Stress Measurement in Container Glass

Annealing Stress Measurement

Cord Stress Measurement

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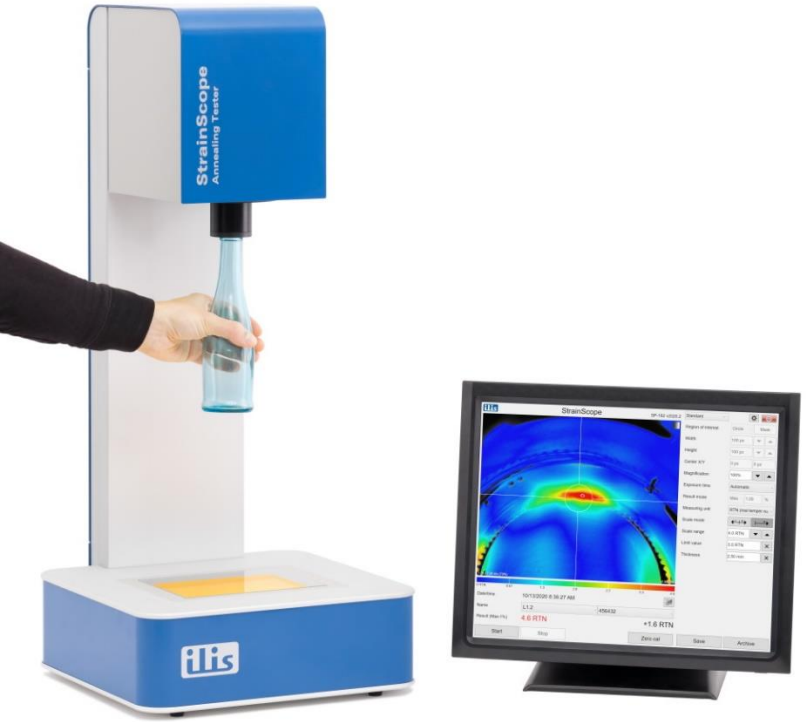
Overview

- Measurement of residual stress after annealing
  - Performing the measurement
  - Dependence on the position in the annealing lehr
  - Dependence on the forming process
- Measurement of cord stress
  - Sample preparation
  - Performing the measurement
- Summary

