Distortions of rubber pressed composite panels

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Introduction

During the forming of a continuous fibre reinforced plastic panel, shape distortions occur when the product is released from the mould. These are due to inhomogeneous thermal shrinkage of the orthotropic composite and process induced internal stresses. Especially, the often difficult to measure out-of-plane thermo-elastic properties seem to be of great influence[1].

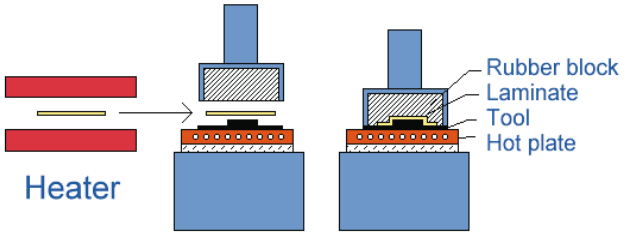

Figure 1 Moulding cycle of a thermoplastic laminate

Objective

To reduce the costs of trial-and-error to machine the mould for compensation of the dimensional changes of the product, the objective is to develop a model which predicts these distortions. It incorporates both the thermally induced changes and the distortions caused by the moulding process.

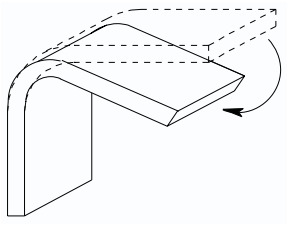

Figure 2 Springforward of an L-shaped part

Methodology

An analytical model was developed to predict the springforward of a curved continuous fibre reinforced plastic product. Using micromechanics, the required three-dimensional thermo-elastic properties were predicted. To verify the theory, an experimental procedure was designed to measure the through-thickness coefficient of thermal expansion of the composite, and the temperature dependent spring-forward.

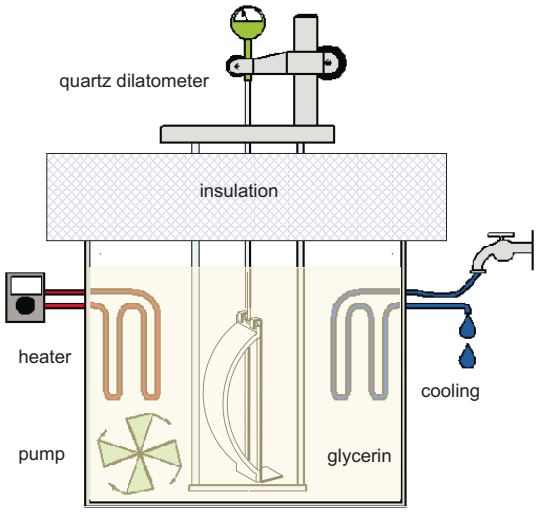

Figure 3 Quartz dilatometer for measuring small temperature dependent displacements, with curved panel specimen

Results

The temperature dependent distortions of curved panel specimens were analytically predicted and experimentally determined. Both results agree very well.

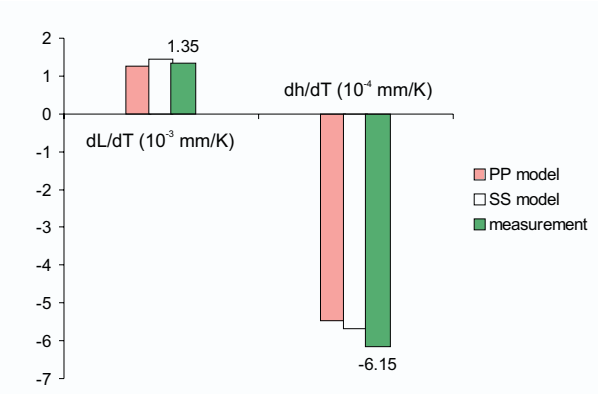

Figure 4 Temperature dependent dimensional changes of the curved panel specimen

Discussion

For simple geometries, the thermal distortions were predicted successfully. More complex product shapes and the inclusion of the process induced residual stresses are to be modeled using FEA.

References

1 H.W. Wiersma, L.B.J. Peeters and R. Akkerman, *Prediction of springforward in continuous-fibre/polymer L-shaped parts*, Composites, **29**, 1998, 1333-1342.