The Plastic Truck Bed and New Composite Solutions in Exteriors

Frank Silvagi
Vice President of Engineering & Product Development
Continental Structural Plastics
Agenda-at-a-glance

• History of Composite Truck Boxes
• Why Light Weighting Matters
• Material Advancements and Structural Ultra Lite
• Future Considerations
History of Composite Truck Boxes and Current Market Acceptance
History of Composite Boxes

• Thoughts of plastic and composite truck boxes as a way to reduce weight have been studied by engineers and designers starting back in the early 1980s.

• Since that time, the auto industry has seen multiple forms of plastic boxes emerge through multiple OEMs and truck platforms.

• Material options have included SMC, thermoplastics, and UV Stable formulations. Designs range from a single piece box to multiple piece boxes with integrated features.

• Light weighting, feature enhancements, and durability are key factors in an OEM’s decision for material selection.
The Last Three Decades
Composite Box Development 1980s – 2000s

1987 Ford Ranger
Ford's first composite box from 1987-1990. The one-piece box inner, box tops, wheel liners, and tailgate inner was compression molded with 50% glass vinylester SMC. Over 600 trucks were produced for field testing by rental fleets.

1987 Ford Ranger ProTec
This one piece box was Structural Reaction Injection Molded (SRIM). Offered as the “ProTec” option for MY01-03 Chevy Silverados.

2001 ProTec 2001 SPE Award Winner, Most Innovative Use of Plastics
ProTec 2001 SPE Award Winner, Most Innovative Use of Plastics. Offered as the “ProTec” option for MY01-03 Chevy Silverados.

2001 Ford Sport Trac
SMC single-piece pickup box. First use of Class-A SMC Box Outers.

2004 Toyota Tacoma
The longest running composite bed on the market, producing over 2M units since its introduction in 2004.

2004 Toyota Tacoma
SMC Bed and Cargo area with light weight LFTD side and back panels. UV formulation, unpainted.

2006 Honda Ridgeline
SMC bed, headboard, and side panels on unibody construction with steel reinforcements.

2007 Next Gen Ford Sport Trac
Next generation Sport Trac was built off the Explorer Frame. Utilized a multi-piece bonded construction to take advantage of storage and added features.
Next Generation Advancements

The last few years have seen major advancement in composite material technology as well as new players entering the marketplace.

- The Next Generation Honda Ridgeline added multiple composite materials to the box including thermoplastics, SMC and UV stable formulations.
- The Ford F-150 came on the scene in 2015 with an all aluminum cab and box structure, boasting a 700+ lb. savings.
2017 Honda Ridgeline

2017 MY Honda Ridgeline is the latest entry to the composite box market
2017 Honda Ridgeline

- **Material:** Continental Structural Plastics UV SMC and UV DLFT. This reduces cost by eliminating the need for top coat.

- **Applications:** Multi-Piece Bed, In-Bed Stowage Trunk Assembly, Spare Tire Carrier, Trunk Lid, Tailgate Liner, and significant component integration.

- **Utility:** The Ridgeline is the only pickup that features a lockable, weatherproof in-bed stowage trunk.

The composite box takes full advantage of the ability for plastics to manage multiple features and integrate components on a unibody construction.
2017 Honda Ridgeline

Thermoplastic DLFT Side and Headboard

SMC Floor, Trunk Lid, and Stowage
Material Innovations

The 2017 Honda Ridgeline truck bed is the first high-volume automotive-exterior application of:

- Weatherable, UV-stable, Mold-in-Color Structural SMC

- Multi-material “hybrid solution” (thermoplastics, thermoplastic composites, structural SMC, and steel) for the optimal performance, mass, and value of a structural assembly.

- Material is black, even when scratched.
Aluminum Truck Beds

The 2015 Ford F-150 brought a new material into the truck box market…

And made every OEM think about their material and light weighting strategies.
The 2015 Ford is the industry’s first aluminum box and cab.

Built with higher gage aluminum panels, reinforcements and beta braces for stiffness support.

Required a complete retooling of assembly plants with a published $1B investment strategy.

The entire vehicle saved over 700+ Lbs. with all aluminum panels and high strength steel in selected areas of the chassis.
Marketing Warfare Begins

With the onset of a new material, OEMs committed to steel and composites demonstrate the durability of their applications.

GM Silverado  Ford F-150  Honda Ridgeline

Steel v Aluminum.mp4  Honda Ridgeline.wmv
The Current Market Picture

Composites has shown the industry its ability to compete with steel and aluminum in the pick up truck market.

- Composites have successfully demonstrated their ability to survive durability and structural integrity test better than other materials.

- Structural composite materials need to continue to explore ways to maintain durability and functionality while further reducing overall weight.

