Go Further

Carbon Fiber Reinforced Polypropylene Body Panels

Megan Shewey
Ford Research and Advanced Engineering

September 4th, 2019

Overview

- Project Overview
- Institute for Advanced Composites Manufacturing Innovation (IACMI)
- Density and Part Weight
- Material Characterization of Test Plaques
- Limitations of the Technology
- Paint Appearance for Plaques and Fenders
- Dimensional Analysis
- Ongoing Work

Project Overview

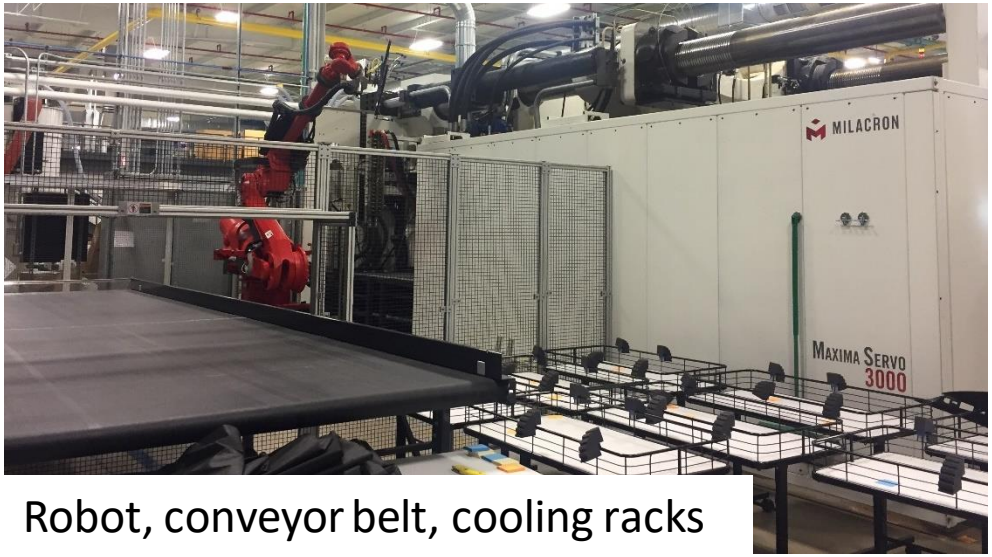
- Lightweight material development - utilizing polypropylene (PP) and recycled carbon fiber (rCF) - to enable cost-effective, exterior body panels and closures for future BEV platforms
  - Weight reduction
  - Cost opportunity
  - Dimensional stability
  - Improved dent and ding performance
  - Enable offline paint process
  - Design flexibility and part integration
  - Savings in tooling investment compared to stampings
  - Green: increase recyclability and re-use of carbon fiber

- Partners:
  - IACMI: Molding, headcount, neutral site
  - Borealis: Material Supplier

