Progress in Detecting and Removing Cotton Contaminants in Spinning

33rd International Cotton Conference

Bremen, March 17, 2016
General Remarks
General Remarks

Cotton has been losing market share, continuously and for many years.
World Cotton Consumption and Market Share of Cotton

Market Share of Cotton (%)

Source: ICAC
General Remarks

Cotton has been losing market share, continuously and for many years.

Cotton is substituted by Polyester as its primary competitor.
General Remarks

Cotton has been losing market share, continuously and for many years.

Cotton is substituted by Polyester as its primary competitor.

Complex global economic interactions are the reason for this trend, but there are also purely technical aspects to be considered.
<table>
<thead>
<tr>
<th></th>
<th><strong>Cotton</strong></th>
<th><strong>Polyester</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trash</strong></td>
<td>1.0 ... 12.0 %</td>
<td>none</td>
</tr>
<tr>
<td><strong>Dust</strong></td>
<td>200 ... 1000 g⁻¹</td>
<td>none</td>
</tr>
<tr>
<td><strong>Short fibers by weight</strong></td>
<td>6 ... 10 %</td>
<td>0.1 ... 0.3 %</td>
</tr>
<tr>
<td><strong>Fiber fragments</strong></td>
<td>0.050 ... 0.400 %</td>
<td>none</td>
</tr>
<tr>
<td><strong>Neps</strong></td>
<td>100 ... 350 g⁻¹ (AFIS)</td>
<td>0 ... 1 g⁻¹ (visual counting)</td>
</tr>
<tr>
<td><strong>Seed-coat fragments</strong></td>
<td>10 ... 50 g⁻¹</td>
<td>none</td>
</tr>
<tr>
<td><strong>White specks</strong></td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td><strong>Stickiness</strong></td>
<td>0 ... 50 points</td>
<td>none</td>
</tr>
<tr>
<td><strong>Contaminants</strong></td>
<td>depends on origin</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td><strong>Cotton</strong></td>
<td><strong>Polyester</strong></td>
</tr>
<tr>
<td>------------------</td>
<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Trash</td>
<td>1.0 ... 12.0 %</td>
<td>none</td>
</tr>
<tr>
<td>Dust</td>
<td>200 ... 1000 g(^{-1})</td>
<td>none</td>
</tr>
<tr>
<td>Short fibers by weight</td>
<td>6 ... 10 %</td>
<td>0.1 ... 0.3 %</td>
</tr>
<tr>
<td>Fiber fragments</td>
<td>0.050 ... 0.400 %</td>
<td>none</td>
</tr>
<tr>
<td>Neps</td>
<td>100 ... 350 g(^{-1}) (AFIS)</td>
<td>0 ... 1 g(^{-1}) (visual counting)</td>
</tr>
<tr>
<td>Seed-coat fragments</td>
<td>10 ... 50 g(^{-1})</td>
<td>none</td>
</tr>
<tr>
<td>White specks</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Stickiness</td>
<td>0 ... 50 points</td>
<td>none</td>
</tr>
<tr>
<td><strong>Contaminants</strong></td>
<td>depends on origin</td>
<td>none</td>
</tr>
</tbody>
</table>
General Remarks

Cotton contamination is an issue that cotton producers are seemingly unable to resolve.
General Remarks

Cotton contamination is an issue that cotton producers are seemingly unable to resolve.

Spinners worldwide therefore took the initiative and invested some US$ 0.5 billion in electronic systems for contaminant detection/removal in cotton cleaning lines since the mid 90’s.
General Remarks

Cotton contamination is an issue that cotton producers are seemingly unable to resolve.

Spinners worldwide therefore took the initiative and invested some US$ 0.5 billion in electronic systems for contaminant detection/removal in cotton cleaning lines since the mid 90’s.

That is not counting electronic yarn clearers with foreign fiber detection capabilities installed on spinning and winding machines.
General Remarks

The total investment in all systems to prevent cotton contamination problems therefore is in the range of low single digit billions of US$. 
**General Remarks**

The total investment in all systems to prevent cotton contamination problems therefore is in the range of low single digit billions of US$.

The spinners’ money spent for a solution to the problem went to European machinery/electronics manufacturers.
General Remarks

The total investment in all systems to prevent cotton contamination problems therefore is in the range of low single digit billions of US$.

