Composites Applications for the Aston Martin DB9

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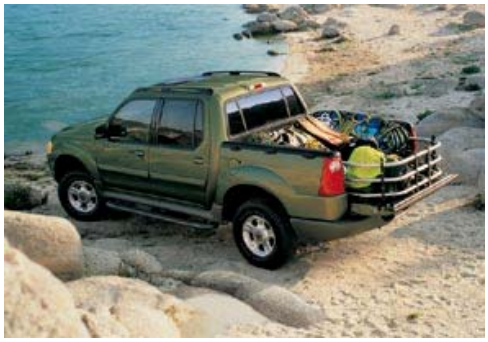
Composites provide a wide range of advantages over conventional metal forming processes used in automotive manufacture. These include weight reduction, styling flexibility, lower tooling investment, part consolidation and customer satisfaction. Composite components can be found in structural and semi-structral applications, under-the-hood components, and exterior (Class-A) body panels. The vast majority of the components used at Ford are exterior body panels produced using the SMC process and include : hood, GOR and front fenders (Lincoln Navigator); tailgate (Volvo V70); hood, decklid, front fenders, package tray and removeable hard top (Ford Thunderbird); rear fenders (Ford F150 Flareside); and GOR, pickup box inner/outer and tonneau cover (Ford Explorer Sport Trac). Data from the Automotive Composites Alliance has shown that SMC useage in North America has almost doubled from just over 100,000 tonnes in 1998 to almost 200,000 tonnes in 2004, with the growth trend almost certain to continue. The same study showed that Ford had a 45% share of this market.



SMC Usage at Ford

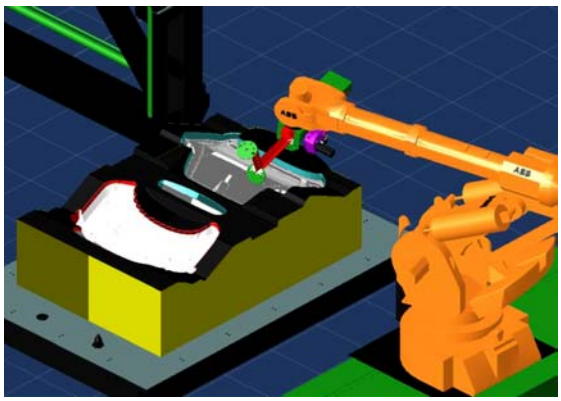
In contrast to the scale of SMC useage in North America, several composites applications at Aston Martin demonstrate that the technologies have uses over a wide range of volumes. The design challenges and investment constraints on the Aston Martin V12 Vanquish, a completely new vehicle from the ground up with no carry-over body parts, were such that 24 composite components were specified, all being manufactured by the RTM process. In addition to the noteable and novel use of tri-axial braiding to produce safety-critical, structural carbon fibre A-Pillar reinforcements and a structural carbon fibre Strut Brace, the Vanquish was used to pioneer the Ford Programmable Preforming Process (F3P). The application of F3P-RTM in the manufacture of the Vanquish Bodysides demonstrated the capability of the process to produce Class-A panels. This success has recently been expanded upon with the introduction of 8 further Class A F3P-RTM panels on the DB9.

F3P is a progression of the P4 process in which glass fibre rovings are chopped and are deposited along with a binder onto a component screen using a robotic system. The fibres are held in place on the screen by air flow until the compaction phase where hot air is used to melt the binder. Cold air then freezes the binder which holds the fibres and sets the preform before it is de-moulded.

F3P offers low cost, high speed, reliability, quality, and flexibility. The raw material, conventional glass fibre roving supplied by PPG, is only part of the reason for the low cost. At €1.5/kg, it is more than 40% cheaper than conventional roll-stock chopped strand mat. These savings are magnified further with the much lower waste (< 3%) and net-shape preforming with F3P. The Aplicator SMART chopper gun provides high fibre output (up to 4kg/min) and the ability to vary fibre output and length during deposition. This helps increase speed and improves flexibility while the automated robotic system provides a consistent areal density part-to part and within the part to ensure reproduceable preform quality.

To implement F3P-RTM on Vanquish it was necessary to design and manufacture a preforming cell. A 2-station machine was designed which allows fibre deposition in one station while preform consolidation occurs in the second. The 6-axis robot transfers between the two stations on a 7th axis track. This equipment is now installed at Sotira's facility in Saint Meloir des Ondes, France.

F3P Installation @ Sotira

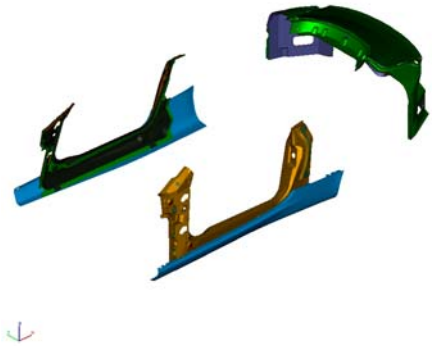


Offline Robot Programming

Off-line programming of the F3P robot provides additional time savings in the component development phase (up to 2 weeks saving) and it can be carried out prior to delivery of preform tooling. In addition it provides assistance in the design of the preform tool in that reach and access can be simulated and potential collisions can be avoided.

Specific resin formulations have been developed in conjunction with Scott Bader and the University of Nottingham to optimise surface finish whilst restricting volatiles to a minimum. This combined with proprietary moulding techniques provide the resultant Class-A finish required for Aston Martin.

The Door Opening Rings and Sill Applique are common to the DB9 Coupe and Volante while the Decklid and Decklid Surround are unique to each vehicle. A comparison between conventional thermoform preforming and F3P on the DOR demonstrated the immense material savings possible using F3P - 72%, over two thirds, of the thermoformed preform was scrap (process waste) while the waste from the F3P preform was barely measureable at much less than 1%.



DB9 Coupe F3P-RTM Parts **Waste from Thermoforming**

In addition to the F3P-RTM parts, the Rear Quarter Inners and Grille Opening Panel are manufactured using LPSMC (low pressure SMC), also by Sotira. The Rear Quarter Inners and Door Opening Rings are assembled to the body prior to delivery to Aston Martin's assembly plant at Gaydon, England. The body is constructed primarily from extruded aluminium sections, castings and superformed panels adhesively bonded together using a structural epoxy. The Decklid Surround is assembled in the BIW framing cell prior to the aluminium Rear Quarters and the aluminium Roof Spider. As with the Rear Quarter Inners and the Door Opening Rings, the body panels assembled at Gaydon are bonded with a flexible polyurethane adhesive. The adhesive is applied to the panels in a cell using the first and only robot in Aston Martin's history. The closure panels are fitted prior to painting the BIW in a low temperature bake paint system. Final assembly occurs within some 27 stations on an indexing track.

DB9 Framing Fixture **End of DB9 Trim & Final Assembly**

In summary, the F3P preforming machine has been constructed and is currently producing 11 parts by RTM for 2 vehicle lines at Aston Martin, with more extensive use being planned in the near future. The cell is currently manufacturing approximately 15000 parts/year with plans to exceed 25000 parts/year. Part surface quality meets Aston Martin's demanding quality standards and is suited to our paint process. The dimensional quality and repeatability of the parts are also ideally suited to our unique vehicle assembly processes.