Long Glass Fiber Reinforced Polypropylene (LGPP) for Automotive Structural Applications

Presented by

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Overview

- **Introduction**
- **Materials - Technology/Characterization/Applications/Trends**
- **Case Studies – Innovations/Challenges highlighted in the following areas:**
  - Material
  - Process
  - Assembly
  - Quality
- **Summary**

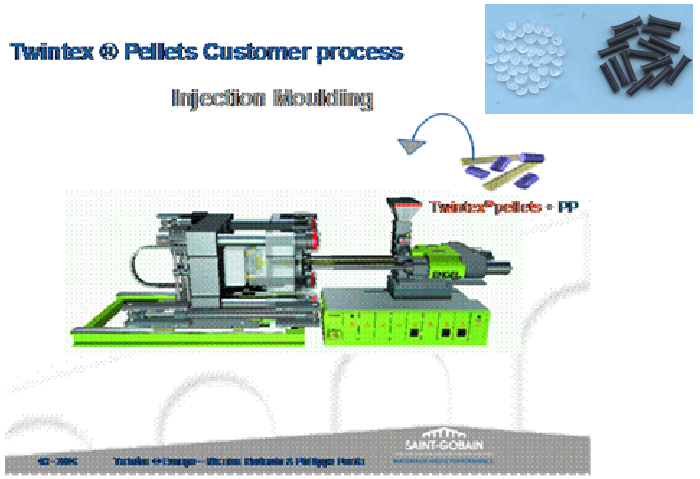
Introduction

- Automakers are facing more challenges than ever. The type of material being selected is driven by:
  - Cost – resin, fiber etc.
  - Weight – low density or light weight material
  - Design – strength, stiffness, toughness, impact resistance, etc.
  - Process – wide processing window, conventional equipment, etc.
  - Innovation – D-LFT, Metal/Plastic Hybrid, LESA etc.
  - Recyclability etc.

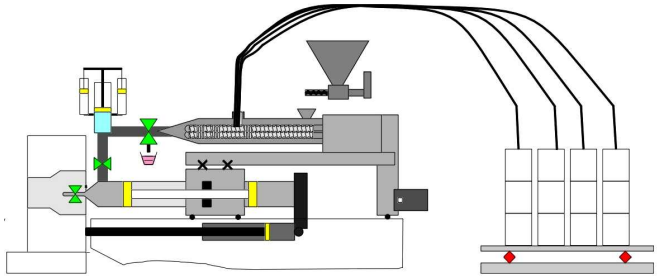
LGPP is considered as the first candidate and has gained rapid growth.

Materials – Technology for Injection Molding

Pre-compounded



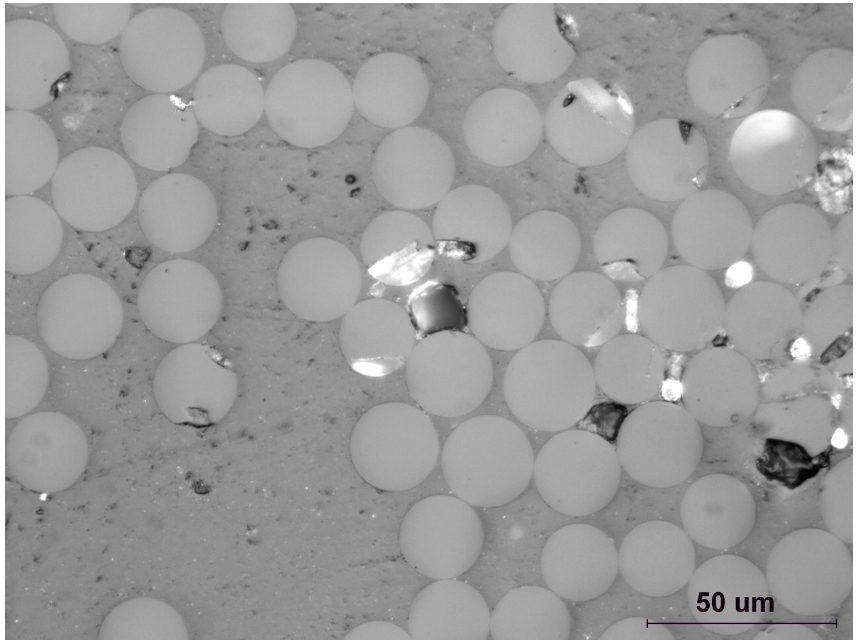
Fiber Concentrates



Direct In-line Compounding and Molding (D-LFT)