Molding Equipment at IACMI

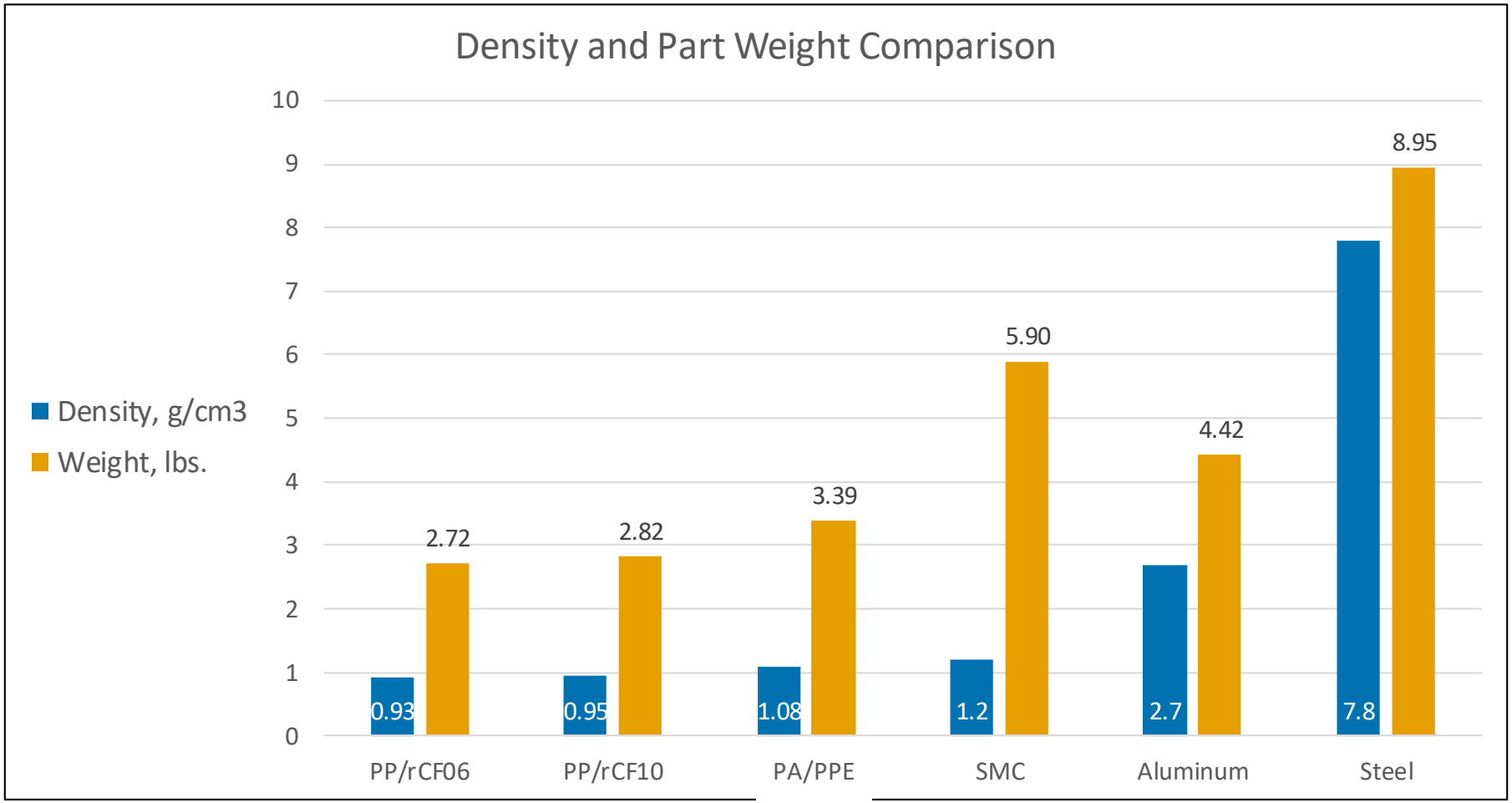
Injection molding machine

Dryer



Robot, conveyor belt, cooling racks

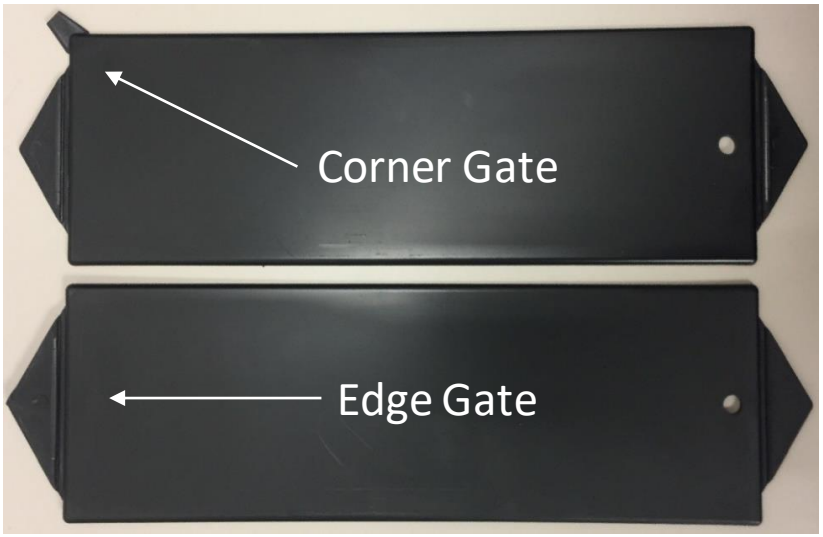
Density and Part Weight



Compared to PA/PPE benchmark, PP/rCF formulations yield a 14% density reduction and a 20% weight reduction.

