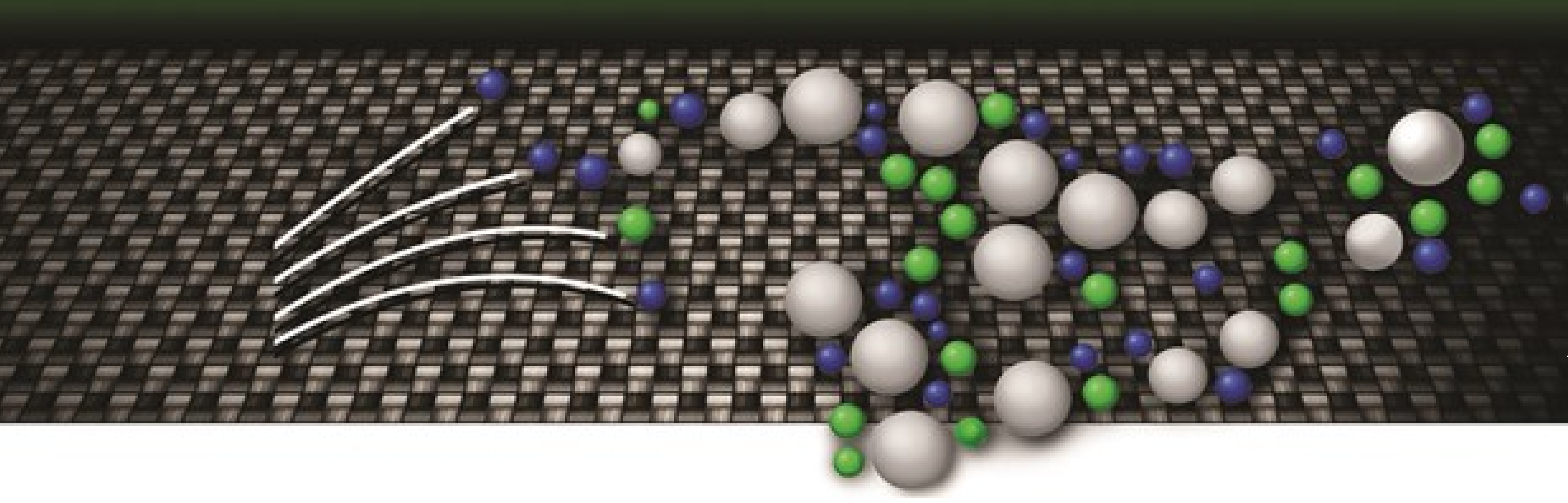
PERMEABILITY DETERMINATION OF RESISTIVE WELDED CARBON FABRICS



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Introduction

Production of endless fibre reinforced plastics in an automatized and reproducible way requires a robust draping process. To minimize undulations and variations in fibre orientation bindered textiles are under consideration, but permeability determination due to consolidation becomes a challenge. Usage of local resistive welding makes textile's handling easier while providing flexibility in shaping the preform. The welding zone (cf. fig. 1) has impact on textile's permeability thus a numerical resin flow prediction during further manufacturing steps is of interest.