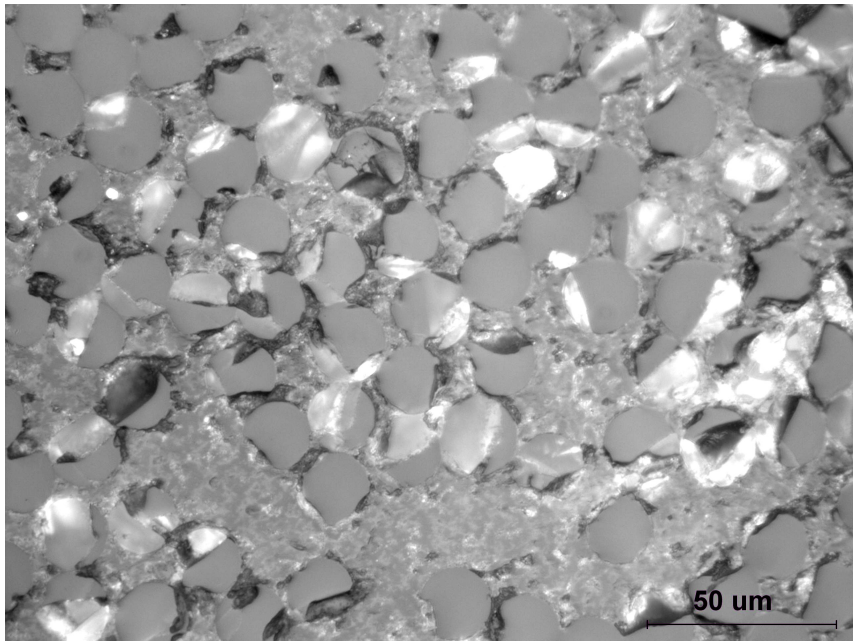
Materials – Microstructure

Pre-compounded Pellets: 40% LGPP
Irregular shape, 11 mm long and 24 um diameter filament produced by supplier C