Test Plaque Evaluation

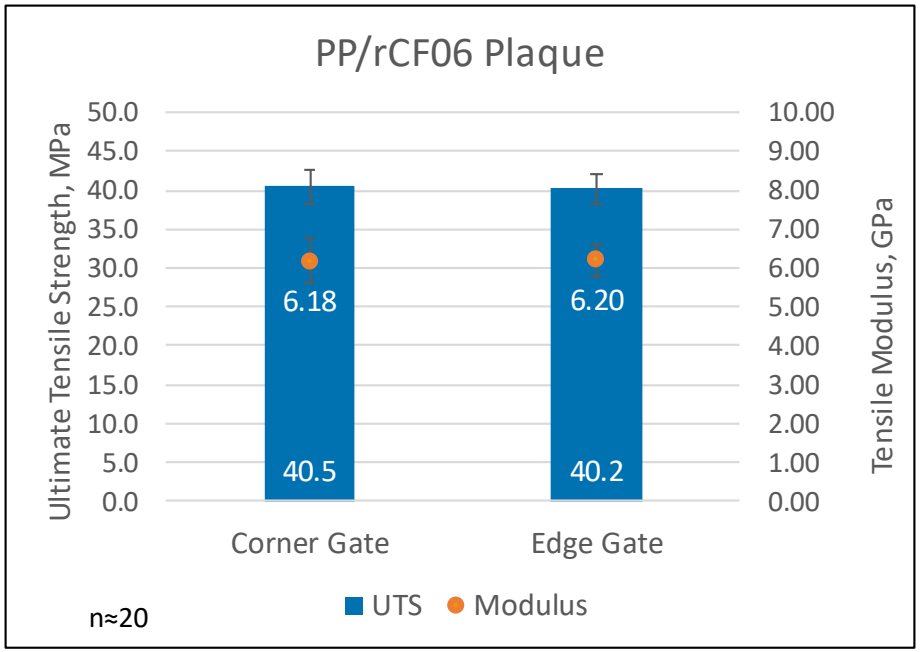
- Plaques were molded with two different gating systems to simulate both random and oriented material flow.
- Molded plaques were used for mechanical testing, paint trials, surface analysis, dimensional analysis, and weathering.

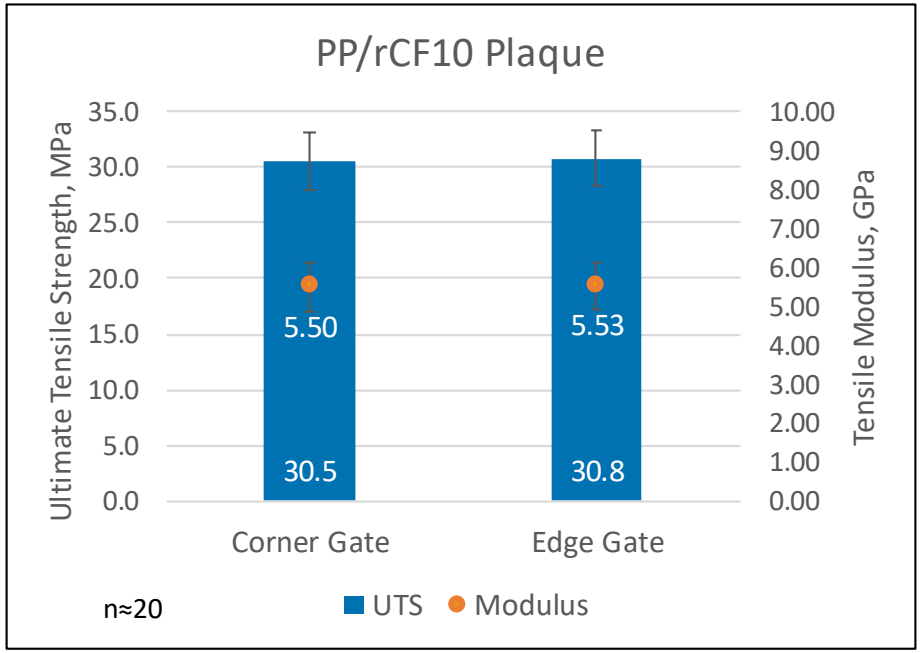


This evaluation is important to verify that these are viable material solutions that meet performance targets.

Mechanical Property Results

- Target tensile modulus is ≥ 3.0 GPa as outlined in the IACMI project charter.





Exceeded tensile modulus requirement with both materials.