Measurement of Annealing Stresses

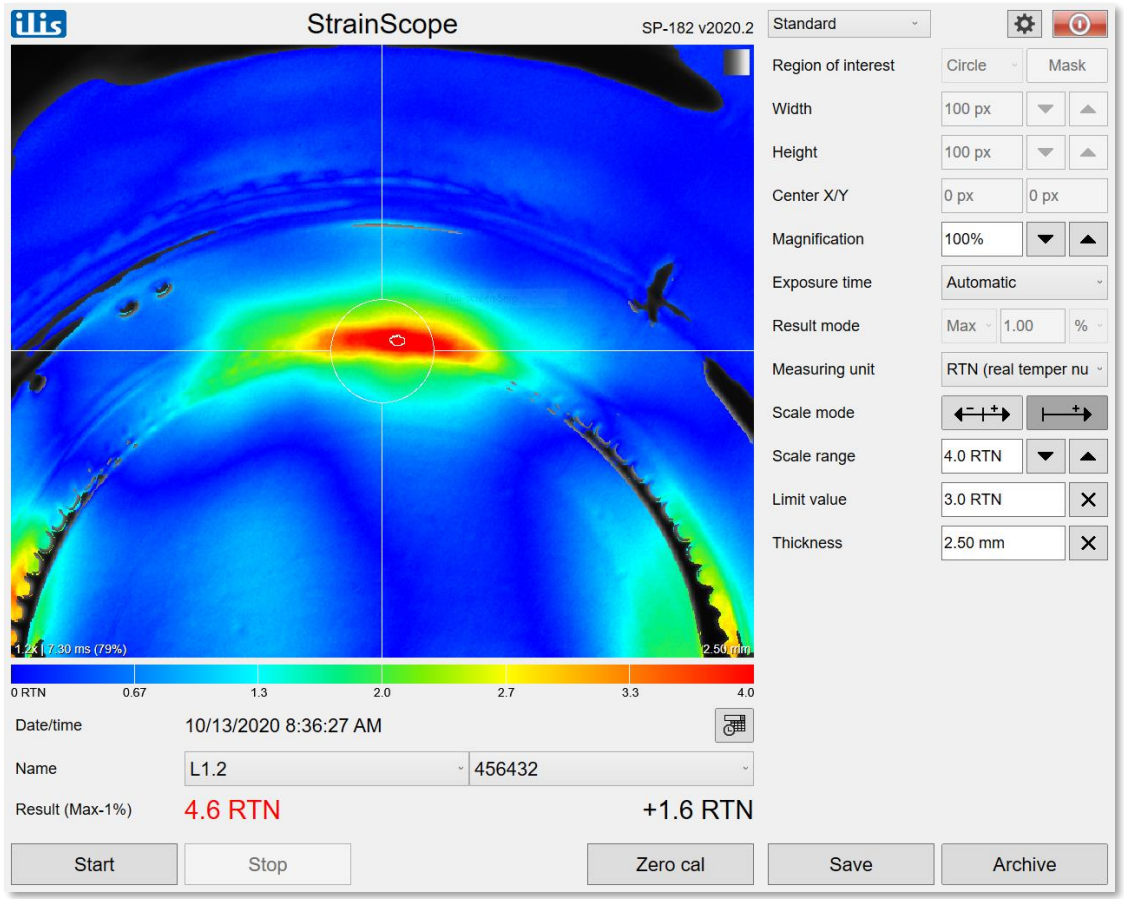
- Monitoring of residual stresses after the annealing process