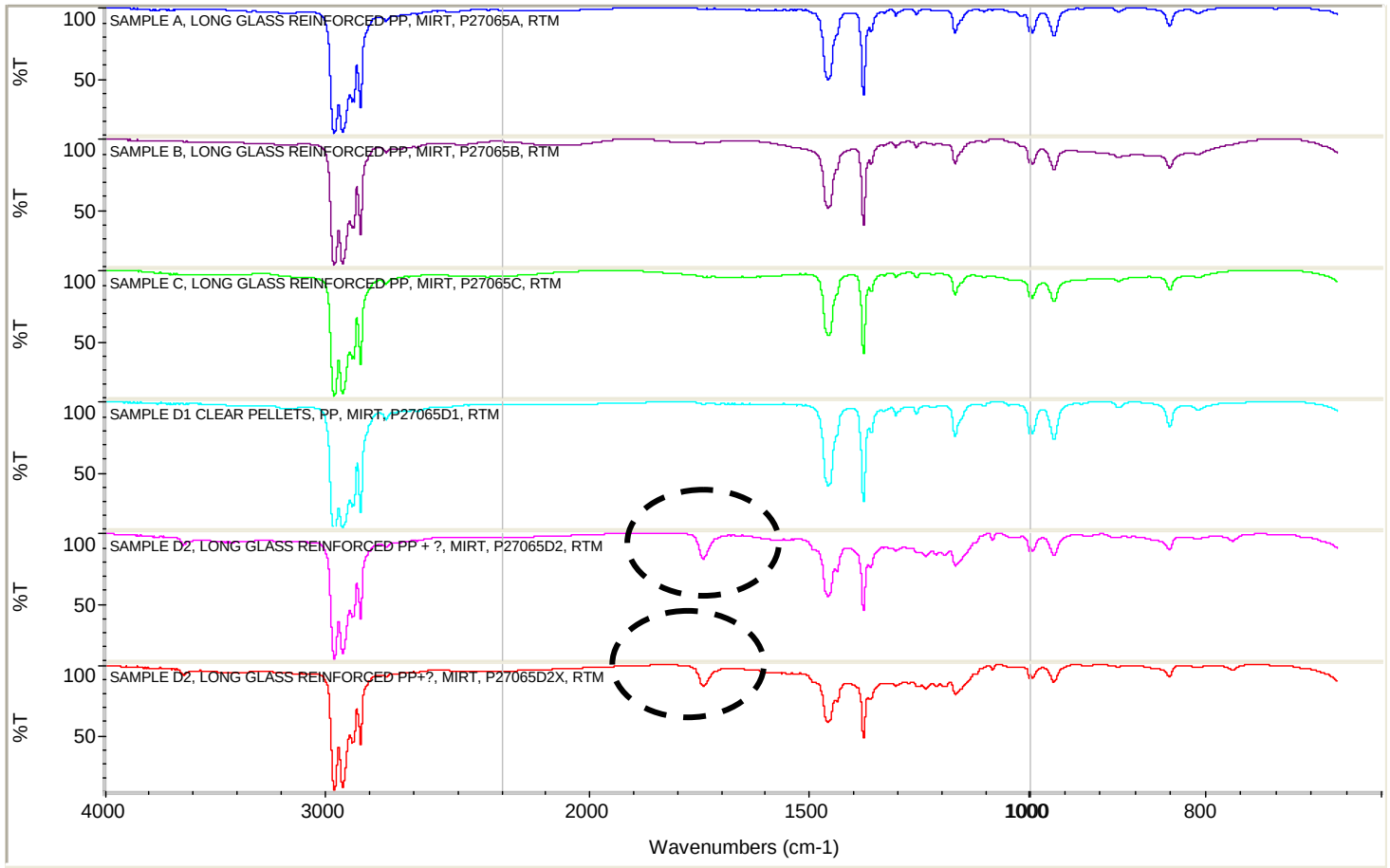


Materials – Microstructure

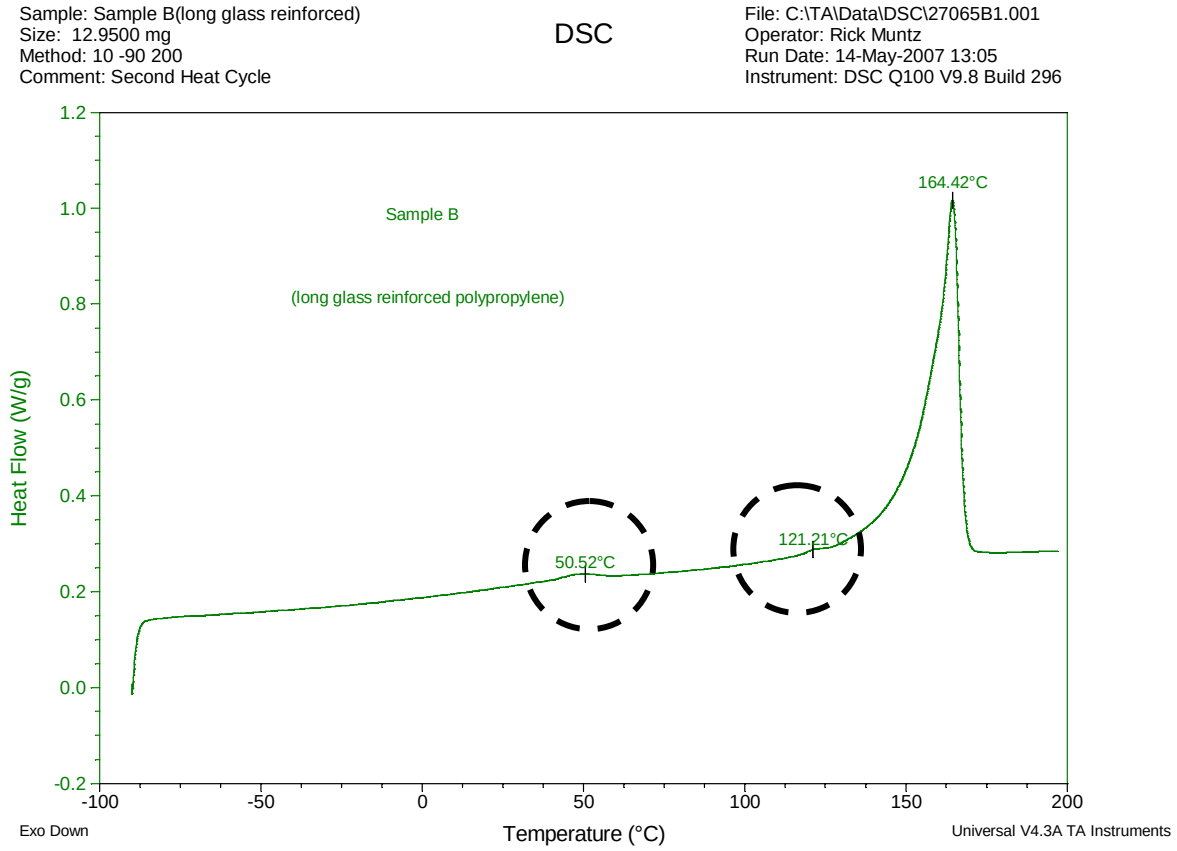
Fiber Concentrate Pellets: 75% LGPP
circular shape, 12 mm long and 19 um diameter filament produced from supplier D



