LONG FIBER REINFORCED THERMOPLASTICS

ENABLING ECONOMICAL VEHICLE LIGHT WEIGHTING THROUGH NEW GLASS REINFORCEMENT SOLUTIONS

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TOPICS FOR TODAY’S TALK

WE’LL TOUCH ON...

Market Drivers for Long Fiber Thermoplastics

Long Fiber Thermoplastic Advantages

Owens Corning’s new Performax® SE4849 roving for LFT PP
**CO2 Emission Regulations on the 3 Continents**

**Key Drivers for Weight Out Initiatives in Automotive**

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**Mega Trends**
- Lower CO2 emissions
- Urbanization
- Globalization

**Transportation Trends**
- Need for light, less pollutant vehicles
- 50% of automotive sales from BRIC
- Increased comfort demands

**Automotive Industry Trends**
- Improve fuel efficiencies
- New OEM & market concentration
- Increased vehicle functionality

**Impact for Materials and Chemicals**
- Advanced composites solutions
- Advanced polymers
- High strength metals
- New battery materials & chemicals

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Source: Owens Corning Marketing Intelligence
REACHING EMISSIONS & FUEL EFFICIENCY TARGETS

- Efficient Diesel Engines
- Smart Gasoline Engines
- Alternative Power Train Designs
- Light Weighting With The Use Of Composite
  -100 Kg
- Use Of Bio Fuels And Bio Diesel
  -0.35 l/100km
- Alternative Transmission Systems
  -9.0 g/km
THE MARKET DRIVER FOR LONG FIBER THERMOPLASTICS
LEADING EUROPE CO₂ EMISSIONS REGULATIONS

The 2012 EEA report indicates OEM’s will achieve the 2015 CO₂ emission targets.

CHALLENGE
Reach the 2020 target of 95g CO₂ /km

by 2015: 130 g CO₂/km
by 2020: 95 g CO₂/km
by 2025: 75 g CO₂/km

Average CO₂ emissions from new passenger cars

Source: European Environment Agency database 2012 - Tailpipe Emissions, g CO₂/km
THE MARKET DRIVER FOR LONG FIBER THERMOPLASTICS
LIGHT WEIGHTING

- **C02 emissions are linked to vehicle mass**
- **Light weighting is essential to C02 emission reductions**

Source: European Environment Agency database 2012
Short term
- Aluminum will displace steel for one on one replacement,
- With pure focus on weight out.

Medium-long term
- Composites allow for enhanced function integration,
- But requires re-engineering of the car modules.

Approximately 200kg of weight reduction per vehicle will be required to address OEMs CO₂ gap
GLASS REINFORCED COMPOSITE OPPORTUNITIES IN AUTOMOTIVE

Vehicle production expected to exceed 100MM units* by 2020

Potential of weight out due to composites is estimated at ~100 kg by 2020 (20-25 kg of reinforcements per car)

Source: Owens Corning estimate, 2013. *: IIHS Global Insights and CSM Auto Forecast December 2011

The graph excludes the amount of non-structural composites used in vehicles today.
LONG FIBER REINFORCED THERMOPLASTICS

ADVANTAGES OF LONG FIBER THERMOPLASTICS
WHY LONG FIBER THERMOPLASTICS?

Advantages versus Short Fiber
- Significant lower warpage vs short glass fibers
- Much lower CTEs and higher isotropy than short glass fibers
- Improved impact performance (especially Low temp.)
- Improved creep resistance (better than PA short glass fiber)
- Improved long and short term heat resistance

Advantages versus Metal
- Lower weight
- Parts consolidation leading to lower cost

Source: Owens Corning
THE LONG FIBER ADVANTAGE

Stress is transferred to the fibers

*The structural members of the composite*

Long glass fibers create a “skeletal structure” within the molded article

*Resists distortion and provides unmatched strength, toughness and overall performance*

Source: Ticona
LONG FIBER VS. SHORT FIBER GLASS REINFORCED LFT

LFT Technology boosts material property profile: Dry-as-molded as well as Creep and Heat Resistance.
GLASS REINFORCED LFT SNAPSHOT

