

Surface analysis of painted carbon fibre composites for automotive body panels – Results in progress

Background

Carbon fibre composite automotive body panels have the potential to reduce vehicle mass by as much as two thirds when compared to traditional sheet steel panels. Carbon fibre composites are currently only available on exotic high-performance vehicles due to the large expenses associated with their manufacture and costs required to obtain and retain a Class A painted surface finish. The Quickstep™ process for curing composite laminates allows for substantial time savings over the traditional autoclave process by using a heat transfer fluid, rather than a gas, and also using lower curing pressures.



Figure 1. Exotic vehicles such as the Ferrari Enzo feature carbon fibre composite body panels. Source: Ferrari.

Objective

To compare the unpainted and painted surface finish of Quickstep and autoclave manufactured composite panels, and to investigate surface changes when exposed to accelerated ageing. In addition, 2x2 twill and unidirectional fibre orientations will be compared.

Method

Toray G83C epoxy 12k 2x2 twill and unidirectional carbon fibre prepreg was used, in conjunction with Henkel Loctite SynSkin® HC 9837.1 surface film. The unpainted, painted and aged surfaces were compared using stylus profilometry. The painted surface was characterised using BYK Gardner Wave-scan DOI. Panels were exposed to various accelerated environmental ageing tests including GM 9505P, ASTM D870, D2247, and G155.

Progress

The Quickstep roughness results prior to painting had large error, with all surfaces rougher than autoclave. However, painting the surface covers the smaller irregularities, creating more consistent results, yet followed the same trend as the unpainted surface roughness values. Painted unidirectional laminates submerged in water at 40°C resulted in surface blisters occurring only for the autoclave laminates. The blisters occurred where the mould release water marks were present on the surface, however both Quickstep and autoclave laminates had the same treatment of mould release removal (Figure 2). Fibre print through occurs first on Quickstep twill surfaces when aged, however autoclave print through is delayed and eventually tends to be visibly worse.

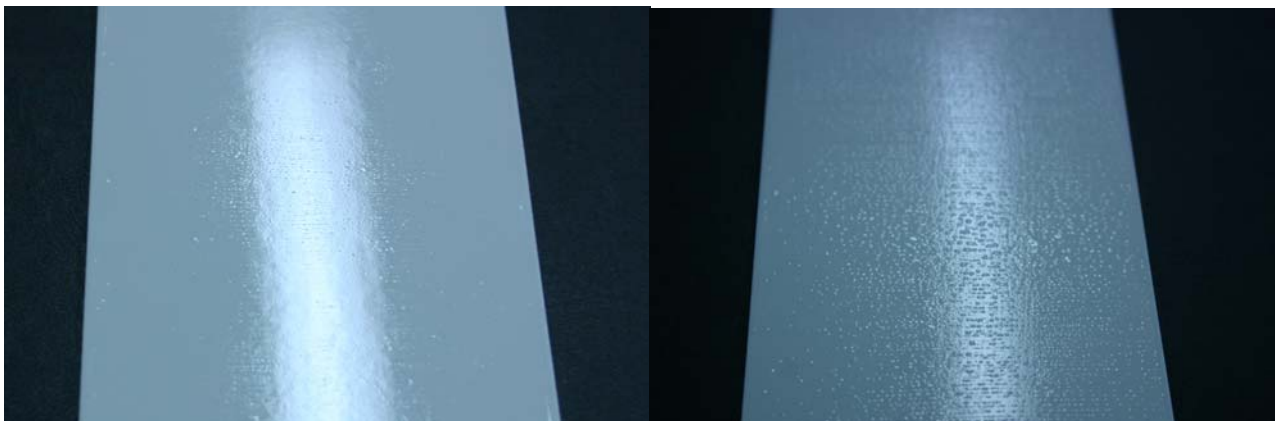


Figure 2. Painted unidirectional autoclave laminate submerged in water at 40°C after 1 week (left) and 5 weeks (right).