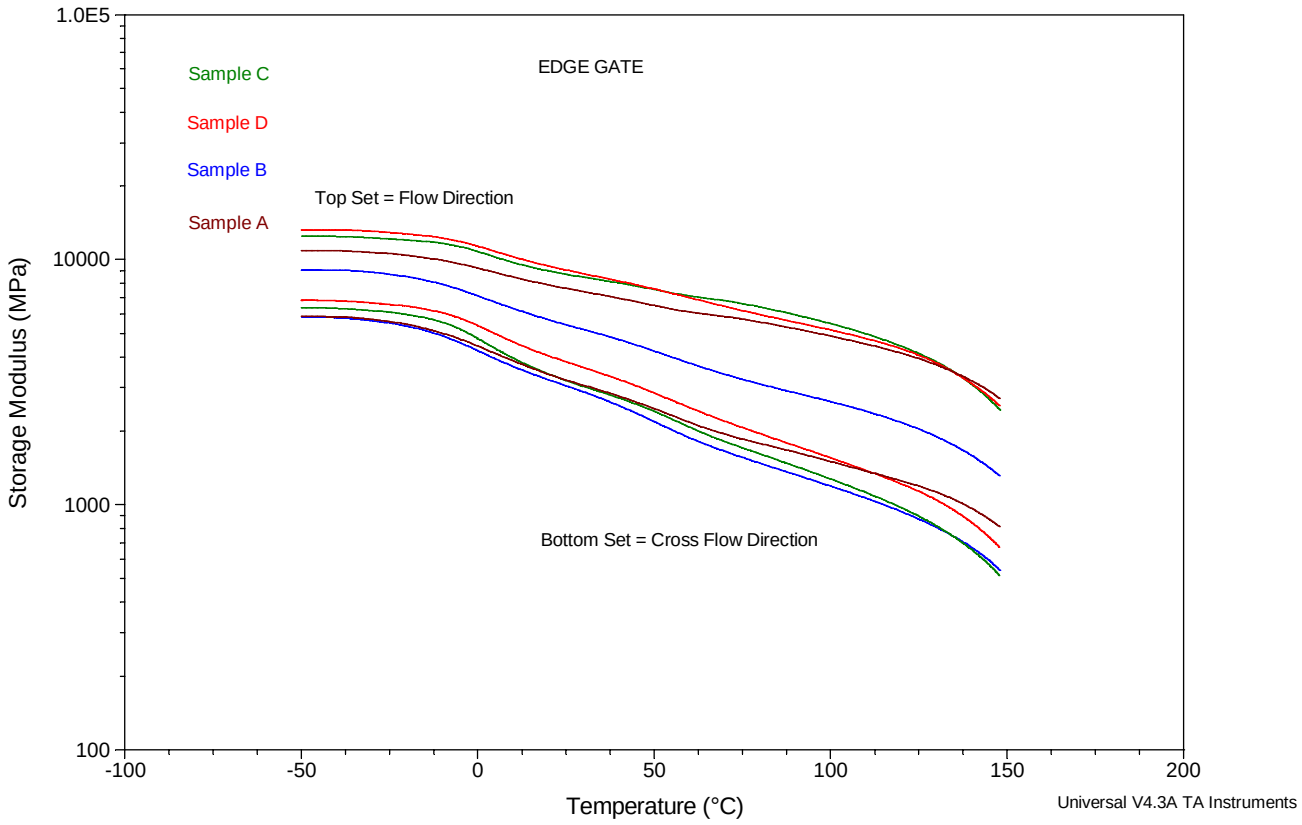
Materials – FTIR



Materials - DSC



Materials - DMA

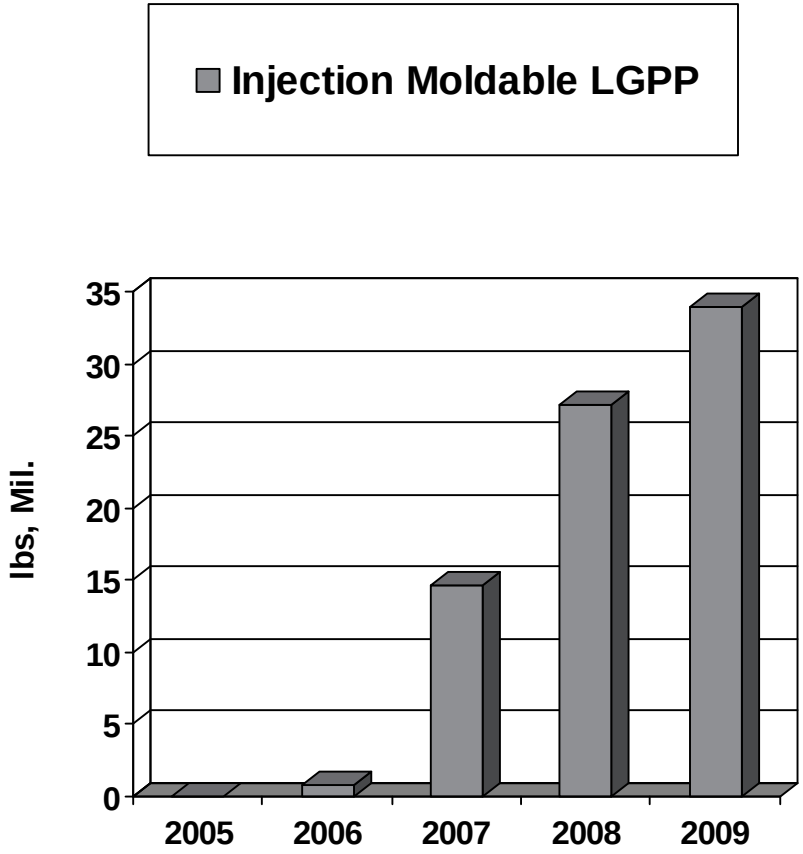


