Manufacture High Throughput Sustainable Automotive Parts Using Spray Transfer Molding (STM) Technology

Joint development
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Outline

• Concept of Lightweight Sandwich Materials
• Spray Transfer Molding (STM) Process
• Sustainable Polyurethane (PU) Application
• Natural Fiber- Jute, Flax, and Bamboo fibers
• Natural Reinforcements: Basalt
• Test results
• Parts made
• Conclusions
STM – Polyurethane Honeycomb Process
STM PU – Automotive Benchmark
Sustainable solution
Elastoflex® 28690 – Accelerator Sustainable Polyurethane

- 15-18% Bio renewable content
- Low demold time
- Non-sag formulation
- Good open time to make large parts
- Compatible with multiple reinforcement fibers
- Compression time can be reduced up to 40sec in the tool
Standard PU Vs Sustainable PU

15 mm paper core height on 450 (grams/m²) chopped random glass

Mechanical performance of sustainable PU is slightly higher than commercial PU
Why natural fiber for Structural approach?

- Renewable Resource
- Growth Rate
- Superior Mechanical Behavior (Particularly Flexural)
- Low Density
- LCA benefit
Material Preparation
Plaque Parts

Preparing the material

Plaque made with half size include basalt net
Adding Basalt net increases the strength 38%, stiffness 28% and weight 4%
Flexural testing results on Honeycomb

- Jute has higher ductility
  - At failure, it has softer failure than brittle Glass fiber
- Bamboo fibers increases strength

- Bamboo (35% 4" random)
- Jute (70% Jute, 30 polyester)
Flexural Bending on a Part Compared to GF

- Bamboo part matched the performance of GF
- Fracture of GF was louder than the bamboo
- The fracture occurred on the same location for both materials
STM-PU with natural fiber did not uptake water
Life Cycle Assessment - Benchmarked to PP on a part

• Polypropylene benchmark
  ▪ 1 kg part (70% PP + 30% Glass fiber)
  ▪ 8% scrap rate
  ▪ Benchmark 1 assumes molding energy of 6 MJ / kg
  ▪ Benchmark 2 assumes Plastics Europe data for injection molded part (2005)

• Polyurethane System
  ▪ PU System is Elastoflex® 28690
  ▪ 150 gsm jute/polyester sheets (3 layers; 450 gsm) (jute imported from Asia / Bangladesh; rain fed)
  ▪ 3% scrap rate
  ▪ Energy requirement estimate of 3.6 MJ / part
  ▪ Final part weight (measured): 0.726 kg (mass) 0.5005 m² (area)
Life Cycle Assessment

Life Cycle Assessment results
Overall Environmental Impact, including USE Phase (light weighting)
Parts Production
Auto Parts Made

Door panel
- In mold coating with grain look
- 80% sustainable material (Jute, Honeycomb)

Underbody panel
- Reinforced with basalt
- 80% sustainable material (Jute and Flax)
Auto Parts Made continued

Center Console
- Bamboo and Flax
- 3D inserts inside for joining
- 40% weight reduction vs control

Honeycomb loadfloor
- Jute and Flax
- 70-80% sustainable
Conclusions

• STM PU allows manufacturing of complex shapes

• STM PU has low cycle time for high throughput applications

• Identified Elastoflex® 28690 as an accelerator PU
  ▪ Works well with all natural fibers

• Natural Fiber can be a good replacement for semi structural application

• Sustainable PU has good LCA results
Thank You