**Introduction**

The initial idea for this project was born out of a requirement from the Concepts department of Bentley Motors Ltd (BML), Cheshire, UK to have a feasible procedure for obtaining the required surface paint finish on exterior body panels produced from carbon/epoxy composites. The aim of this project was to determine an optimised procedure to obtain surface finish and quality that satisfies the requirements of the automotive manufacturer with a carbon/epoxy composite with an applied gel coat.

**Methodology and Testing**

9 samples were produced in two-stages of manufacturing consisting of first applying an epoxy gel coat followed by a resin infusion process.

A comprehensive test programme was conducted on samples before and after being exposed to the Bentley paint process consisting of:

- Wave-Scan DOI (Distinctness Of Image) test to measure surface quality
- Pull-off test to measure gel coat-to-adhesion
- Paint adhesion test
- Thermal Cycling from -40°C to +80°C for 1200 cycles
- Extended High Humidity Environment – 20 days at 100% relative humidity at +40°C

**Composition of samples produced**

<table>
<thead>
<tr>
<th>Thickness of gel coat</th>
<th>0%</th>
<th>2%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 mm</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1.0 mm</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>1.5 mm</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Results and Conclusions**

3 samples with the best initial Wave-Scan results were chosen to be painted and underwent further testing. The use of a cheaper filler material proved effective in providing a potential cost saving if the technology were to be applied to a production scenario.

All 3 samples met the requirement set by Volkswagen for surface quality but would require further development before scaling to production volumes to avoid unwanted twisting of panels. This was found to be due to the laminate stack sequence [+45/-45].

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“The initial results from the samples provided at Plymouth by Dan Hanratty show very encouraging signs (meeting our requirement for Short-wave and Long-wave surface roughness before environmental conditioning) employing a novel process that we believe should be commercially and technically viable for our anticipated production volumes.”

Lee Bateup, Technical Manager – Innovation Management at Bentley Motors Ltd