CARDING AND COMBING FINE WOOL

Gary Robinson
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<th>PLANT</th>
<th>Reduction of 1% Romaine</th>
<th>Plant efficiency %</th>
<th>Product Value USD</th>
<th>Potential Gain USD/ann.</th>
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<td>+3.5kg/hr</td>
<td>70</td>
<td>15.0/lin.metre (3m/kg)</td>
<td>1.32M</td>
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STAGES in ESP of WOOL

- Greasy Wool Blending
- Scouring
- Scoured Wool Blending
- Carding
- Gilling
- Combing Top Finishing
WOOL BLENDING

- **Quality**: To meet customer requirements
- **Price**: To meet the spinners price
- **Profitability**: To produce the best product for the lowest price
BALING OF SCOUNRED WOOL

- Storing to 12mths reduces Huateur by 2 to 3mm
- Bi-axial pressing worse than mono-axial pressing
- Packing density has little effect
- Regain during pressing not significant
- Losses erased if scoured wool relaxed >Tg
Carding
SCOUR QUALITY CONTROL

- **Moisture Content**
  - Fine Merinos (low VM) 15-17%
  - Fine Merinos (<3% VM) 12-14%
  - Fine Merinos (High VM) <10%
SCOUR QUALITY CONTOL

- TFM content after scouring 0.3-0.5%
- Dirt content after scouring 0.4-0.6%
REGAIN FOR PRODUCTION

- Increased regain reduces fibre strength
- Increased regain increases fibre extension
- At both conventional and high card speeds, feed regain does not affect fibre breakage.
- Regain important for fibre control – 16 to 18% optimum
- For high VM wools, drier is better
Lubricating wool
HAUTEUR AND FRICTION

Coeff. Of Fibre-Metal friction vs. \( \Delta H_{mm} \)

- Wool Micron:
  - 20
  - 21
  - 23.5
  - 21
  - 21.7
  - 21.7
THE FLOW OF FIBRES

\[ \text{MFD} = \text{FFD} + \text{RFD} + \text{WFD} \]

\[ \text{TFD} = \text{FFD} + \text{RFD} \]

**Diagram:**
- **SWIFT:**
  - Loose Stock In
  - Angle Stripper
  - WFD
- **STRIPPER:**
  - TFD
- **WORKER:**
  - WORKING ZONE
- **DOFFER:**
  - Sliver Out

**Equations:**
- \[ \nu_s \]
- \[ \nu_d \]
PRODUCTION RATE EFFECTS

Card Production Rate kg/h vs. HAUTEUR mm

HAUTEUR mm decreases as CARD PRODUCTION RATE kg/h increases.

Card Production Rate kg/h vs. ROMAINE %

ROMAINE % increases as CARD PRODUCTION RATE kg/h increases.
EFFECTS OF FIBRE DENSITY AND CARD SPEED

<table>
<thead>
<tr>
<th>Experimental Condition</th>
<th>Card Production Rate kg/m/h</th>
<th>Card Speed (Swift) m/min</th>
<th>Fresh Fibre Density g/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>17</td>
<td>450</td>
<td>0.6</td>
</tr>
<tr>
<td>II</td>
<td>30</td>
<td>450</td>
<td>1.1</td>
</tr>
<tr>
<td>III</td>
<td>30</td>
<td>800</td>
<td>0.6</td>
</tr>
<tr>
<td>IV</td>
<td>53</td>
<td>800</td>
<td>1.1</td>
</tr>
</tbody>
</table>
Effect of Fresh Fibre Density and Speed on Hauteur and Romaine

Carding Conditions

<table>
<thead>
<tr>
<th>Fresh Fibre Density (g/m²)</th>
<th>Card Production Rate (kg/h)</th>
<th>Swift Surface Speed (m/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6</td>
<td>30</td>
<td>450</td>
</tr>
<tr>
<td>1.06</td>
<td>52</td>
<td>450</td>
</tr>
<tr>
<td>0.6</td>
<td>52</td>
<td>800</td>
</tr>
<tr>
<td>1.06</td>
<td>90</td>
<td>800</td>
</tr>
</tbody>
</table>