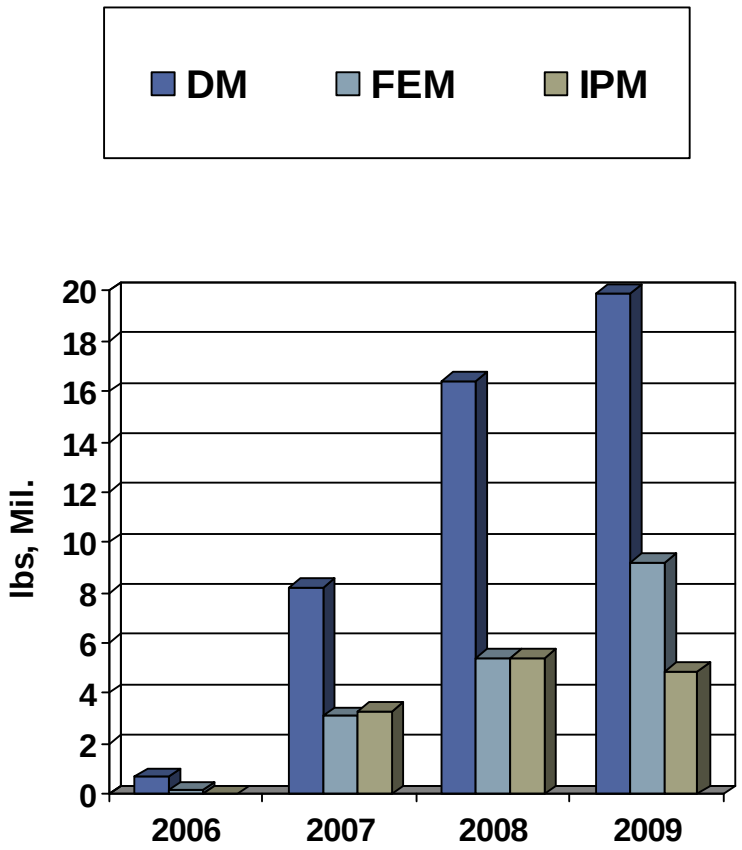
Materials - Applications

LGPP has gained tremendous growth at Chrysler Group in the following vehicle areas:

