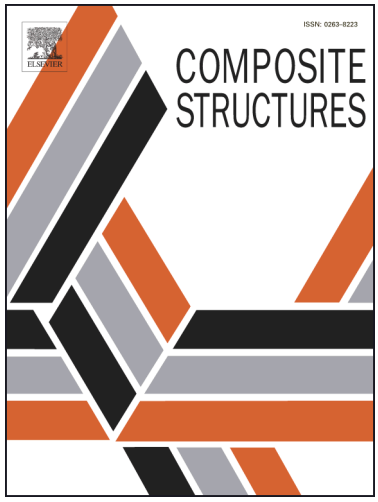

Investigation of Fast Curing Epoxy Resins Regarding Process Induced Distortions of Fibre Reinforced Composites

Fabian Groh, Erik Kappel, Christian Hühne, Wojciech Brymerski

PII: S0263-8223(18)32585-6
DOI: https://doi.org/10.1016/j.compstruct.2018.09.003
Reference: COST 10149

To appear in: *Composite Structures*

Received Date: 21 July 2018
Accepted Date: 4 September 2018

Please cite this article as: Groh, F., Kappel, E., Hühne, C., Brymerski, W., Investigation of Fast Curing Epoxy Resins Regarding Process Induced Distortions of Fibre Reinforced Composites, *Composite Structures* (2018), doi: https://doi.org/10.1016/j.compstruct.2018.09.003

INVESTIGATION OF FAST CURING EPOXY RESINS REGARDING PROCESS INDUCED DISTORTIONS OF FIBRE REINFORCED COMPOSITES

Fabian Groh[1], Erik Kappel[1], Christian Hühne[1] and Wojciech Brymerski[2]

[1]Institute of Composite Structures and Adaptive Systems, German Aerospace Center
Lilienthalplatz 7, 38108 Braunschweig, Germany
Email: fabian.groh@audi.de, web page: http://www.dlr.de/fa/

[2]Department of Technology Development, Composites, AUDI AG
NSU-Straße 1, 74172 Neckarsulm, Germany
Email: wojciech.brymerski@audi.de, web page: http://www.audi.com

Keywords: Automotive, Composites, Fast curing epoxy resins, Process induced deformations, Shape distortion

ABSTRACT

Unavoidable deformations occur during part production due to the non-isotropic nature of carbon fibre reinforced plastics (CFRP). These deformations often lead to dissatisfaction of tolerances or result in cost and time intensive rework of the tooling. In a cost driven production environment, similar to the automotive industry, it is essential to predict the deformations early on in the part development process in order to compensate toolings accordingly. In future applications, **F**ast **C**uring **E**poxy **R**esins (FCER), with curing times of less than 20 minutes, will play a key role in high rate CFRP-production at low cost.

The present paper reports on a comprehensive experimental study on different FCER systems. It includes the thermo-chemical characterization of neat resin samples as well as the quantification of spring-in deformations of L-profiles. Essential part and processing parameters, as the lay-up, the curing temperature, the cooling rate and the fibre volume fraction are varied and their effect on process induced deformations is quantified. Results for FCER system are compared to slower curing systems to assess differences.

1 INTRODUCTION

In order to meet strict emission reduction targets and to enable electro mobility, it is essential to reduce the structural weight of future automobiles. An effective way to accomplish this reduction is the increased use of CFRP parts. Compared to branches like aerospace industries, sports goods production or the wind energy branch where the use of composites is already quite established new questions arise. In particular the challenges of high rate production, more complex geometries and more strict tolerances have to be faced. Figure 1 shows a car structure with a B-pillar made of CFRP. The multi material mix used in this construction is exemplary for the complex nature of recent car designs. In order to guarantee precise and cost efficient assembly, CFRP parts must provide a high level of dimensional fidelity. Deformations which occur during part production have to be foreseen and controlled early on at virtual state in the part design process. Therefore it is critical to understand and examine the mechanisms leading to deflections of the components during manufacturing.

The present paper focusses on fast curing epoxy resins (FCER) with processing times of less than 20 min. These systems are essential to enable high rate production of CFRP parts and to be able to compete economically with classical metal processing. Until now only minimal experimental data exists concerning FCER.