The spinners’ money spent for a solution to the problem went to European machinery/electronics manufacturers.

In a figurative sense: Some of that money went to people like myself and not to the cotton producers for a solution at their end.
General Remarks

Spinners are willing to and actually do pay us money to fix the problem. But, they want it fixed 100%. They constantly challenge us to develop the “perfect machine”.
General Remarks

Spinners are willing to and actually do pay us money to fix the problem. But, they want it fixed 100%. They constantly challenge us to develop the “perfect machine”.

Our response to that is the new T-SCAN or TS-T 5 foreign matter separator.
T-SCAN or TS-T 5

Electronic camera-based foreign matter separator installed in the cotton cleaning line
T-SCAN or TS-T 5

Electronic camera-based foreign matter separator installed in the cotton cleaning line

Scans the cotton with advanced industrial image analysis technology while tufts are passing through the machine carried by air flow
**T-SCAN or TS-T 5**

Electronic camera-based foreign matter separator installed in the cotton cleaning line

Scans the cotton with advanced industrial image analysis technology while tufts are passing through the machine carried by air flow

Introduced in November 2015, delivery planned for June 2016
T-SCAN or TS-T 5

5 modular detection technologies

- F-Module: colored/dark/bright foreign objects
- P-Module: transparent foreign objects
- UV-Module: fluorescent foreign objects
T-SCAN or TS-T 5

5 modular detection technologies

- **F-Module:** colored/dark/bright foreign objects
- **P-Module:** transparent foreign objects
- **UV-Module:** fluorescent foreign objects
- **G-Module:** reflective foreign objects
- **LED-Module:** small/thin foreign objects
General Remarks

The biggest foreign matter problem for spinners worldwide is plastic contamination, Polypropylene (PP) in particular.
Detecting PP with **Standard Trützschler Technology**

F-Module: Colored PP  
Visible Light, Color/Contrast

P-Module: Transparent PP  
Polarized Light, Birefringence

UV-Module: Fluorescent PP  
UV Light, Fluorescence
Detecting PP with New Truetzschler Technology

G-Module: Reflective PP
Polarized Light, Specular Reflectance

LED-Module: Small PP
Visible Light, Light Emitting Diodes
T-SCAN or TS-T 5: Machine Details

- Cotton In
- Contaminant Suction Fan
- Velocity Sensors
- Nozzle Bar
- Contaminant Removal System
- Cotton Out
T-SCAN or TS-T 5: Machine Details

Velocity Sensors
Velocity Sensors
T-SCAN or TS-T 5: Machine Details

Nozzle Bar
Nozzle Bar

Contaminant ejection with 144 compressed air nozzles, individually controllable via 48 solenoid valves.
Integrated pressure tank
T-SCAN or TS-T 5: Machine Details

Contaminant Removal System

Contaminant Suction Fan
Installation Example
T-SCAN or TS-T 5: Machine Details

- 4-CCD
- 4-CCD
- Mirror
- Water Cooling System
- LED
- LED
- UV
- Mirror
- Mirror
- 3-CCD
- CCD
- Water Cooling System
- CCD
T-SCAN or TS-T 5: Machine Details

5 Detection Technologies:
- F  color/contrast
- G  reflective objects
- P  transparent objects
- UV fluorescent object
- LED small/thin objects

F and G-Module:
4-CCD cameras (T-SCAN)
LED, reflected light mode

P and UV-Module:
3-CCD camera
Fluorescent tubes, transmitted visible light mode, reflected UV light mode

LED-Module:
528 high-power LEDs and lenses
New 4-CCD Color Line Scan and Polarization Camera

• Color line scan camera for the F-Module
• Polarization camera for the G-Module
• Scanning frequency 4 x 19 kHz
• 2048 pixels/line
• Vertical resolution: 0.5 mm/line (10 m/s)
• Horizontal resolution: 0.6 mm/pixel

Advantages:
• Simultaneous detection of colored and reflective foreign matter such as white opaque PP or colored PP
• Detection of even the smallest pieces of foreign matter
4-CCD Line Scan Camera Technology

Color line scan camera:
Red, Green 2, Blue
Application in F-Module

Polarization camera:
Green 1, Green 2
Application in G-Module

Green 1: vertically polarized
Green 2: horizontally polarized
G-Module: Raw and Processed Image Data

