Analysis of glass fibres orientation and concentration in thin wall moulded components using CT scanning and numerical simulation

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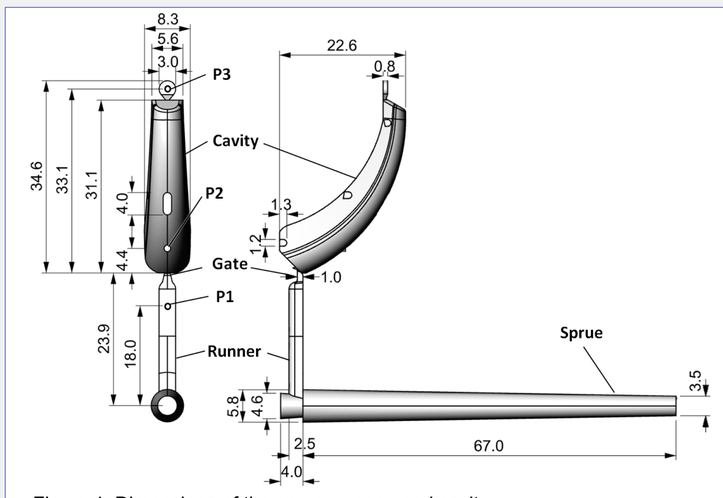

Figure 1: Dimensions of the sprue, runner, and cavity.

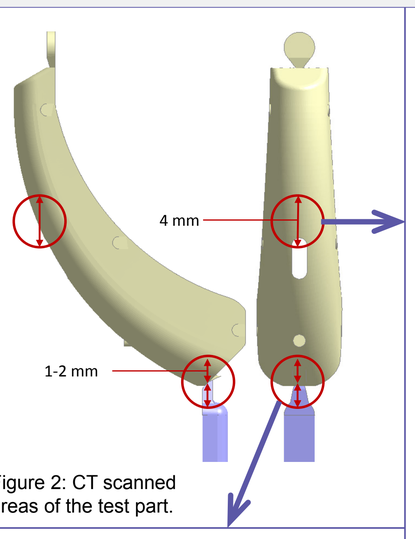

Figure 2: CT scanned areas of the test part.

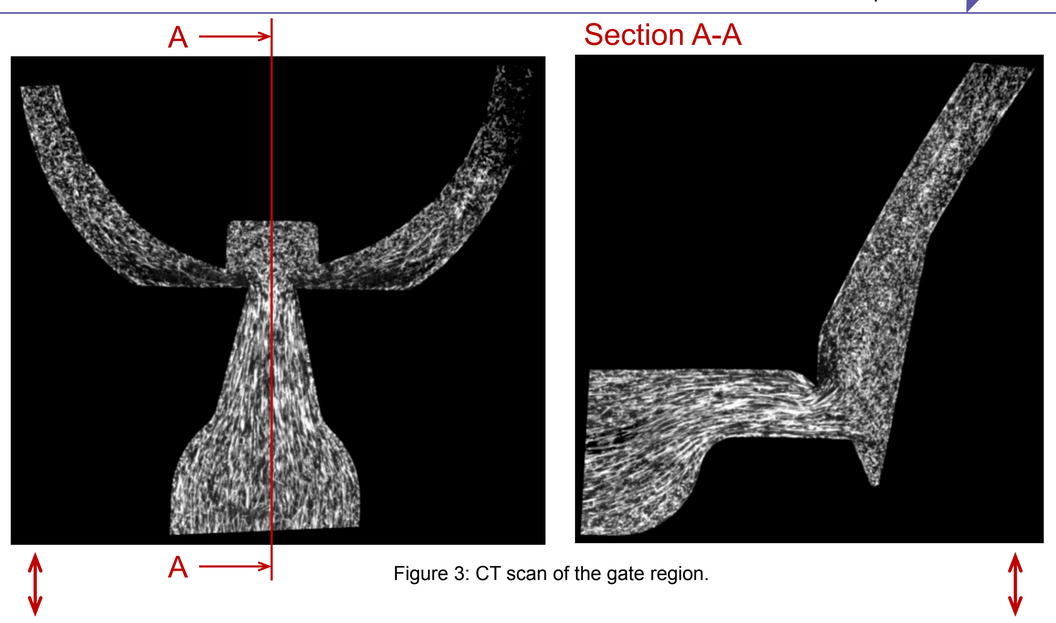

Figure 3: CT scan of the gate region.