- Potential to reduce the amount of carbon fiber used

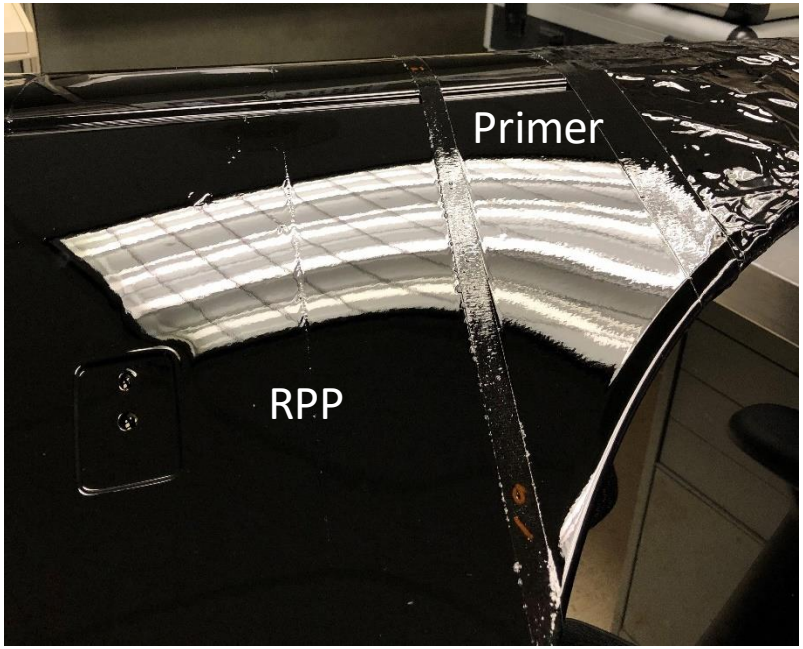
Limitations

- Not capable of mold in color
- This material can only be molded in black (carbon fiber)
- This material cannot go through e-coat (not painted online)
- Could be concern for panel sag on horizontal body panels

PP/rCF10 fender molded at IACMI and painted at PPG.

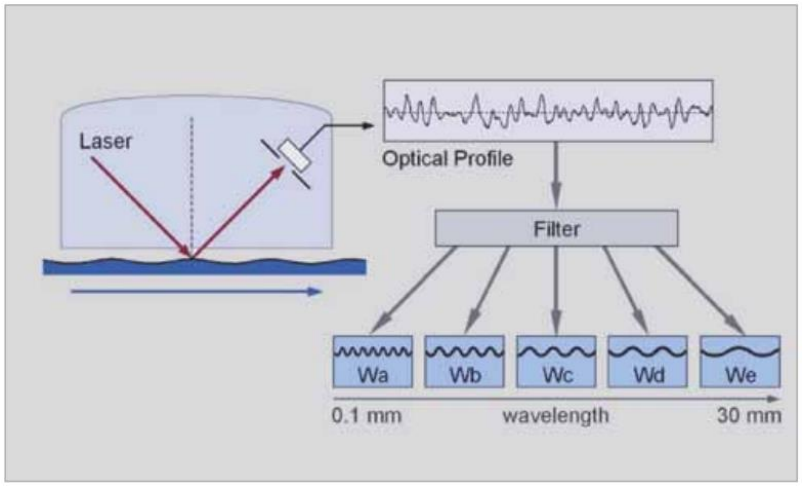
Paint Appearance

- Evaluate the effect of different primers on the appearance of plaques and fenders compared to current PA/PPE materials.
  - AdPro : Commercially available primer currently used for TPO
  - RPP : Commercially available primer currently used for SMC
  - Primer : Developmental flexible primer developed by PPG to improve appearance of PP/CF materials
- Appearance was measured with a BYK Gardner wave-scan. Painted fenders did not meet the target for Combined Ford (CF) number.



