Pultrusion Overmolding
For Energy management

BASF Composite Technology
Solutions
Specimen continues to carry the load on post-initial fracture region.

Owing to progressive delamination, the material exhibits a “ductile” behavior and absorbs significant amount of impact energy (Mallick, 2008)³


Potential for significant cost and weight savings
Roving and Fiber Mats
- Provide the strength to the structure

Fiber Alignment
- Defines the anisotropic properties of the structure
- Can be optimized for application requirements using ULTRASIM® BASF proprietary tool

ELASTOCOAT
- BASF Polyurethane System used to bind fibers together

Heating Zones
- Used to control the curing time

Mixing Chamber
- Controls the impregnation of fibers with ELASTOCOAT PU system

Customized Length Profiles
PULTRUSION
Performance on Tensile Test

- Pultrusion strength is comparable to Steel grades (fiber direction)
- Pultrusion elastic modulus is comparable to Magnesium
- Pultrusion density is only 1/3 compared with steel
PULTRUSION
Fiber Architecture (CT Scan Pictures)

- Loose glass rovings bonded by resin
  - Alternating layers of 0° and 90° oriented glass roving

- Top and bottom layer: biaxial
  - Bundled glass rovings bonded by veil

- Middle layer: all roving
PULTRUSION
3Pt Bending Impact Performance

Max Force and Total Energy at 23°C

- Biaxial
- Uniaxial
- Hybrid
- All Roving

Max Force [kN] and Total Energy [J]
PULTRUSION
Overmolding BASF Multi-Test Part

Thermoplastic Overmolding
Ultramid®
  - B3Z HP (PA6 Impact Modified)
  - B3WG6 (PA6 30%SGF)
  - B3ZG7 OSI (PA6 35%SGF Impact Modified)
  - B3WG13 HPX (PA6 63%SGF)

Pultrusion Insert
Elastocoat® 74850
“All Roving” Architecture
PULTRUSION Overmolding Dynamic Test

Weight: 50lb
Velocity: 2m/s
Temperature: 23°C
Energy ≈ 50 Joules

Test Conditions
PULTRUSION Overmolding
Dynamic Test

Force vs Displacement
Ultramid B3WG6 Solid and Overmolded Specimens

B3WG6 + Pultrusion
B3WG6 Solid
PULTRUSION Overmolding
Dynamic Test

No GF + Impact Modif.  30%GF  35%GF+Impact Modif.  63%GF
PULTRUSION Overmolding
Dynamic Test – Force vs Displacement

Solid

Fracture
Fracture
Slipped
B3ZHP Solid
B3WG6 Solid
B3WG13 HPX Solid
B3ZG7 OSI Solid

Pultrusion

Fracture was initiated but component bounced back and remained in 1 piece

B3ZG7 OSI + Pultrusion
B3Z HP + Pultrusion
B3WG6 + Pultrusion
B3WG13 HPX + Pultrusion
PULTRUSION Overmolding
Dynamic Test – Displacement and Energy Absorption

- More fiber, less difference on weight (solid vs overmolded)
- More fiber, less deflection.
- Pultrusion reinforced components absorbed energy due progressive delamination.
PULTRUSION Overmolding
Dynamic Test – Energy Absorption

Improvement on energy management capabilities using Elastocoat®
pultrusion inserts

Ultramid B3WG6 Comparison Impact Test

- 20% Mass Increase
- 118% Additional Energy

B3WG6 Solid
B3WG6 + Pultrusion

Ultramid B3WG13 HPX Comparison Impact Test

- 3% Mass Increase
- 112% Additional Energy

B3WG13 HPX Solid
B3WG13 HPX + Pultrusion

13% Mass Difference
Conclusions

- The experiment confirmed the effect of CFR pultrusion inserts: ductile behavior and increase of impact energy absorption due progressive delamination.

- Thermoplastic overmolding opens an opportunity for joining methods and features incorporation to pultrusion structural members.

- Pultrusion offers a high-performance weight ratio that is traduced on weight and cost savings opportunities.

- Several components have been identified for the implementation of pultrusion components with overmolded thermoplastics.
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