- **Growth Rate:** 11-13% CAGR for the period 2013-2017
- **Glass Reinforcements:** >140Kt/yr
- **LFT Process:** 64% LFTP Compounding, 21% DLFT, 15% CFRT (Tapes)
- **Polymer:** 80% PP, 13% PA, 7% Other
- **Market Segmentation:** 81% Automotive, 7% Furniture, 5% EE, 7% Other

Source: Owens Corning Marketing Intelligence- Total LFT industry glass volume demand.
LONG FIBER REINFORCED THERMOPLASTICS
PERFORMAX® SE4849 ROVING
SE4849 ROVING
REDEFINING LFTP PP & CFRT PP COMPOUND PERFORMANCE

Provides outstanding glass processing and wet out

Enables up to a 30% increase in compounding line speed

Opens new applications through high glass loading

Inner door module application example
SE4849 ROVING

BENEFITS

- Improved resistance to fuzz generation for easier processing
- Reduced strand stiffness for easier splaying
- Increased lubricity for lower strand tension
- Improved splice tensile strength enhancing line efficiencies
- Improved LOI consistency for uniform compounding
- Outstanding compatibility with PP for better wet-out and dispersion
- Optimized adhesion to PP to meet all mechanical performance needs
- Exceptional Color

Owens Corning internal tests
SE4849 ROVING
EXCELLENT RESISTANCE TO FUZZ ENABLING
SUPERIOR GLASS PROCESSING

FUZZ generation **50%-83% better** than competitors

**FUZZ** is an accumulation of short broken or untangled glass filaments that collect at a strand contact point.

**Impregnation Die Nozzle Fuzz Level (mg)**

- **SE4121**
- **SE4805**
- **SE4849**
- **Comp 1**
- **Comp 2**
- **Comp 3**

**Outstanding Fuzz Resistance** (along with Dispersion) enables up to **20%** increase in glass loading.

Owens Corning internal tests - Ibaraki Q4 2013
**SE4849 ROVING**

EXCELLENT GLASS DISPERSION DELIVERING HIGHER GLASS LOADING and FASTER LINE SPEED POTENTIAL

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**DISPERSION 21% better** than OC standard product

**DISPERSION UP TO 40% better** than some competitors

**DISPERSION** refers to the ability of the reinforcements to flow and scatter evenly within the polymer matrix thereby providing uniform fiber-polymer adhesion and load transfer.

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**Undispersed Glass Count**

<table>
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<th>Count of white spots</th>
<th>SE4121</th>
<th>SE4849</th>
<th>Comp1</th>
<th>Comp2</th>
<th>Comp3</th>
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<td>16</td>
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<td>20</td>
</tr>
</tbody>
</table>

**Outstanding dispersion** (and Fuzz resistance) enables up to **30% increase in LFTP line speed**

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**Physical count of undispersed glass on twenty 89mm x 89mm x 2mm low shear injection molded plates**

75% line speed increase realized on the lab line while up to 30% achieved on Industrial lines

Owens Corning internal tests (Ratio [%] of GC50) - Granville and Ibaraki Q4 2013
SE4849 ROVING
EXCELLENT SPLICE STRENGTH FOR EFFICIENT PROCESSING

46% better than OC standard products
UP TO 38% better than some competitors

Owens Corning internal tests - Ibaraki Q4 2013

*Kilogram-force

Air splicer: JOINTAIR 116 by MESDAN
Test conditions: Air pressure 0.7MPa, L6, T6, Chamber 127M
SE4849 ROVING
TOMORROW’S PROCESSING CHARACTERISTICS COUPLED WITH MECHANICAL PROPERTY PERFORMANCE TO MEET TODAY’S DEMANDS

SE4121 at 100% for reference

TENSILE

FLEX

Competitors Average

Competitors Average

Owens Corning internal tests - Granville and Ibaraki Q4 2013
SE4849 ROVING
TOMORROW’S PROCESSING CHARACTERISTICS COUPLED WITH MECHANICAL PROPERTY PERFORMANCE TO MEET TODAY’S DEMANDS

SE4121 at 100% for reference
SUMMARY

Market Growth for LFT looks bright

Automotive Light Weighting will drive growth

Glass Reinforced LFT is one of the most economical solutions

Owens Corning Performax® SE4849 will help improve the overall economics
Thank you.

For more information or inquiries, please contact

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