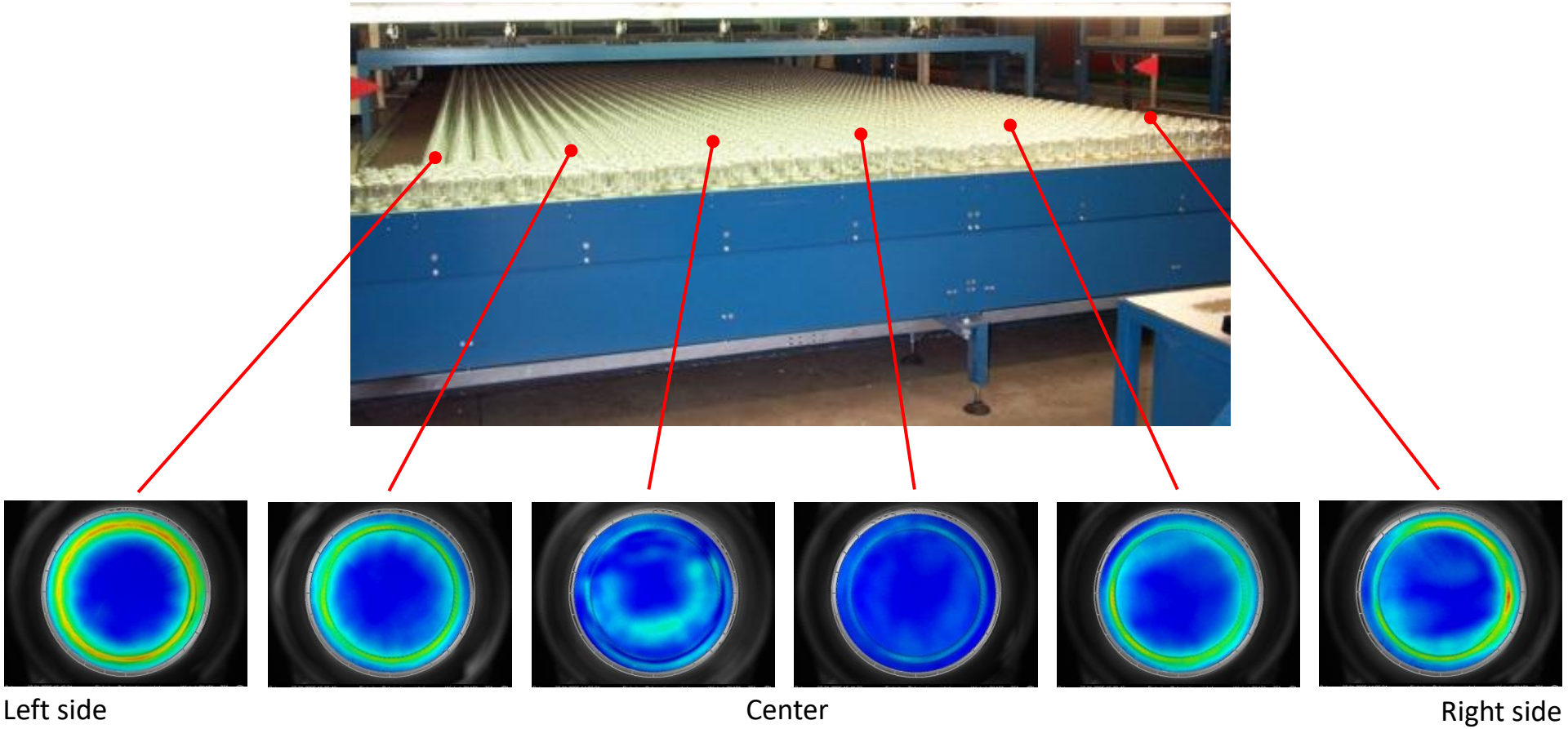
StrainScope® Annealing Tester

Performing the Measurement

- The highest stresses are to be expected in the contact area to the conveyor belt
- Usually the measurement is therefore done in the base area of the container
- Real temper number (acc. to ASTM C148) or nm/cm is typically used as measuring unit

