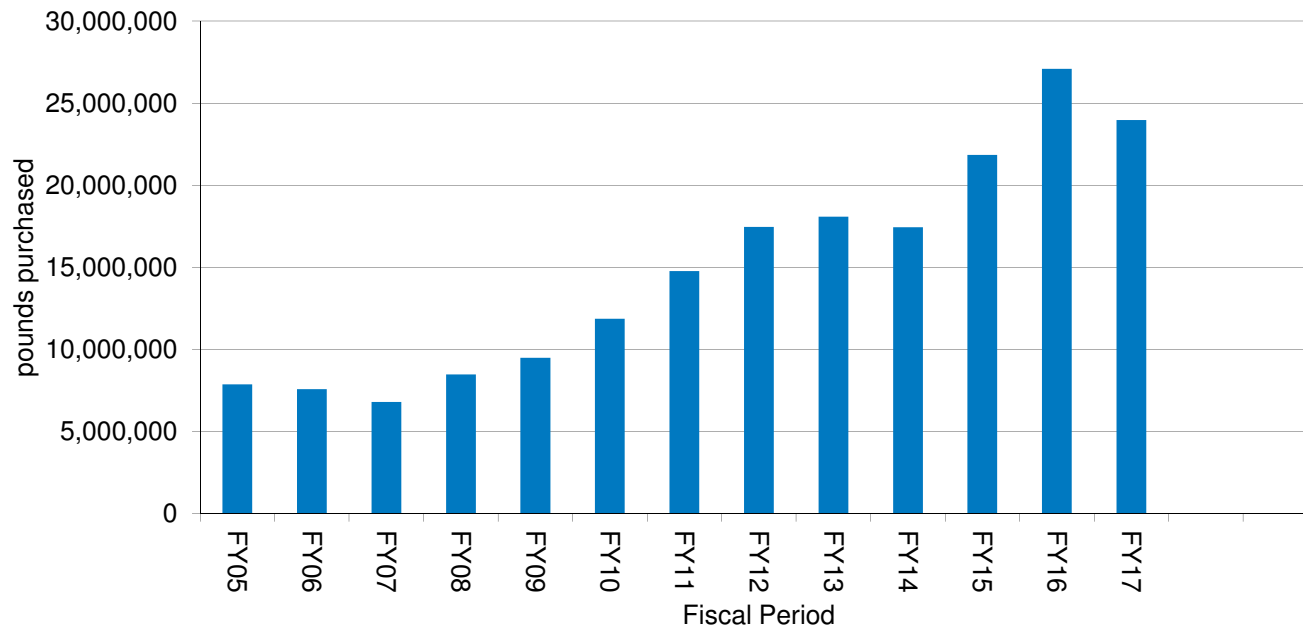
Overcoming the Challenges

Current PCR Usage



Cascade Engineering Corporate Goal – 25% PCR Usage Across All Products

Cascade Engineering Alternative Material Usage



Part & Mold Design



- Part Design

- Design for High Recycled Material Content
 - Decade RACX Pallet (40 x 48) – 100% Recycled Content
 - Ford Wheel Liner – 100% Recycled Content
 - Cascade Cart Wheel – 100% Recycled Content



- Mold Design

- Gate/Drop Design to accommodate recycled material
- Moldflow Analysis with Recycled Content

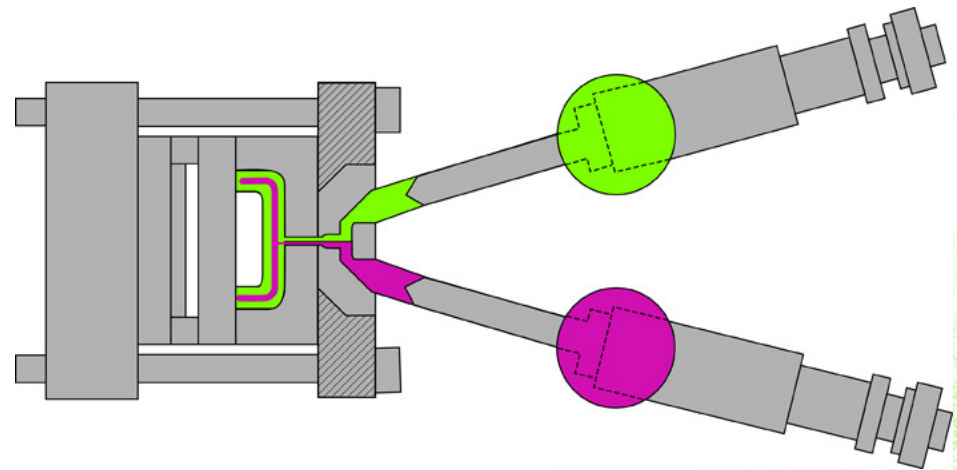
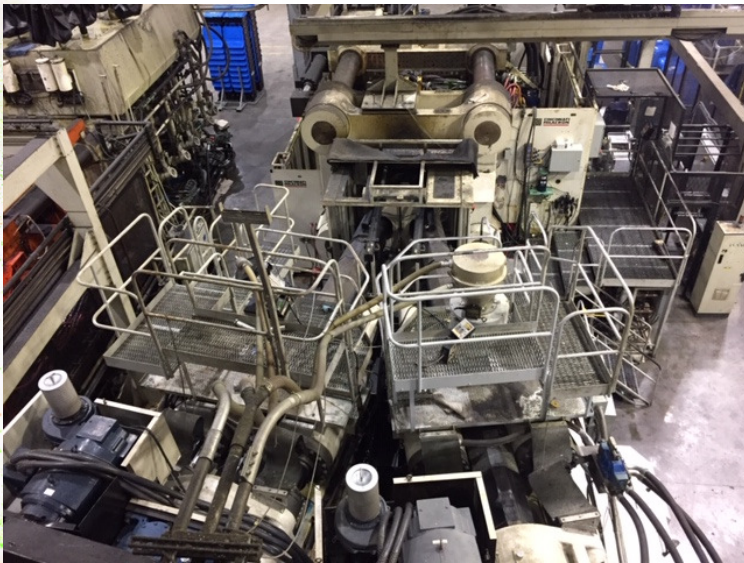


