

Stamp-forming of reactive-thermoplastic carbon fibre/PA12 composite sheet

M.D. Wakeman, M. Kohler, J.-A. E. Månson, P. Blanchard, E. Kleven
Ecole Polytechnique Fédérale de Lausanne (EPFL), Laboratoire de Technologie des
Composites et Polymères (LTC), CH-1015 Lausanne, Switzerland,

Ford Motor Company, Ford Research Lab, 2101 Village Road, Mail Drop 3135,
Dearborn, MI 48121, USA

ABSTRACT

In response to the increased driving forces requiring weight reduction in the automotive industry, a stamp-forming process has been developed using carbon fibre fabrics impregnated with reactive thermoplastic material systems. Stamp-forming trials were performed using a novel instrumented generic shell tool with active blank holder control. Prepreg sheets of carbon fibre reinforced PA12 were used and benchmarked with commercially available sheet materials. A batch TP-RTM process was used as an interim process for experimental CF/PA12 sheet production. In order to accommodate local thickness variations during the stamp-forming process induced by fabric shear, a central polymer rich flow-core was used to provide a degree of compliance to reduce pressure differentials and hence void content variations in the generic shell structure. Design of experiment techniques were used to determine statistically significant parameters and optimise the blank holder parameters via mechanical tests prior to more detailed investigations. Void content evolution from the initial sheet products, the preheating stage, and the final stamp-forming stage was quantified by feret diameter and count using image analysis techniques. Having demonstrated the effectiveness of the stamping process, coupled impregnation and polymerisation models, linked to a technical cost model, were used to establish the feasibility of a continuous reactive impregnation line to feed such a stamping process.

Keywords: Stamp-forming, reactive-thermoplastic systems, image analysis