CT for non-destructive testing of plastic joints

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Introduction to the SKZ

- Material-Testing
- Product-Certification
- Training of Professionals
- Certification of Management Systems
- Research and Development
- Failure Analysis
### Overview the business segments

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<tr>
<th>Product quality</th>
<th>Training</th>
<th>Research</th>
<th>Certification</th>
<th>Consulting</th>
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<tbody>
<tr>
<td>Product Inspection</td>
<td>Conferences</td>
<td>Component Properties</td>
<td>ISO 9001</td>
<td>Material research</td>
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<td>Seminars</td>
<td>Compounding and Extrusion</td>
<td>ISO 14001</td>
<td>Feasibility analyses</td>
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<td>Injection Moulding</td>
<td>FW 605</td>
<td>Process analyses/optimizations</td>
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<td>Joining</td>
<td>BS OHSAS 18001</td>
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<td>Material Development</td>
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<td>Sustainability</td>
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<td>European Center for Dispersion Technologies</td>
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Turnover 2004 - 2012

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<td>2012</td>
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Activities

Research and Development

We improve materials
- Thermoplasts
- Elastomers
- Compounds
- Nano composites
- Functional materials
- Wood Plastic Composites

We develop methods
- to evaluate materials
- to optimize production and quality assurance processes
- to gather and evaluate your process data

We improve your economic efficiency
- Analysis and Optimisation of process efficiency as well as sustainability assessments
- Optimise processes as well as test methods

We develop technologies
- to enable new field of applications for polymeric materials
- for the production of composite materials
- to reduce process steps

We care about colour
- Processes to colour materials
- Design aspects
- Colour formulations
- Test methods
Focus: Non-destructive testing (NDT) on SKZ

• Comparison of different methods
• Availability or at least knowledge of all relevant NDT methods
• Evaluating the best method for each individual task
• Further development of NDT methods
• Examples: ultrasonic, terahertz, microwaves, thermography, current testing, X-ray (tomography), shearography, MRT...
Computed tomography on SKZ

• Computed tomography-Workstation exaCT® S50
  • maximum measurable component size: Ø 50 x 40 mm
  • X-ray Source: 130 kV
  • Detector: 1.6 Megapixel and about 40 µm pixel size
  • Detail resolution: 5 µm

• Computed tomography-Workstation exaCT® M150
  • maximum measurable component size: Ø 150 x 250 mm
  • X-ray Source: 125 kV
  • Detector: 3.7 Megapixel and about 45 µm pixel size
  • Detail resolution: 40 µm
Inclusions on plastic parts

- The CT can be used as NDT measurement of shrink holes and inclusions in welded plastic parts
- Virtual sections for accurately positioning the fault are possible

HS welded PP-specimen (65 x 65 mm) with sand grains 0.8 - 1.2 mm
Inclusions on plastic parts

- Hot gas welding parts can be non-destructive investigated for shrink holes
- Beside the position its also possible to mark the volume of the holes and check the seriosity of the defect
WPC (Wood Plastic Composites) joints

• WPC is often used in building sector, automotive or furniture industry
• During the production process the parts has to be connected by bonding or welding
• Errors in the joint plane reduce the strength significantly
• Picture shows Ultrasonic-welded WPC-Parts
NDT with computed tomography

WPC (Wood Plastic Composites) joints

• Full 3d reconstruction shows the separation of plastic and wood
• Inclusions were detected automatically by the analysis software and displayed in color-coded
• The orientation of the wood fibers in the joining plane also affects the strength of the connection

In cooperation with WENZEL Volumetrik GmbH
Failure detection for the electrofusion welding (HM)

• The computed tomography is in principle very well for the examination of HM welding of polyethylene
• Detectable faults
  ✓ Incorrect insertion of the pipe
  ✓ Different gaps
  ✓ Angular deviation
  ✓ Inclusions of air or foreign matter in the joining seam
  ✓ Movement of the heating coil

In cooperation with WENZEL Volumetrik GmbH
Investigation of adhesive bonded plastic joints

- SKZ already performed studies to determine correct adhesive amount for plastic parts
- Minimal density differences (0.05 to 0.1 g/cm³) between adhesive and plastic part can be, dependent on the X-ray source, successfully separated
Fibre orientation on plastic joints

• SKZ research current the influence of the fiber orientation in the welding zone for filled thermoplastics
• In an orientation of fillers across the bond level, a significant decrease in weld strength is determined

Aim:
• Analysis of the filler orientations
• Development of an innovative tool for the reduction of the filler orientation

High fibre orientation, welding pressure too high

Low fibre orientation
Variance analysis on plastic parts

- With the iCT it is possible to measure the dimensioning of plastic parts
- The difference between proper component and the draft of it are shown color coded
Non-destructive material analysis

• Due to the very high resolution, computed tomography is suitable for non-destructive material analysis.

• Possible applications:
  ✓ Particle/ volume size distribution
  ✓ Characterization of Compounds
  ✓ Particle size change through processing steps
NDT with computed tomography

Analysis of the concentration different plastic components

• SKZ researching plastics, in which the filler content over the cross section varies continuously
• This different filler content, respectively the different densities, can be made visible by the CT
Thank you for your attention

For more information please visit our Website
www.skz.de/forschung/fuegen

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