Paint Appearance

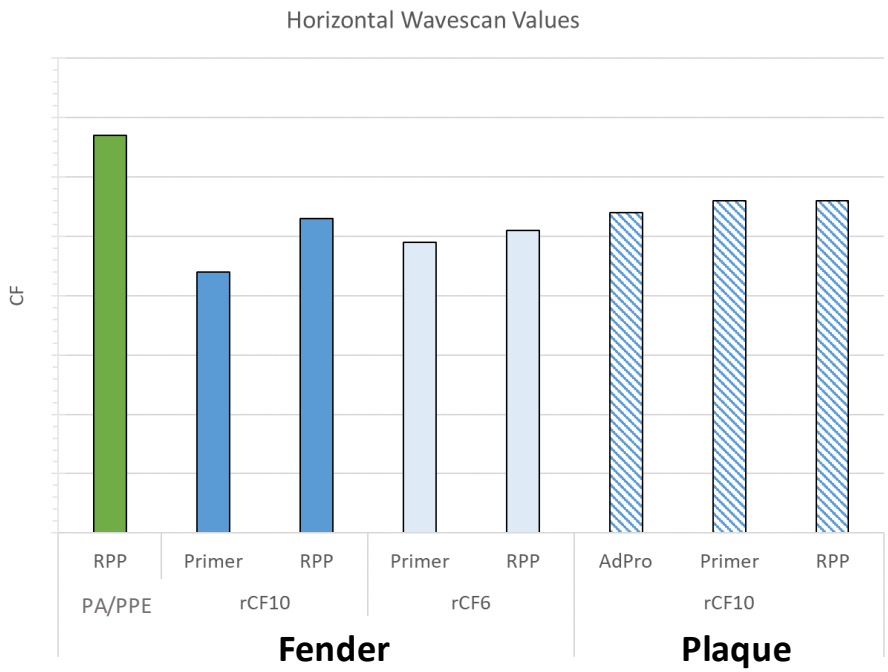
- CF value is determined by a combination of weighted factors at different wavelength frequencies from the optical profile.

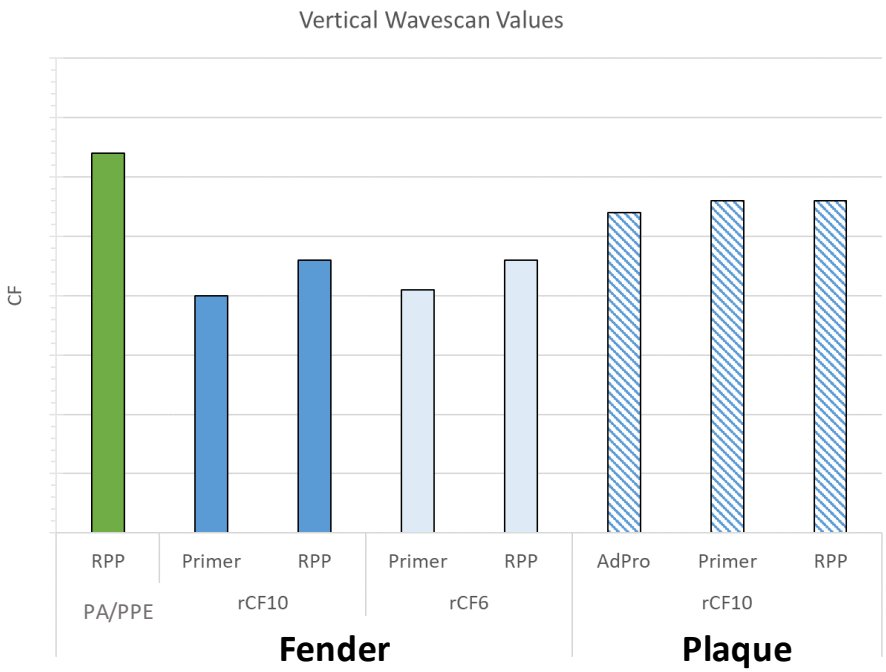


BYK Wavescan Dual https://www.byk.com/en/instruments/products/?a=1&b=14&f=0&faction=

Paint Appearance

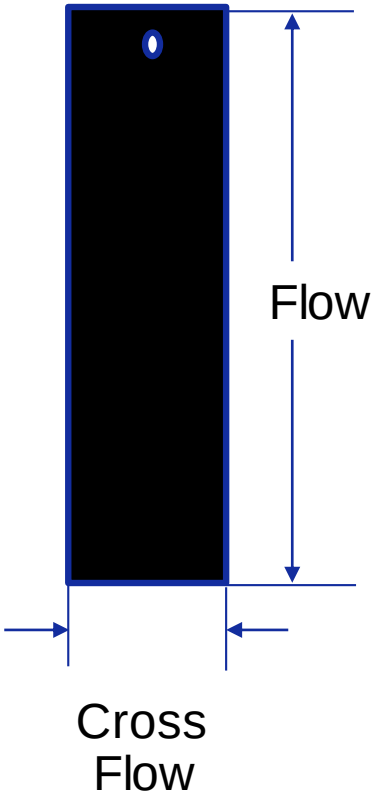
- Wavescan Combined Ford values for the plaques are significantly higher than the fenders.
  - Fenders were painted without optimization of robot path
  - Combined Ford numbers are close for PP/rCF materials, but the appearance difference is still noticeable when compared to PA/PPE.