- Continued light weighting efforts will be the key to further advancements.
Why Light Weighting Matters
First enacted by Congress in 1975, CAFE reduces energy consumption by increasing fuel economy of cars and light trucks.

- NHTSA and EPA have issued joint Final Rules for Corporate Average Fuel Economy and Greenhouse Gas emissions.
- Creates standard fleet-wide averages for each automaker.
- This will include pickup trucks manufactured in model years 2017 through 2025.
- The standards from 2017-2021 are set. Standards for 2022-2025 are under review.
Light Truck CAFE Requirements

The Light Truck segment will realize a significant improvement in fuel economy over the next decade.

- The first phase will be for model years 2017-2021 and will require a light truck fuel economy to reach 25.3 mpg.
- The second phase is not final for model years 2022-2025, but is projected to be 30.2 mpg.
- Overall improvement of 35%.

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<th>Segment</th>
<th>Make &amp; Model</th>
<th>2012 mpg goal</th>
<th>2017 mpg goal</th>
<th>2021 mpg goal</th>
<th>2025 mpg goal</th>
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<td>25.1</td>
<td>25.3</td>
<td>30.2</td>
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The Pickup Truck segment can realize a significant mpg improvement by light weighting.

- A 2017MY average pickup truck weight is 5,263 lbs.
- A 10% weight improvement is 526 lbs. for the entire vehicle.
- Achieving this 10% reduction will move the 2017 requirement of 25.1 mpg to 26.0 mpg, well beyond the 2021 requirement.
Ok, light weighting is important and can make significant strides to meeting 2025 CAFE requirements.

How can composites reduce specific gravity (weight) without sacrificing performance?
TCA Ultra Lite®
and
Structural Ultra Lite™
Next Generation Composites

TCA Ultra Lite is revolutionary material that offers weight savings comparable to aluminum while maintaining all of the significant advantages of TCA.

• Improved surface finish, comparable to steel and aluminum.
• Maintains mechanical properties allowing for real weight reduction without thickening parts or adding patches
• Completely e-coat oven capable
• Provides a 40 percent reduction in density compared to standard TCA
• Specific gravity = 1.2
Density Reduction 1.9 to 1.2

Managing the resin-bubble interface is the key to reducing specific gravity while maintain mechanical properties.

• Hollow glass microspheres replace traditional heavier fillers (e.g. CaCO$_3$)

• High crush strength bubbles survive compounding and processing.

• Resin/bubble interface plays a key role in mechanical properties, paint adhesion, and bond strength of the SMC.

• Maintain mechanical properties.
Paint Adhesion

Managing the resin-bubble also improves paint adhesion and surface quality for Class-A panels.

- Water immersion
- Paint adhesion
- Humidity
- OEM e-Coat compatible at 410 deg F.
Next Generation (C7) Corvette

This technology has been implemented across the C7 Corvette as a major weight savings opportunity.

- Launched in June 2015.
- Implemented on the SMC composite body panels for all production models.
- Saved General Motors 40 Lbs. per vehicle when compared to standard 1.9 spg material.
Next Generation Boxes

The technology used to developed TCA Ultra Lite for Class A e-coat compatible materials has now been taken to structural applications.

- A higher glass truck box formulation has been developed for truck box applications.
- Further reduces application weight by 15-20% when compared to standard density SMC structural materials.
Future Considerations
Future Considerations

Future vehicle models will require the use of Structural Ultra Lite as a way to reduce truck box weight further and become competitive with aluminum.

- The OEMs will look for additional weight savings as they look to reduce overall vehicle weight 15-20%.
- Feature-enhanced vehicles will be necessary in the industry.
- The ability to e-coat is also a real desire. This allows the OEM to assemble in the body shop (minimal process change) and offer body-color boxes.
Process in the Body Shop

Feature enhancements also include the ability of composites to withstand e-coat process temperatures.

- This allows the OEM to assemble in the body shop, requiring minimal change to the body build and paint process.
- Processing through the body shop also allows for a body color option on the box.
- Available with TCA Ultra Lite as well for Class-A quarter panels.
Performance Specifications

OEM Engineering will require composite boxes to meet the same loading requirements as steel.

- Composites have demonstrated improved dentability and durability when compared to steel or aluminum.
- Design studies have proven that composites can meet or exceed the same static load cases used to design steel boxes.
A composite box system with TCA Ultra Lite and Structural Ultra Lite material is a significant weight savings.

- The composite option is half the weight of a steel box with a bed liner.
- The composite box is weight competitive with an aluminum box and a 12% weight savings if a bed liner is included.
Future Models

Future vehicle models will demonstrate the continued usage of composites.

- Composite materials will continue to be utilized as a lightweight solution to steel and as an aluminum alternative.
- Composites will offer feature enhancements only commercially feasible with the use of composites.