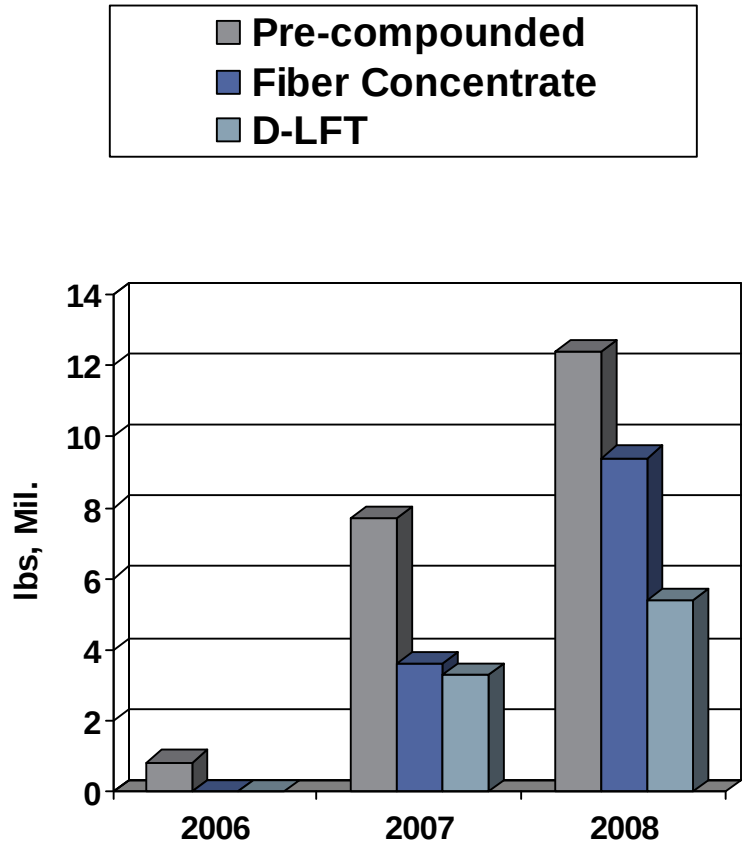
- Front-end Modules (FEM)
- I/P Modules (IPM)
- Door modules (DM)

Materials – Consumption in CG





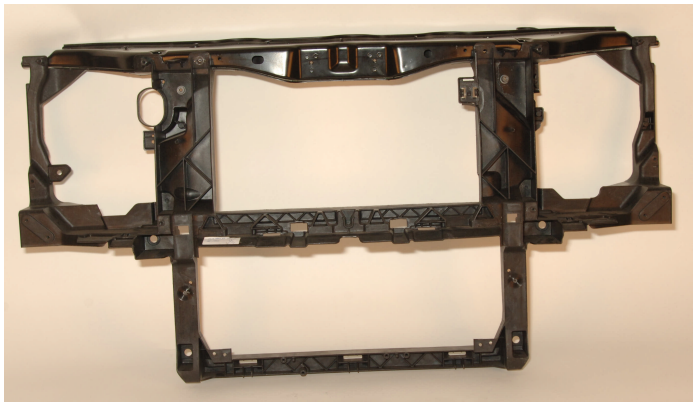
Materials - Technology Trends in CG



Case 1: 2008 Jeep Liberty – FEM Carrier

LGPP: Pre-compounded

- **Tier 1**
  - Decoma
- **Molder**
  - Plydex
- **Mold Maker**
  - Omega
- **Material Supplier**
  - Ticona
- **Material**
  - PP-GF40-03



Front View of FEM Carrier

FEM Carrier – Part Consolidation and Function Integration

The carrier is the key component of the FEM, all module components are connected to it!

- Hood Seal, Hood Bumpers
- Seals, Mounting Bracket
- Engine Cooling Module
- Wire-harness, Sensors
- Grille, Headlamps
- Prop Rod, Hoses
- Sirens, Horns
- Hood Latch
- Carrier Panel, washer bottle, coolant bottle etc.

Common Components Shared Between 2008 Jeep Liberty and 2007 Dodge Nitro

The most important potential benefit of modular construction is standardization, allowing suppliers to offer standard solutions to different programs and hence bring cost down.

- 40% LGPP
- Sirens
- Horns
- Hood bumpers and seals
- Hood latch
- Fasteners
- Compression limiters etc.

FEM Carrier - Highlights

- **Material**
  - Pre-compounded, 40% glass LGPP
- **Process**
  - Injection molded one piece: weight: 10 lbs
- **Assembly**
  - Post-mold assembly
    - Innovation: Metal/Plastic hybrid through bonding from Dow
    - Innovation: LESA from Dow
- **Quality**
  - Material Specifications – MS-DB41 for LGPP; MS-CC634 for adhesive

Top View of FEM Carrier

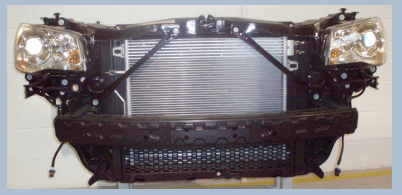
Case 2: 2008 Fifth Generation of Minivan – FEM Carrier