Green 1, raw

Green 2, raw

Reflection = f(G1, G2)

Algorithmic Enhancement
Detection Examples with Reflective Contaminants
T-SCAN or TS-T 5: Machine Details
Mirrors
T-SCAN or TS-T 5: Machine Details

5 Detection Technologies:
F  color/contrast
G  reflective objects
P  transparent objects
UV fluorescent object
LED  small/thin objects

F and G-Module:
4-CCD cameras (T-SCAN)
LED, reflected light mode

P and UV-Module:
3-CCD camera
Fluorescent tubes, transmitted visible light mode, reflected UV light mode

LED-Module:
528 high-power LEDs and lenses
LED Illumination System

- Generates high-intensity polarized light
- Long service life due to water cooling
- Absolutely dust-proof and maintenance-free
- Light comes from 528 high-power LEDs and lenses
- Background finished in cotton color

Advantages:
- very bright light
- long service life
- no maintenance
T-SCAN or TS-T 5: Machine Details
Water Cooling System
T-SCAN or TS-T 5: Machine Details

5 Detection Technologies:
F  color/contrast
G  reflective objects
P  transparent objects
UV fluorescent object
LED small/thin objects

F and G-Module:
4-CCD cameras (T-SCAN)
LED, reflected light mode

P and UV-Module:
3-CCD camera
Fluorescent tubes, transmitted visible light mode, reflected UV light mode

LED-Module:
528 high-power LEDs and lenses
P-Module and UV-Module
Quick and Easy Access to Illumination Systems

Operating position: duct hermetically sealed

Service positions: easy access to glass surfaces and fluorescent tubes
Outer Dimensions/Performance Data

Max. production rate: **1200 kg/h**  
Working width: **1200 mm**
Operation via Touch Screen Panel

Machine ready

Trützschler T-SCAN

3800 m³/h 0 Pa

Ejections
--- /h
--- /h
--- /h
--- /h
# Redundancy Matrix: Simultaneous Detection with at Least Two Independent Modules

<table>
<thead>
<tr>
<th></th>
<th>F-Module</th>
<th>G-Module</th>
<th>P-Module</th>
<th>UV-Module</th>
<th>LED-Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>White PP</td>
<td>-</td>
<td>reflective</td>
<td>transparent</td>
<td>fluorescent</td>
<td>thin strips</td>
</tr>
<tr>
<td>Colored PP</td>
<td>colored</td>
<td>reflective</td>
<td>transparent</td>
<td>-</td>
<td>thin strips</td>
</tr>
<tr>
<td>White Plastic Film</td>
<td>-</td>
<td>reflective</td>
<td>transparent</td>
<td>fluorescent</td>
<td>small parts</td>
</tr>
<tr>
<td>Colored Plastic Film</td>
<td>colored</td>
<td>reflective</td>
<td>transparent</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Threads</td>
<td>colored</td>
<td>-</td>
<td>-</td>
<td>fluorescent</td>
<td>thin threads</td>
</tr>
<tr>
<td>Pieces of Fabric</td>
<td>colored</td>
<td>-</td>
<td>-</td>
<td>fluorescent</td>
<td>-</td>
</tr>
<tr>
<td>Jute</td>
<td>colored</td>
<td>reflective</td>
<td>-</td>
<td>-</td>
<td>thin threads</td>
</tr>
</tbody>
</table>
Summary – What’s New?
Summary – What’s New?

• 5 modular technologies to detect all typical cotton contaminants (F, P, UV, G, and LED: color, transparency, fluorescence, reflection, and LED illumination)
Summary – What’s New?

• 5 modular technologies to detect all typical cotton contaminants (F, P, UV, G, and LED: color, transparency, fluorescence, reflection, and LED illumination)

• Sophisticated 4-CCD color line scan and polarization camera technology for the recognition of color and reflection
Summary – What’s New?

• 5 modular technologies to detect all typical cotton contaminants (F, P, UV, G, and LED: color, transparency, fluorescence, reflection, and LED illumination)

• Sophisticated 4-CCD color line scan and polarization camera technology for the recognition of color and reflection

• High-power, maintenance-free LED illumination technology
Questions, Comments ... ?
Thank you very much for your time.

You can also visit us on the internet.
www.truetzschler.com