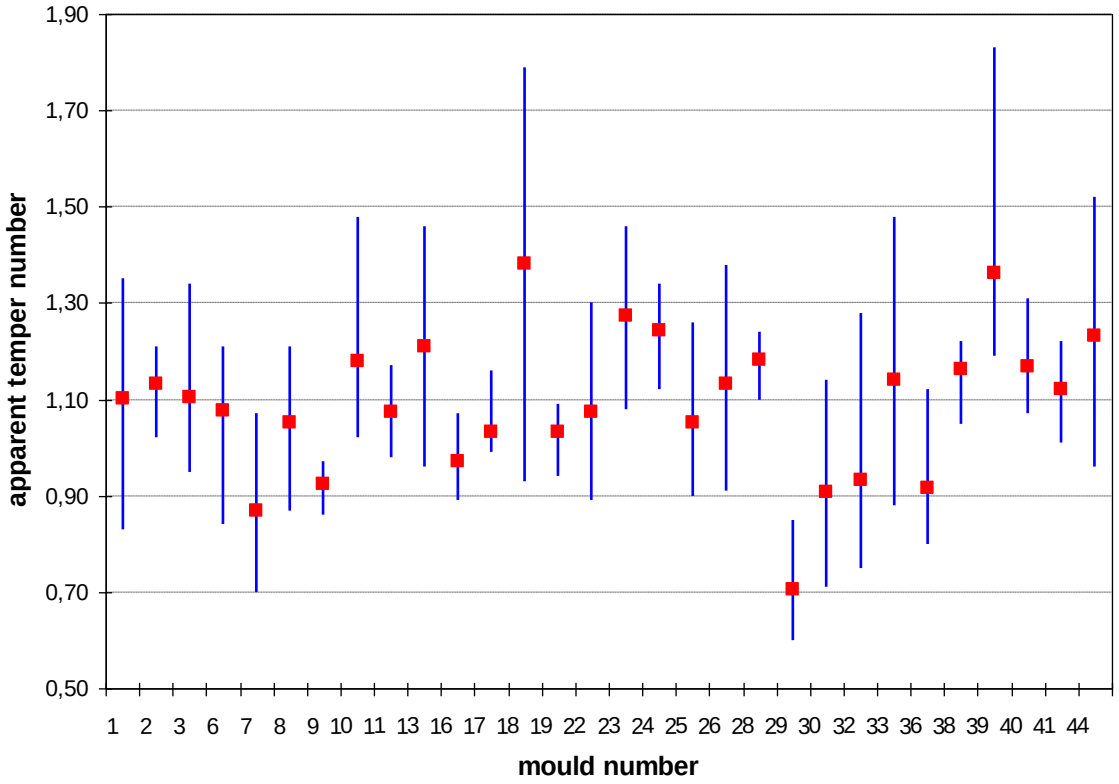


Dependence on the Position in the Lehr



Dependence on the Forming Process

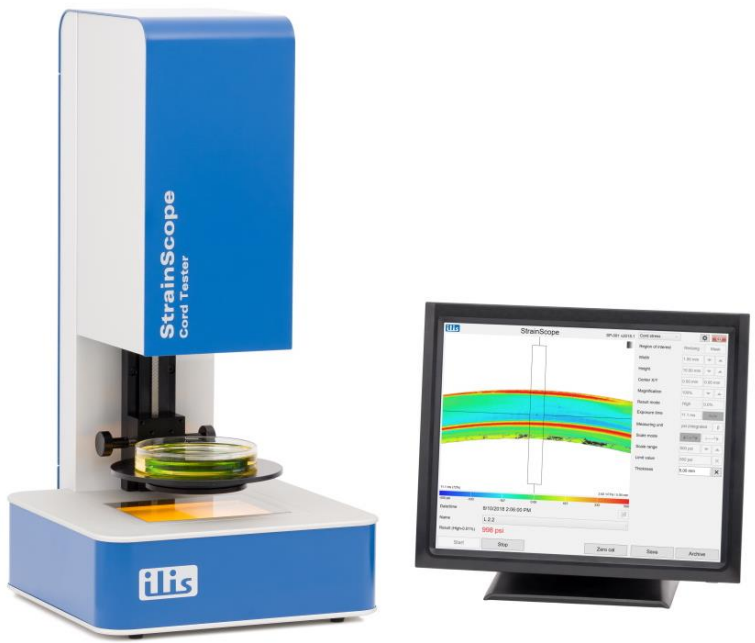
- The residual stress level also correlates with the position in the IS machine
- Possible influencing factors:
  - Mold temperature
  - Mold cooling
  - Distance to annealing lehr



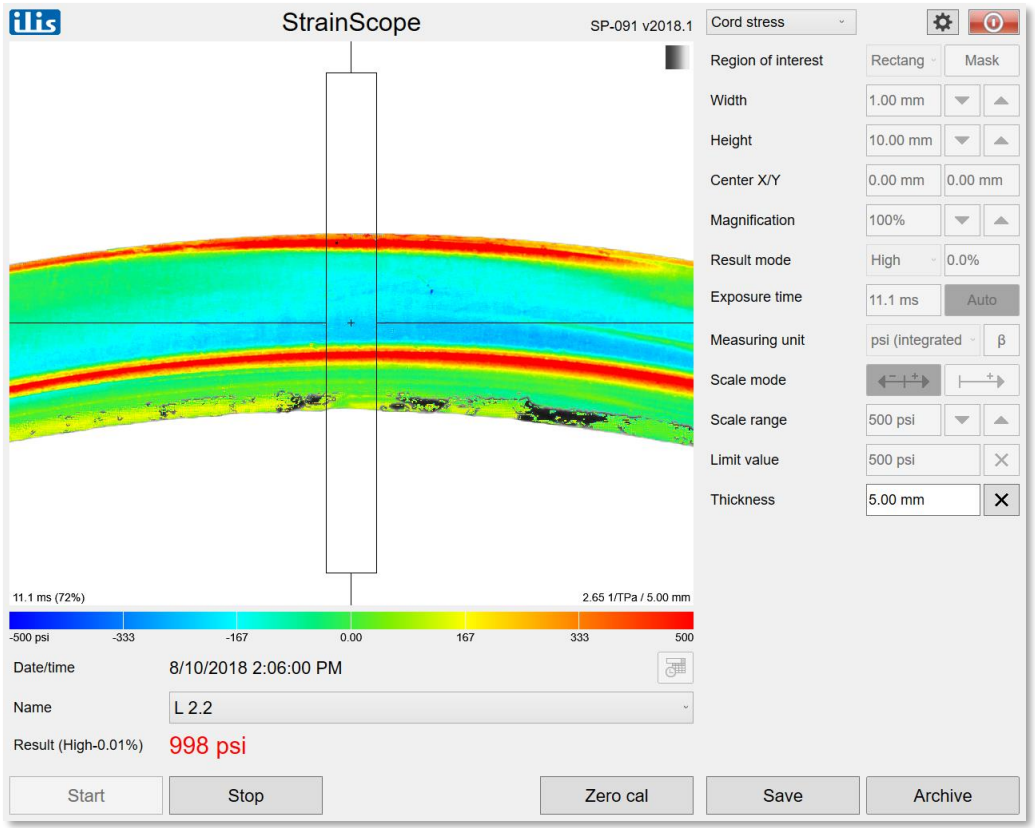
Mean temper number and variance depending on the mold number