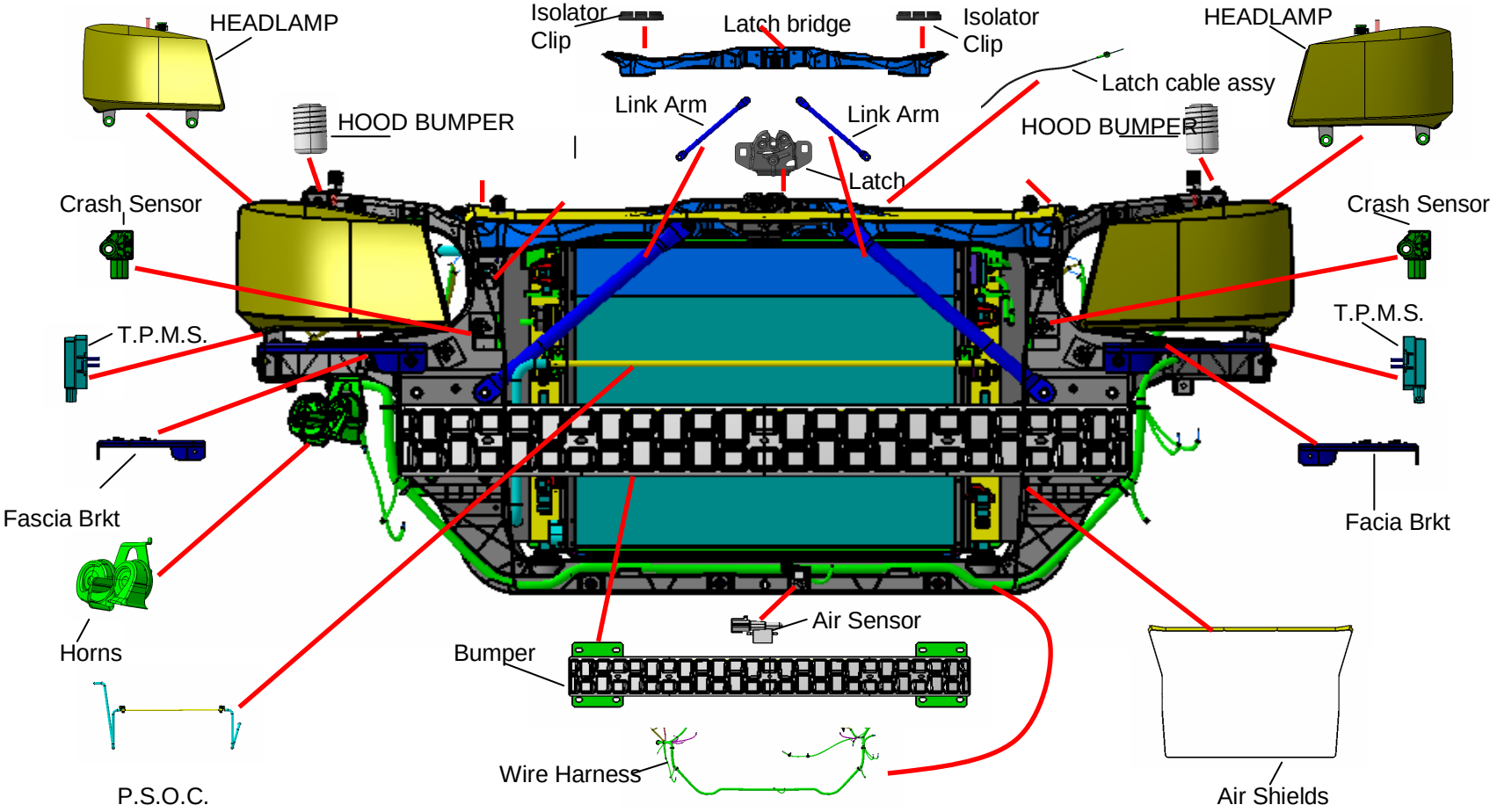
LGPP: Fiber Concentrate

- **Module Supplier**
  - HBPO N.A.
- **Molder**
  - AP Plasman & KollerCraft Plastics
- **Mold Maker**
  - Windsor Mold & Build-a-Mold
- **Material Supplier**
  - Sunoco Chemical (Base Resin)
  - Saint-Gobain Vetrotex (Fiber Concentrate)
- **Material**
  - 20% PP LFG

Plastic Portion of the Carrier

FEM Carrier – Part Consolidation and Function Integration





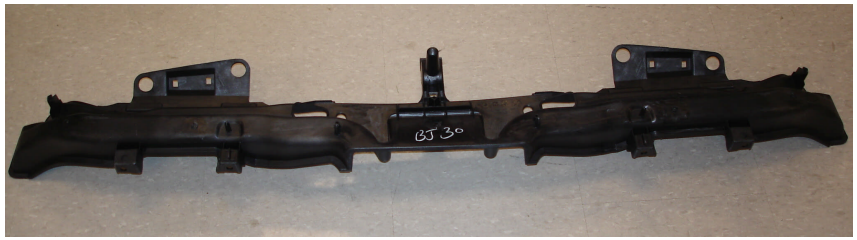
FEM Carrier - Highlights

- **Material**
  - 20% LGPP
  - Innovation: utilize 75% fiber concentrate
- **Process**
  - Injection molded one piece – 6.6 lbs
  - Challenge – To obtain consistent material blend. Selecting a qualified gravimetric feeder is crucial for success.
- **Assembly**
  - Post-mold assembly – Metal/plastic hybrid using rivets
- **Quality**
  - Material specification – Utilize ASTM & line call-out to specify LGPP

