Quality-assured mass production of NCF through an intelligent production machine

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Product

• Increasing use of non-crimp fabric (NCF)
• Large series production of components
• No-standardized quality requirements from different companies / industries

Reference:
[1]: http://www.business-on.de
[2]: http://www.auto-bild.de
[3]: http://www.boldmethod.com
Outline

1. Introduction and Motivation
2. Approach for a quality control system
3. Machine modifications
4. Investigation on the pressure roll
5. Conclusion and Summary
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Introduction

NCF Production
- High productivity
- Manual adjustment of production parameters
  - Tension of stitching yarn
  - Tension of reinforcement fibers
  - Preload of pressure roll

Typical set-up of NCF fabric

LIBA Copcentra Max 3 machine

Reference:
Karl Mayer LIBA GmbH
Introduction

NCF Production

- Pressure roll is used to homogenize the fabric and to reduce gaps
- Manually adjusted pre-load on springs
Motivation

Errors within the production process
• thread tension prone to error
• possible inhomogeneous texture outcome
• angular deviation
• errors within intermediate layers
• foreign object

Deficits of the production process
• non-existing quality monitoring of the production process
• no detection of errors within intermediate layers
• no continuous record keeping of texture quality
• mainly manual on sight quality inspection
Motivation

Research Project: AiF Auto-NCF

Goals:
• Higher quality of the product
• Less quality cost
  – Quick adjustment of optimum machine settings
  – Lower reject rate
  – Detailed „error map“ for every roll of produced textile

Implementing an in-line quality control system into the production of NCF
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Approach for a quality control system

Development of actuators

Development of sensors

Model-based control
Approach for a quality control system

Closed loop control
- Combination of all sensor data
- Feedback loop to adjust pressure roll
- Documentation of all data
  → Creation of error map
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Machine modifications

Light Barriers

- Breakage of reinforcing fibers

- Breakage of warp knitting fibers
Machine modifications

Detection systems

• Areal weight detection

• Fiber misalignement detection

X-Ray Sensor

Camera 1

DSP-Box

Camera 2
Machine modifications

Pressure Roll System

- Camera 1
- Pressure Roll
- Pressure Valve
Machine modifications

Overall System

Control Cabinet

Mobile Panel

LabView PC
Outline

1 Introduction and Motivation

2 Approach for a quality control system

3 Machine modifications

4 Investigation on the pressure roll

5 Conclusion and Summary
Investigation on the pressure roll

Load cells
- Load cells are installed
- A pressure measurement film is used to investigate the influence of the pressure roll and the homogenizing effect
Investigation on the pressure roll

Pressure measurement film
- Curved irregular characteristic
- Conclusions about height and width of thick spots can be drawn
- But: gaps need to be detected without influence on the textile
## Investigation on the pressure roll

### Results

<table>
<thead>
<tr>
<th>300 g/m² – low speed</th>
<th>600 g/m² – low speed</th>
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<tbody>
<tr>
<td>Pressure roll: low tension</td>
<td>Pressure roll: high tension</td>
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</table>

<table>
<thead>
<tr>
<th>Without pressure roll</th>
<th>With pressure roll</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
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<tr>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
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</table>
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Conclusion and Summary

- High economical use of quality control system for NCF-production
- Homogenizing effect of the pressure roll
Thank you for your attention!

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