Investment in Equipment



- Co-Injection Presses

- Co-Injection is the process of injecting two separate materials into the same mold which allows one polymer to be encapsulated by another, one forming the skin, the other forming the core
- Multi-layer effect maintains product integrity and performance while allowing for the maximum recycled material content in the industry



Investment in Equipment



- Silo
 - Allows for the bulk transport and storage of large quantities of recycled material.
- Rail Spur
 - Allows for recycled material to be brought to the facility in rail carts cutting down on the transportation costs.



Current PCR Usage - Materials



- Partnerships
 - Leverage our supplier network to ensure consistent, clean, and reliable streams of recycled material
 - Provide material specification target
 - Certificate of analysis provided by suppliers
 - Pelletize
 - Color Sort
 - Pre-Color
- We rely heavily on our getting our own materials back from the market to reuse in our products. This way we know the heat history and the properties are consistent.



Current PCR Usage - Testing



- Qualify Material // A2LA Accredited Lab:

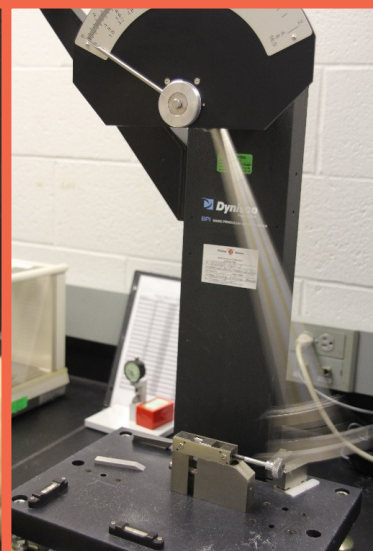
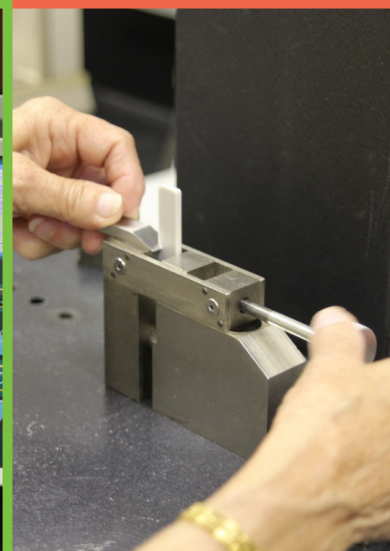
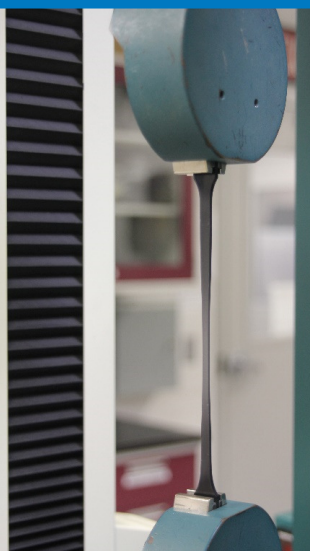
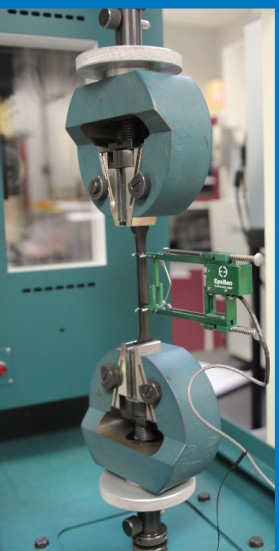
Tensile

Izod Impact

MFI

Density

- 1 Gaylord for 30 piece molding tryout and initial performance testing
- 300 piece capability study and final performance testing
- Ongoing supply audits of material properties



Ongoing Product Durability Testing



- Daily Product Testing

- We have built a reputation for producing durable products by constantly testing our ideas. Every concept is proven before entering the field

- Life Cycle
- Durability
- Bottom Wear
- Weather Condition Impacts
- Cycle Test
- Customer Testing





QUESTIONS?

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