Measurement of Cord Stresses

- Cord stress is caused by inhomogeneities in the glass composition



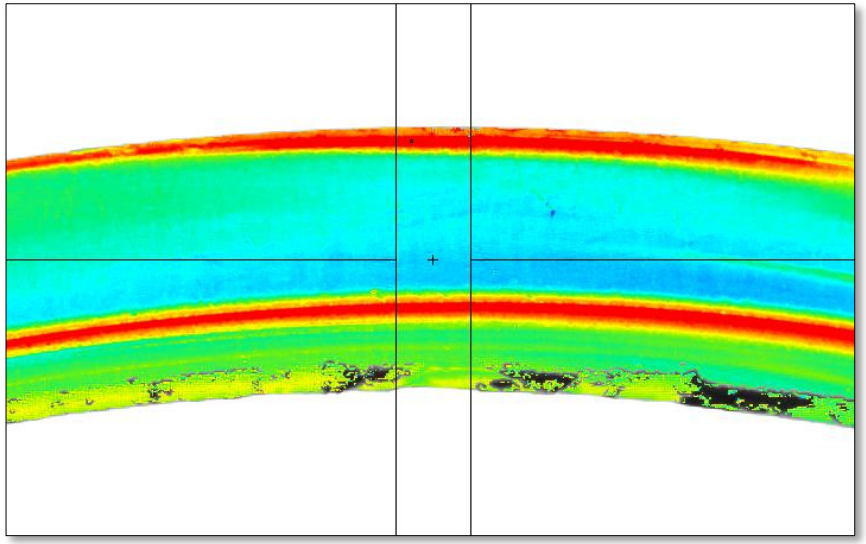
StrainScope® Cord Tester



Sample Preparation

- From the cylindrical part of the glass container, a uniformly thick ring (about 1 cm thick) is prepared
- By cutting the ring, circumferential residual stresses are eliminated
- The roughness of the cut surfaces is optically compensated by a suitable immersion liquid (DMP or vegetable oil)

Performing the Measurement



- Since stress cords can be very thin, the measurement must be made with relatively high spatial resolution
- The measuring instrument therefore always only inspects a small section of the sample at a time
- By rotating the Petri dish, the ring is scanned and the maximum tensile stress (shown in red) is identified
- The measurement of the stress value (in MPa or psi) happens automatically and continuously

Summary

- Automatic, imaging polarimeters simplify the measurement of residual stresses in container glass compared to conventional measuring methods (visual polariscope or polarizing microscope)
- The measurement in real time enables a quick, simple and above all objective assessment of the quality
- Specially adapted solutions exist for the different measuring tasks (annealing stress, cord stress):
  - StrainScope® Annealing Tester
  - StrainScope® Cord Tester