Experimental and numerical investigation of the contact behavior during FE forming simulation of continuously reinforced composites in wet compression moulding

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Abstract. Wet compression moulding (WCM) provides large-scale production potential for continuously fiber reinforced structural components as a promising alternative to resin transfer moulding (RTM). Lower cycle times are possible due to the parallelization of the process steps draping, infiltration and curing during moulding (viscous draping). Experimental and theoretical investigations indicate and prove strong mutual dependencies between the physical mechanisms, especially between resin and laminate [1-3]. However, significant cavity pressures develop only towards the end of the tool stroke, when the cavity is almost filled with either resin or fibres. Thus, the resin's impact on the draping behaviour (intra-ply and interface behaviour) is of great interest since it represents a large part of the draping process [3]. Regarding the investigation and modelling of the tangential contact behaviour, several studies [4-7] show that on a macroscopic scale, rate-, pressure- and viscosity dependent material models need to be applied for both thermoplastic and thermoset based processes. Beyond that, it needs to be questioned whether the assumption of a compressive stress condition within the contact does always apply. In fact it strongly depends on the investigated geometry, used material model and the process conditions weather this assumption holds true. This has not yet been investigated properly, not least because no characterisation methods regarding the normal contact behaviour under tension are yet available.
Therefore, experimental results on dry and infiltrated woven fabrics are presented, which confirm rate-, pressure- and viscosity-dependent tangential contact behaviour within the viscous draping process step (WCM). Based on a parametrisation of these results, FE forming simulation is utilized to assess and evaluate the process relevance on part level. Beyond that, investigations on the contact condition (pressure or tension) are presented to evaluate the relevance of more expensive characterisation and modelling approaches regarding the contact behaviour in normal direction.

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