Case 3: 2008 Jeep Liberty – I/P Structural Duct

LGPP: D-LFT

- **Tier 1 Cockpit**
  - Johson Controls Inc.
- **Tier 2 Instrumental Panel**
  - Intertec System
- **Equipment Supplier**
  - Krauss-Maffei
- **Mold Maker**
  - Phillips Tool & Mould
- **Material Supplier**
  - Basell Polyolefins (Resin);
  - Saint-Gobain Vetrotex (glass)
- **Material**
  - 30% PP LFG



Front View of I/P Structural Duct

I/P Structural Ducts - Highlights

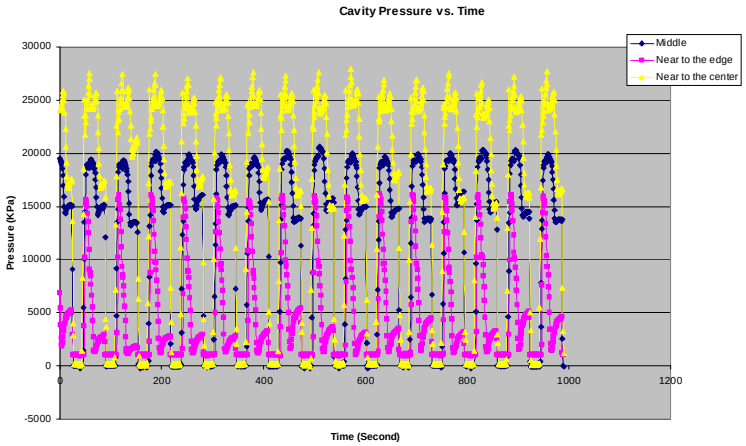
- **Material**
  - Innovation - D-LFT from KM, 30% LGPP
- **Process**
  - Injection molded two pieces – 18 lbs in weight
  - Challenge – A backup plan when the machine goes down.
- **Assembly**
  - Post-mold assembly – Vibration welding
- **Quality**
  - Material specification – Utilize ASTM & line call-out to specify LGPP

Side View of I/P Structural Duct

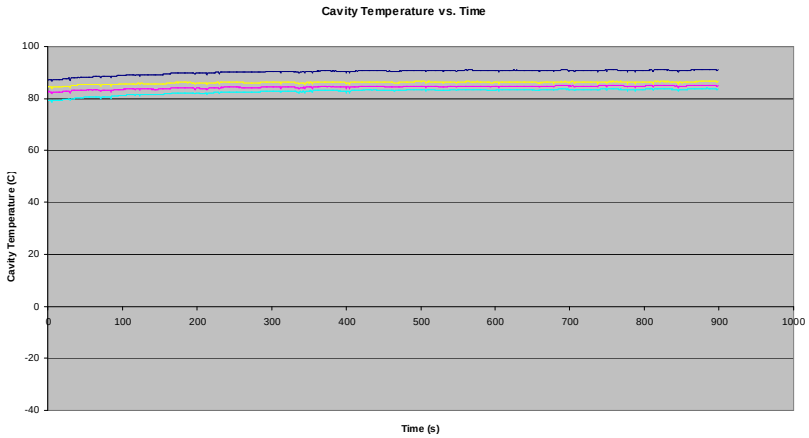
Summary

- **Sustainable growth in FEM, DM and IPM areas**
- **Continuously benchmark existing technologies and evaluate upcoming new technologies**
  - ACC (Automotive Composite Consortium)
    - ACC Materials Working Group
      - Characterization of Thermoplastic Materials
        - A new injection plaque tool – size: 2ftx2ftxt; gate configurations: 3; cavity pressure: 3 locations; tool surface temp.: 4 locations
- **Proactive support and pursuit of an industrial standard to measure or evaluate fiber length and length distribution**

Processing Data – LGPP Plaque Molding



Cavity Pressure vs. Time



Cavity Temp. vs. Time

Acknowledgement

- Chrysler Group – *Bernardo Gonzalez, Jose R Cazares, Rick Muntz, James Shi*
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Q & A

Thank You