

Mechanical behaviour of injection-moulded short glass fibre reinforced polyamide with stagnating weld-lines





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Objectives

- How do stagnating weld-lines affect the mechanical performance of PA6/GF composite?
- How do varying the injection moulding process

C) Effects of the processing parameters

- \succ Increasing the packing pressure \rightarrow More mechanically advantageous fibre orientations at the weld-line
- \succ Increasing the melt temperature \rightarrow Tensile strength and modulus increase and then decrease
- parameters affect the strength of weld-lines?
- How can a constitutive model be developed to predict the stress-strain behaviour of samples with weld-lines?

Study: Case An moulded injection tensile bar with a stagnating weld-line



Results and Discussions A) Weld-lines in neat PA6

- > The weld-line is completely healed in the PA6 matrix.
- Weld-lines don't impact unfilled sample's mechanical strength.
- Samples are not fractured at the weld-line.
- > Why? The high healing ability of the PA6 matrix \rightarrow Low relaxation times 12





B) Weld-lines in the PA6/GF composite

() >50% reduction in the tensile strength of the PA6/GF samples with weld-lines. Why? "Disturbed" fibre orientation at the WL.



Three-parameter constitutive model based on the Weibull formula:

 $(E\varepsilon)^{\mu}$ $\sigma = \mathbf{E}\varepsilon exp$

- For finding σ_0 and β : $ln\left[ln\left(\frac{E\varepsilon}{\sigma}\right)\right] = \beta ln(E\varepsilon) \beta ln(\sigma_0)$
- The Weibull curve's maximum predicts weld strength and fracture strain.





are oriented in-plane Fibres when approaching the weld-line



μCT scans in the ZY plane (The scale bar in each figure shows a distance of 1 mm

Fibre orientation: Moldflow predictions vs. Experiments



MatchID

Metrology beyond colors

Tensile Stress - Predicted

250°C-PP40% 250°C-PP80%



- \succ Weld-lines in neat PA6 \rightarrow completely healed
- \succ Weld-lines in neat PA6/GF \rightarrow partially healed by increasing the packing pressure
- \succ Increasing the packing pressure \rightarrow re-orienting fibres at the weld-line \rightarrow increasing the weld-line strength
- \succ The proposed equation can accurately model the tensile behaviour of the weld-lined samples

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