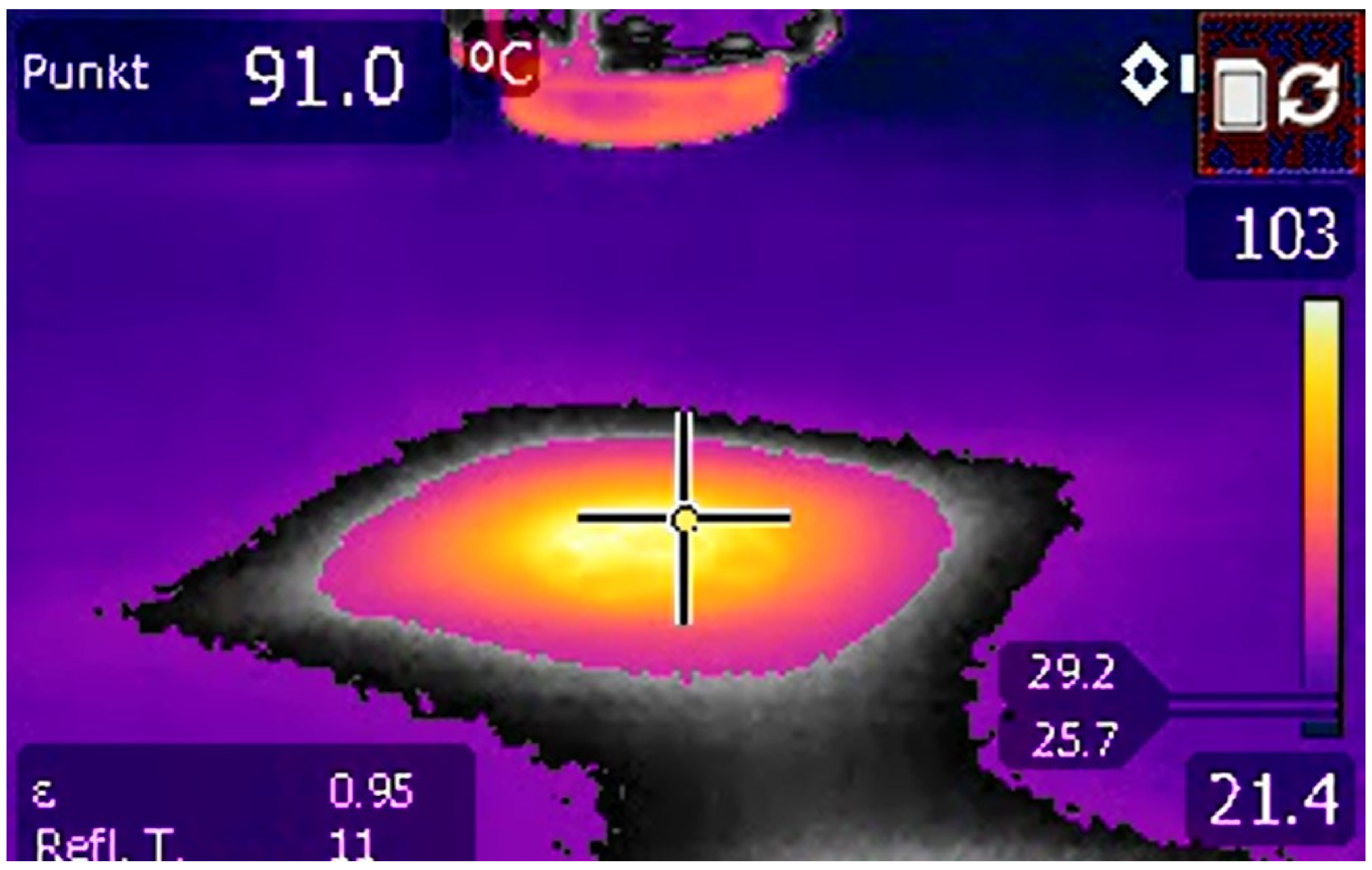

Figure 1: *Heat propagation of resistive welded carbon fabric*

Permeability determination

The challenge of this work was to determine permeability along a defined path with fluctuating fibre compaction and fibre volume ratio. Five experiments were made: two samples (with and without binder) were infiltrated without resistive welding to estimate the overall effect of binder; three samples (bindered and welded) were infiltrated to quantify flow change and estimate permeabilities.

Table 1 : Mean permeability results

	K_1 [m^2]	K_2 [m^2]
Unbindered	1.35E-11	2.54E-11
Bindered	2.28E-11	2.21E-11
Test 1	1.93E-11	3.59E-11
Test 2	2.50E-11	4.52E-11
Test 3	1.28E-11	5.72E-11