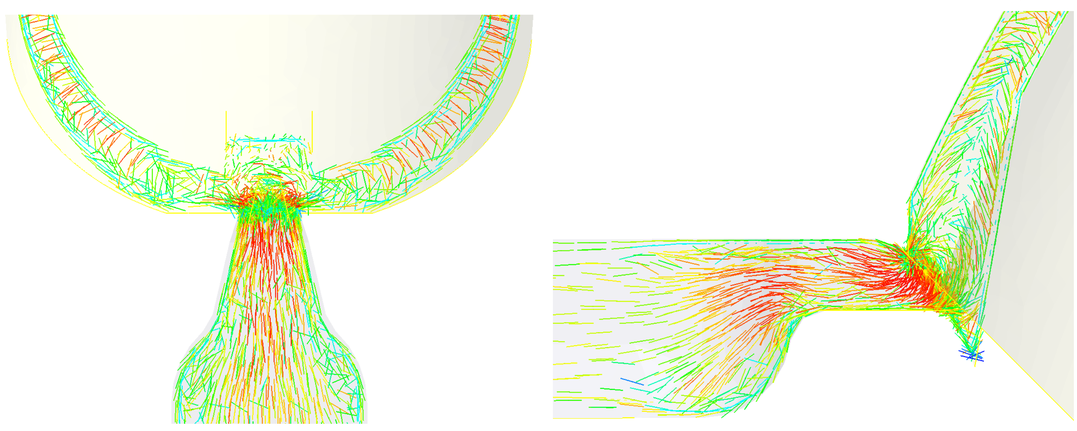

Figure 4: Fibre orientation prediction by the simulation in the gate region.

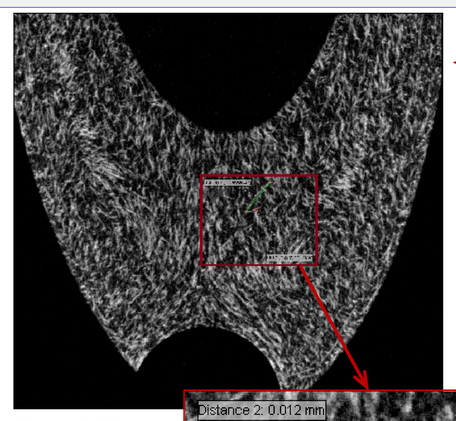

Figure 5: CT scan of the mid section in the part.

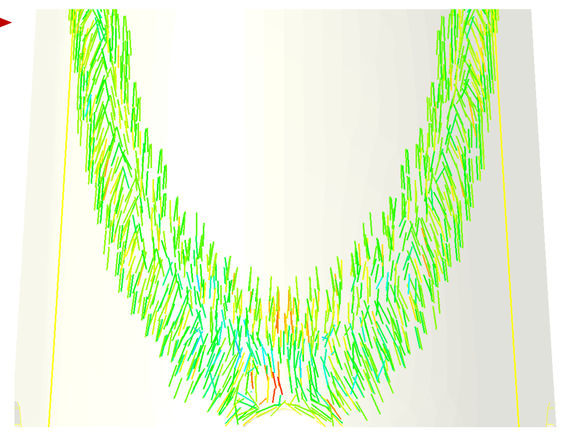

Figure 6: Fibre orientation prediction by the simulation in the region of the part where a weldline occurs.

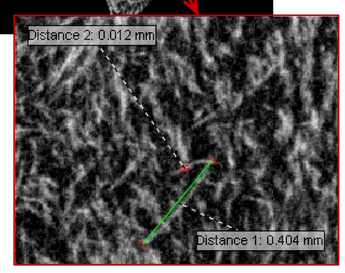

Figure 7: CT scan of the fibre length in the part.
Estimated fibre length is 0.404 mm and diameter is 0.012 mm.