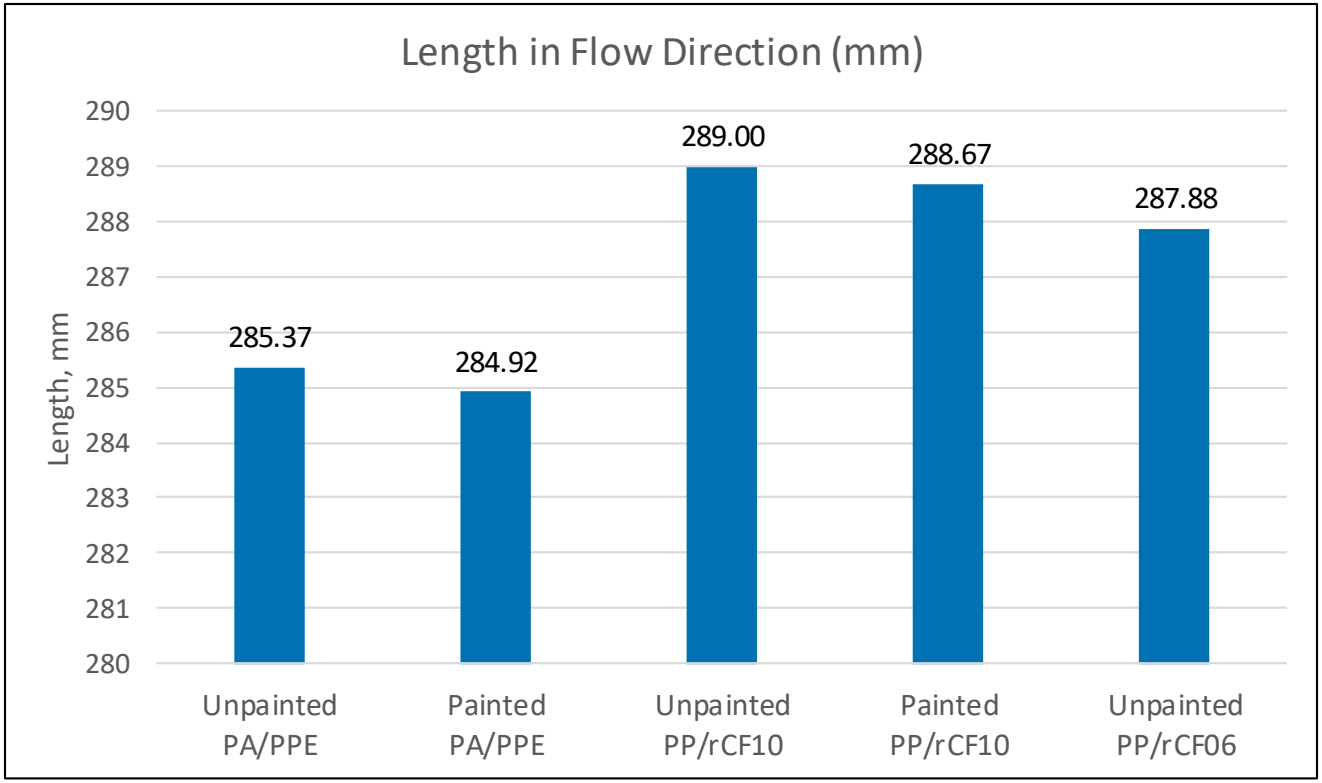




Dimensional Analysis

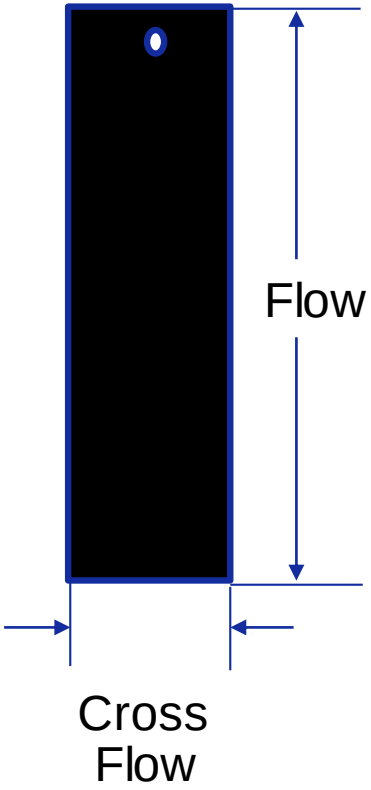
- Initial dimension measurements point to less shrink in the PP/rCF materials, as expected.
- The painted PP/rCF10 is shorter in the flow direction than the unpainted plaque.