HAUTEUR mm

ROMAINE %
## FIBRE DENSITY IN CARDING VERY FINE WOOL (17.2 µm wool)

<table>
<thead>
<tr>
<th>Swift Speed (m/min)</th>
<th>Fibre Density (g/m²)</th>
<th>Combing Noil (%)</th>
<th>Hauteur (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>0.8</td>
<td>12.0</td>
<td>61.4</td>
</tr>
<tr>
<td>900</td>
<td>0.5</td>
<td>9.7</td>
<td>63.2</td>
</tr>
</tbody>
</table>
Higher Carding Speeds can be used in Two Ways

- Condition II to condition III,
  - there has been a gain in product quality and waste control at constant production rate.

- Condition II to condition IV,
  - a large gain in production rate has been achieved without any deterioration in top length or increase in noil.
THIBEAU CA7 CARD
CARDING (NEP FORMATION)

It is generally accepted that nep formation is affected by.....

- The degree of entanglement from scouring
- The stripper settings
- The doffer settings
- The swift speed – fibre density
- SDSR
- The type of card clothing and its condition
- Moisture content
CARDING (NEP FORMATION)

Between any two rollers, there are four influencing factors:

- **Geometry** (diameter, direction of rotation)
- **Speed** (individual, differential)
- **Gauge**
- **Clothing** (type, condition)
CARD SETTINGS

- Final Setting (both worker and doffer) are major determinant

- More open settings gives small gain in H, but a lot more romaine

- Altering setting on forepart has little effect
Romaine & Mean Pin Density on Swift Workers

平均锡林针密度cm² Mean Swift Worker Pin Density points/cm²

碎毛率 Romaine, %

Romaine, % Coarse Setting
Romaine, % Fine Setting
豪特与锡林针布上平均针密度的关系

Hauteur & Mean Pin Density on Swift Workers

平均锡林针密度
Mean Swift Worker Pin Density, point/cm²
The objectives of preparation are to.....

- Align the fibres into a parallel form
- Produce a sliver with a uniform weight / unit length
- Increase fibre blending
- Minimize neps
GILLING

The setting of all gills is critical to quality

- Ratch (nip distance) wool specific
- Draft wool specific
- Speed fibre condition
- Feed load wool specific

The amount of draft (& doublings) is critical to the proper bending of fibres – higher draft is better.
PREPARATION

*Draft is vital for.....*

- Blending
- Fibre distribution
- Removal of fibre hooks
- Drawing fibres parallel
- Nep Minimization
## DRAFT LEVEL in PREPARATION

<table>
<thead>
<tr>
<th>Experimental Condition</th>
<th>Hauteur, mm</th>
<th></th>
<th></th>
<th>Romaine,%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wool 1</td>
<td>Wool 2</td>
<td>Wool 1</td>
<td>Wool 2</td>
</tr>
<tr>
<td>Control, 3 gills with total draft=200</td>
<td>67.2</td>
<td>67.0</td>
<td>5.3</td>
<td>5.9</td>
</tr>
<tr>
<td>High draft, 3 gills, total draft=1350</td>
<td>70.6</td>
<td>69.7</td>
<td>4.7</td>
<td>4.9</td>
</tr>
</tbody>
</table>
GILLING

Machine speed affects…..

- Productivity
- Sliver evenness
- Machine wear
- Fibre breakage
GILLING (Draft Zone)
GILLING (Ratch settings)

The front ratch settings can be calculated with the following formula...

\[
\text{Hauteur} + 5 \text{ (mm)}
\]

\[
\left(\frac{\text{70}}{2}\right) + 5 = 40\text{mm}
\]
GILLING (1/3 Pin projection)
GILLING (1/1 Pin projection)