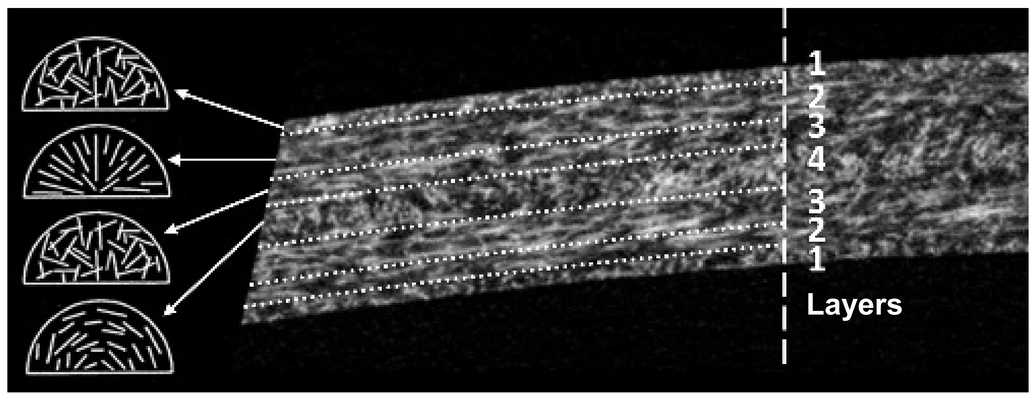

Figure 8: CT scan showing the different layers of fibre orientation generated during filling of the cavity.

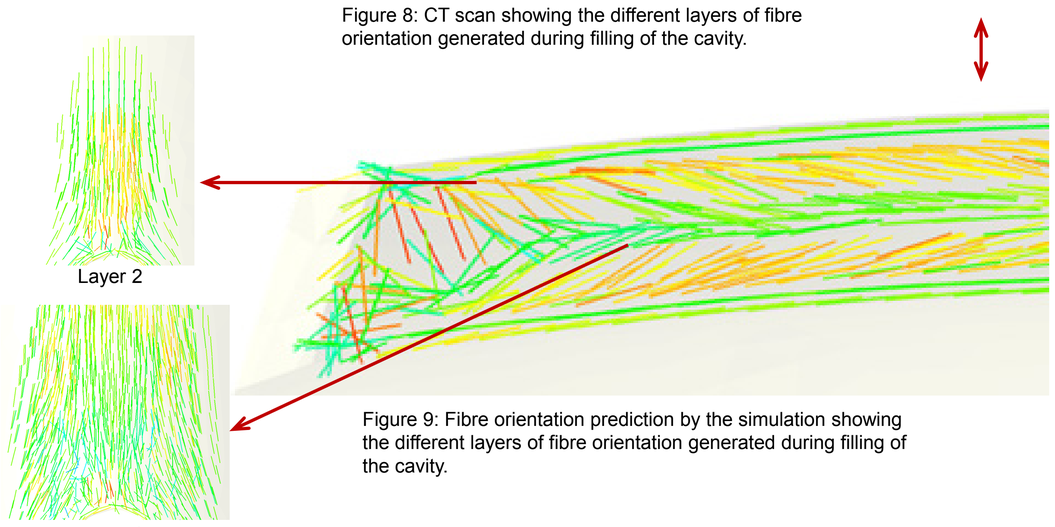

Figure 9: Fibre orientation prediction by the simulation showing the different layers of fibre orientation generated during filling of the cavity.

Introduction

- The purpose of the CT-scan is to estimate the fibre orientation in an injection moulded hearing aid shell, at the gate area and in the part.
- Also to compare with numerical simulations using Moldex3D software.

Fibre density

- In figure 3 the CT scan of the gate area is shown, where the flow is moving through the gate. The fibres are aggregating in the gate.
- As the fibre density is increased at the gate, the viscosity must increase as there is a large amount of friction between the fibres. As the viscosity is determined only with a certain capillary size, this effect might not be reflected in the simulations.
- The simulated fibre density is not actually calculated. Instead, it is an apparent density reflecting the mesh density of the simulated model.

Fibre orientation across the section

- In figure 5 and 8 the CT scan of the mid section of the part is shown.
- The outer most layer (layer 1) has a very random fibre orientation.
- The next layer (layer 2) is orientated in the flow direction as the melt here solidifies while orientated in the flow direction.
- The next layer (layer 3) is a random orientation transition layer.
- In the centre layer (layer 4) the fibres are more orientated towards being perpendicular to the melt flow direction (i.e. not highly orientated in the flow direction), as this flow is an elongational flow forcing the fibre direction to align perpendicular to the melt flow direction.