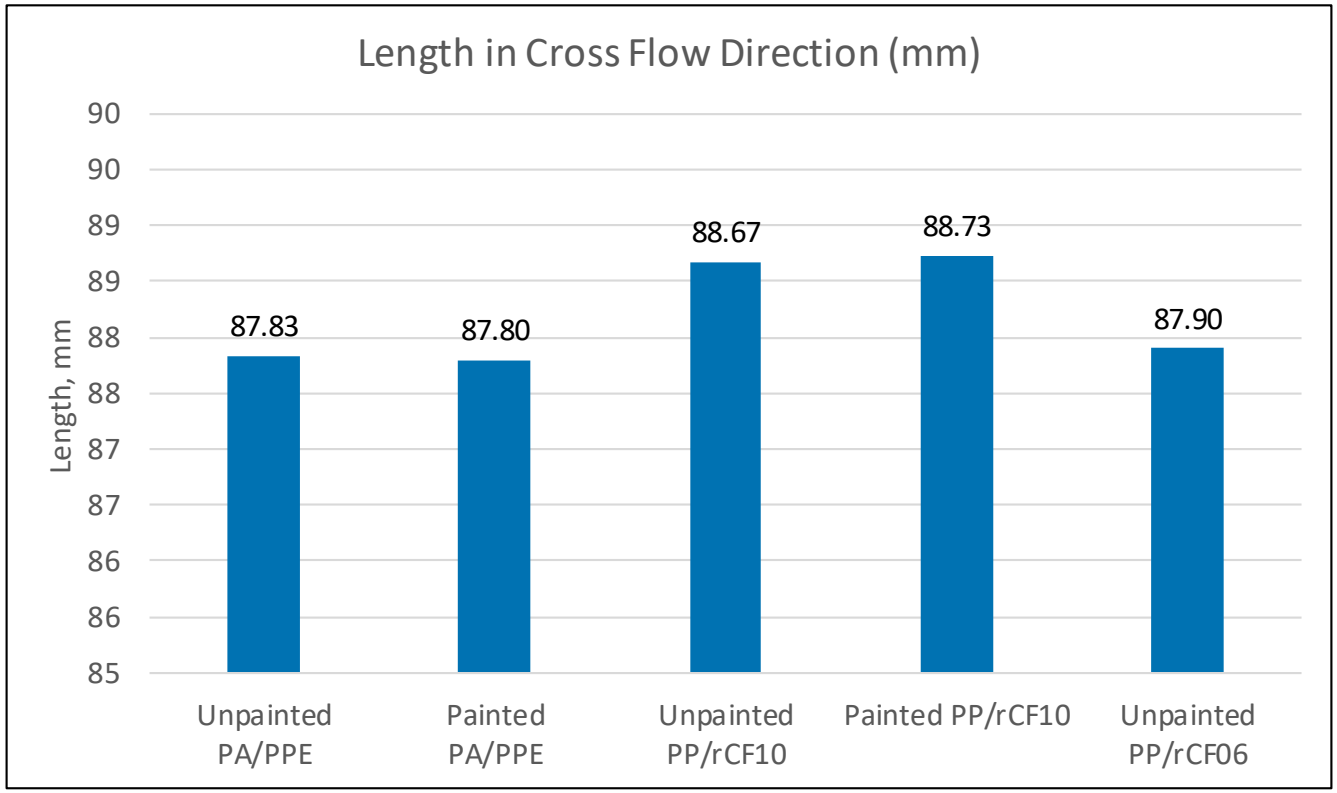




Dimensional Analysis

- Initial dimension measurements point to less shrink in the PP/rCF materials, as expected.
- There is minimal difference between painted and unpainted plaques in the cross flow direction.





Ongoing Work

- Finish dimensional capability and weathering analysis
- Partner with material suppliers to develop material formulations, material cards, and flow simulation
- Investigate warp and fiber alignment
- Work with paint partners and Ford engineers to develop primer technology