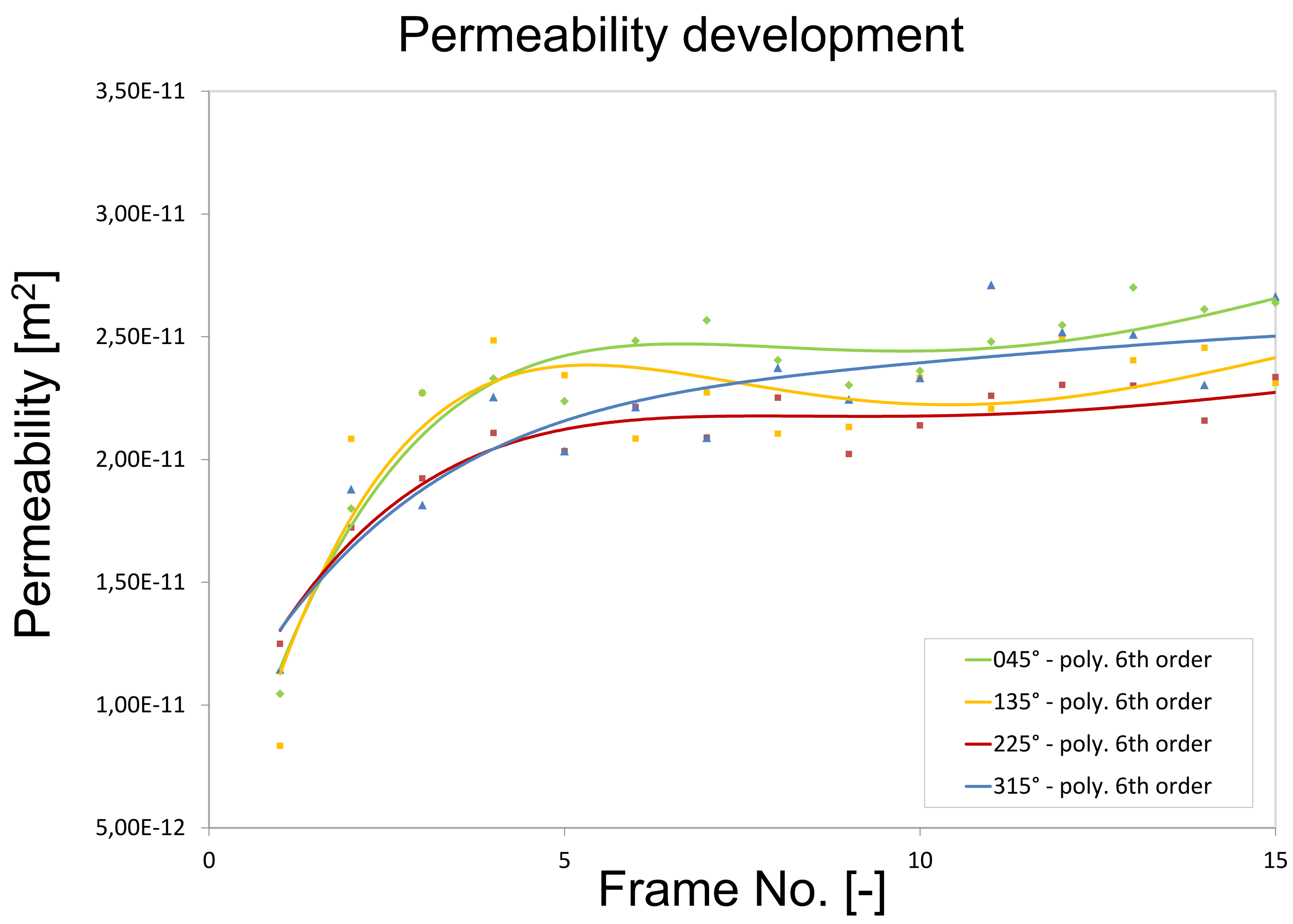

Figure 2: *Permeability development along defined path*

Simulation

Simulations with PAM-RTM (ESI Group) were conducted and the effect on fabrics permeability was estimated. The FEM model was built of triangular shell elements 5 mm in size. Three zones (cf. fig. 3) with different FVC and thus different permeabilities (according to test data) were defined. Simulation was validated by comparing the flow fronts from numerical analysis and experiment.

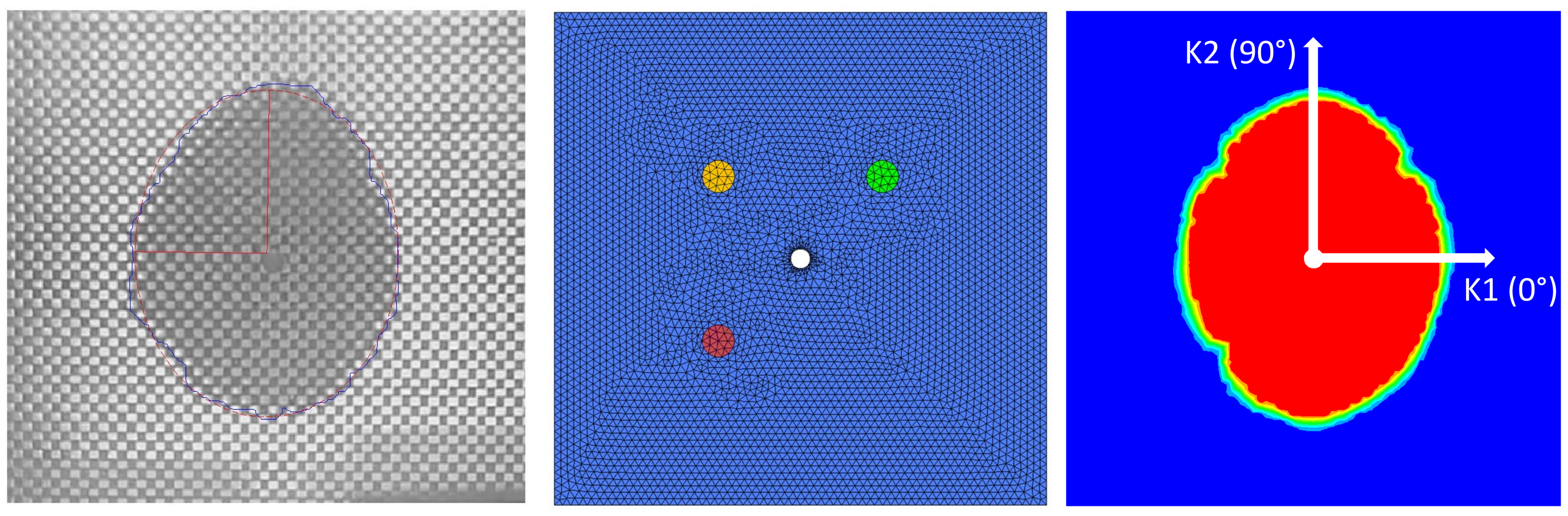

Figure 3: Test view (left), *fabric layer with resistive welding zones (green, yellow, red) (middle), numerical flow front (right)*

Results

The permeability variation along a defined path with resistive welding points was determined and a flow decrease in the welded areas was shown. Simulations showed a good congruence with experimental observations. Adjusted FVC and permeability values for welding zones were validated via simulation and ashing.

Further Research

Firstly, to confirm the obtained results more tests and simulations on part-level should be undertaken. Secondly, the effect of resistive welding on drapeability of the preform should be investigated.

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