Composites + X: Mixed Materials Strategies for the Automotive Industry

Mike Siwajek, Ph.D.
Vice President, R&D
Continental Structural Plastics
Principal VOCs in SMC (VDA 278)

- Thermosetting resins: Unsaturated polyester (UPE) or Vinylester (VE) and **styrene**
  - Most SMC formulations use styrene as the reactive diluent
Who is Continental Structural Plastics?

A global leader in lightweight composite technologies:

- Acquired by Teijin in 2017
- Nearly 50 years’ experience in the industry
- With the recent acquisition of Inapal we now have:
  - 4,200 employees globally
  - Nearly $800 million in sales – projected to reach $2 billion by 2030
  - Booked business with nearly every global OEM
- Innovation leader with numerous patents for materials, processes, and products
- Largest compounder of SMC in North America
  - More than 85,000 tons annually
CSP Global Automotive Footprint

USA: 11 facilities
Mexico: 2 facilities
Portugal: 2 facilities
France: 1 facility
Germany: 1 facility
China: 1 facility
Japan: Teijin Global Headquarters
Composite Market Outlook

30k parts on a car today – 1/3 of those are plastics or composites

- Automotive Composites Market size is estimated to surpass $24 billion by 2024*.  
  - Driven by need for weight reduction, EV range, model variety, design trends
  - Lightweighting trends should endure, regardless of current administration’s proposed changes re: emissions and fuel economy.
  - OEMs will have to sell similar vehicles in other countries which are likely to require cleaner cars — and subsequently spur weight reduction.

*2018 Global Market Insights, Inc.
Composites Market Outlook

Features added for autonomy and connectivity will increase weight, which will need to be offset.

- CAR estimated that by 2025, each car will have added 5 percent of its curb weight in “safety and performance improvements.”
  - Additional 200 to 300 pounds per vehicle will be added for automated driving features.
Advantages of Composites

- Lightweight
- Rapid curing
- Design flexibility
  - Ability to mold complex shapes
- Parts consolidation
- E-coat / OEM paint system capable
- Good surface appearance and dimensional stability
- Dent and corrosion resistance
- Ability to formulate for special characteristics
  - e.g. UV stability, flame resistance, low density, conductivity, etc.
- Reduced costs
  - Lower cost tooling compared to stamped metals
  - Very little waste (offal)
Mixed Materials Strategies

- Mixed material strategies not new: Model T had steel panels, aluminum hood and wood frame (and the original model was designed with hemp-based plastic panels)

- Lightweighting and design strategies are driving the need for multimaterial options:
  - Composites
  - Aluminum and Magnesium
  - Carbon Fiber reinforced components (structural and closures)
  - High Strength Steel
Mixed Materials Strategies

- CAR projects that the U.S. fleet of 2040 will have a smaller percentage of lower-tier steels (e.g. mild steel, high-strength/low-alloy steel, and high-strength steel) than it will have of carbon fiber and other composites.
  - Glass and Carbon reinforced composites (and hybrids)
  - Composite/Metal hybrids
  - Composite/Thermoplastic hybrids
- Structural components
- Closure Panels
- Underbody components
- Interior components
CSP Material Neutral Approach

- Continuing Advances in SMC Solutions
  - TCA Ultra Lite® for body panels
  - Structural Ultra Lite for pickup boxes and semi-structural applications
  - Carbon Fiber SMC
    - Multiple grades including E-coat capable systems

- Continuous Fiber Solutions
  - Carbon fiber, glass fiber, and hybrid RTM
    - Structural
    - Class A (painted and exposed weave)

- Thermoplastic Solutions
  - Sereebo® (Carbon fiber reinforced Nylon)
  - D-LFT
  - New technologies / improvement on old technologies

- Hybrid Solutions
  - SMC/RTM
  - SMC/Thermoplastic
  - RTM/Thermoplastic
  - Composite/Metal (Al, Mg, steel, etc.)
Challenges of Mixed Materials

- Dissimilar Thermal Expansion (CLTE)
  - Critical issue through E-coat/paint process
- Joining/Bonding
  - Adhesive
  - Mechanical
- Galvanic Corrosion
- Cost
  - Rising materials prices
  - Tariffs
    - Jim Hackett/Ford – “…metals tariffs took about $1B in profit from us…” *
    - Similar challenges with chemicals and glass fiber

* - Detroit Free Press, September 26, 2018
OEM Mixed Material Examples

- GM CarbonPro Box
  - Steel frame, aluminum doors
  - TPO bumpers
  - SMC hardtop roof

- Toyota Prius Prime Liftgate
  - CF-SMC Inner reinforcement
  - Aluminum, GFRP, and PP outers

- Jeep Wrangler
  - Steel frame, aluminum doors
  - TPO bumpers
  - SMC hardtop roof
Summary

- Composites present an attractive solution for the automotive market
  - Lightweighting
    - Regulations/fuel economy
  - Model differentiation
  - Electric vehicles
    - Reduce weight for increased range
    - Battery enclosures
    - Styling and functionality

- Mixed Material components offer additional benefits
  - Tailored solutions
  - Utilization of strengths of each material
  - Optimization of cost vs. performance and manufacturability