Improving DLFT Molding Productivity Via Lessons Learned in Non-automotive Applications

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Outline

• DLFT Process Briefing

• Auto Applications and DLFT Brief

• Non-Automotive Case Studies
  – Roof Beam
  – Fan Housing
  – Personal Watercraft Structure
  – Flat Paneling

• Conclusions
The DLFT Process

• **Direct Molding of Long Fiber Thermoplastics**

• Branched off of LFT Pellet compounding to shorten the supply chain to lower material costs and streamline the supply chain.
  - Machine Building, Materials Validation, Product Design, Processing all under 1 roof.

• Globally present technology since the 90’s.
Compounding

Thermoplastics
- Olefins
- Amides
- Styrenics
- Polyesters

Reinforcements
- Glass (13mm-75mm)
- Carbon
- Natural Fibers

Additives
- Colors
- Fillers
- Coupling
- FR

***All materials are gravimetrically fed for precise content***
Molding and Tooling

**Compression Molding**

**Injection Molding**

**Transfer Molding**

- Vertical or Horizontal Presses
- Press Tonnages 1000-5000 Ton
- Compounding from 100#/hr – 2200#/hr
- Part Sizes from 2# - 100#
- Typical Injection Molding Advanced Capabilities (Gas assist, Hot Runners, etc.)
Auto Applications
Past & Present

• Dominant Design Themes
  – Component reduction (fastener and weldment reduction)
  – Weight savings (vs. metal or SMC)
  – Corrosion Resistance
  – Paint Replacement (Molded in Color and UV resistance)
Past/Present DLFT Applications

- Running Boards
- Underbody Shields
- GOR’s
- Grille Guards
- Door and Window Surrounds
Recent Non Automotive Application Case Studies
RV Roof Beam/Rafter
CPIB Proprietary Product

Design Drivers
• Ease of Assembly at Vehicle Manufacturer
  • C-Channel concept and very large windows.
• High volumes
  • 4 cavity thin wall concept

Replaces existing Wood and Metal Rafters
RV Roof Beam – CPIB Proprietary Product

Challenges
- Aggressive material pricing targets.
  - Virgin resins not possible.
  - Thin Walls

Counteractions
- >60% recycled content materials
- Single part testing method to validate variation.
- Gaylord level viscosity control
- Unique Hydraulic Tool preload Setup

- Accept a variety of fasteners.

Wood Piece Molded into each End of Part

- Overmolding of wood block
Fan Shroud & Doors

Design Drivers
- Corrosion Resistance
  - Polypropylene and Glass Fiber
- Maximize component integration
  - Doors and Shroud in one tool and press cycle
Fan Shroud and Doors

Challenges
• High Level of Dimensional Control without the use of ribs
• Post Mold Separation of the Doors from the Shroud

Counteractions
• Creative material placement to create unique radial fiber alignment
• Door/Shroud combination tool with Turntable saw.

Lessons Learned
• Launch Costs were high because of trial and error nature and lack of predictive analysis available at the time.
• Be cautious when applying isotropic shrink to a tool where the part has very high non-isotropic shrink.
Personal Watercraft
Bottom Structure

Design Drivers
• Part Flexibility and Aesthetic Freedom
  • Compression molding with out-of-draw features.
  • Flexibility of rapid z-thickness changes and glass content to streamline launch.
• Fast Cycle Times (compared to spray-up or hand lay-up)
Personal Watercraft Bottom Structure

**Challenges**
- Matching impact and durability of glass filled thermoset.
- Predicting part shrinkage to 99.9% accuracy on a part weighing 90lbs and being 2667mm (105”) long.

**Counteractions**
- Proprietary high impact long glass fiber polyolefin mixture (heat & light stabilized).
- Predictive shrink analysis using long fiber modules Autodesk/Moldflow on both a scaled prototype and applied to the full scale model to cut tool with a unique x,y,z, shrink.

**Results**
- Durability which matched needed performance.
- Part length off by as little as 1mm.
Flat Paneling

**Design Challenge**

- Predict than create a low warp long fiber thermoplastic panel for use in various packaging applications.
- New modeling available from Autodesk
  - Compression molding LFT module
  - Scandium with Sim360
  - Predicting process, dimensions, and strength
Decomposing Variance of Warp

Total Warp

Contribution of Cooling & Cycle Time
Contribution of Geometry
Contribution of Fiber Orientation
Verifying Counteractions

Verify fiber orientation techniques (Low cost solution)

Verify geometry techniques (high cost solution)
Conclusion

• Direct Molding of Long Fiber Thermoplastics has been providing economical solutions for structural plastic parts to the automotive industries for over 20 years. An emphasis on component reduction, weight reduction, enhanced aesthetics and corrosion resistance has driven current application design.

• Gaining experience through the non-automotive applications has driven us to improve the predictability of process characteristics (particularly in compression molding long fibers), product strength characteristics, and dimensional characteristics. Applying past knowledge with these new tools will help improve new product launch lead times and overall quality.