1 (25.4)  
17.5  
12  
14
# EFFECT of MULTIPLE GILLINGS

<table>
<thead>
<tr>
<th>No. of Gillings</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combing Noil, (%)</td>
<td>14.6</td>
<td>12.1</td>
<td>10.8</td>
<td>10.1</td>
<td>9.6</td>
<td>9.3</td>
<td>9.0</td>
<td>8.8</td>
</tr>
<tr>
<td>Total Neps in top/100g</td>
<td>12</td>
<td>19</td>
<td>21</td>
<td>20</td>
<td>18</td>
<td>22</td>
<td>27</td>
<td>29</td>
</tr>
</tbody>
</table>
COMBING
COMBING

The functions of combing are to:

- Remove the short fibres
- Remove neps, slubs & remaining VM
- Arrange fibres into a parallel state & form a sliver
COMBING

Before combing it is important to understand.....

- The specifications of the input blend
- The condition of the wool as input material
- The top specifications required
- The settings required
- The operating conditions for the process
- The historical ability of the combs to produce to requirements
COMBING

All comb settings are CRITICAL.

Settings will affect.....

- Production rate
- QUALITY
- Romaine
- Machine wear
FEED to COMB

- Fine Wools (hi – crimp) → ball feed NOT can feed
- %Romaine savings of 0.5 to 1.0%
COMBING

The comb is very complex both in its settings and its operation

Settings should only be done by skilled technicians
COMBING (hauteur diagram)

豪特图
COMBING

There are two separate combing actions.....

- Combing of the “heads” (Circular comb) and
- Combing of the “tails” (Top comb)
COMBING (Combing the Heads)

- Fibres being combed by the CIRCULAR COMB
- Carriage in the OPEN POSITION
- Input Slivers
- Top Comb
- Shovel Plate (withdrawn)
- Upper Nipper Jaw (closed)
- Nip Brush
- Lower Nipper Jaw (closed)
- Drawing Off Rollers
- Circular Comb
- Pneumatic Tuft Beater
COMBING (Combing the Tails)

Carriage in the CLOSED POSITION

Fibres being combed by the TOP COMB

Nipper Jaws open

Fibre tails being pulled through Top Comb

Shovel Plate (forward)
FAULTS in COMBING

- **Web clarity**
  1. Dirty Circ. Comb.
  2. Nip setting too short
     - TC to DO cyl. Too great
  3. TC too coarse and/or dirty/damaged teeth
FAULTS in COMBINING

- Pin Life/Wear – Vario Combs
  - Normal life 6 months (24/7)
  - New tooth 8% R
  - Worn tooth 12% R
**FAULTS in COMBINING**

- **Top Comb – Pin Wear/Life**
  - Replace after five weeks (24/7) for fine wools and re-combing
  - Six weeks for > 21 micron
FAULTS in COMBING

- Circular Comb – turn brush every 48hrs
- Check TC brush setting every 48hrs
To IMPROVE SLIVER QUALITY at COMB

- Check Nep & VM levels on Apron
- Decrease input load
- Increase feed length
- Consider Finer TC
- Maintains production rate constant
TOP FINISHING

The objectives of finishing are to.....

- Ensures adequate blending of fibres
- Produce a sliver with an even & uniform weight / unit length
- Produces a top of uniform size, weight & density
- Final correction for moisture & oil content
- The final product for the customer
TOP FINISHING (1st Finisher)

The 1st finisher normally:

- Has a moisture application for final adjustments to "conditioning"
- Has a can delivery for economics & sliver reversal
TOP FINISHING

The 2nd finisher normally.....

- Has an autoleveler (mechanical or electronic)
- Can be bobbin or bump
- Has automatic delivery
It is vital that the Sampling & Testing Plan is reflective of the volume produced.
# Quality control table (sampling and testing)

## SAMPLING & TESTING PLAN

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>Test</th>
<th>Frequency</th>
<th>TOLERANCE</th>
</tr>
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<tbody>
<tr>
<td><strong>SCOUR</strong></td>
<td>Moisture Control</td>
<td>Every 4 hours</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>RG content</td>
<td>Every 4 hours</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>BLENDING</strong></td>
<td>Moisture content</td>
<td>Every 8 hours</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>TFM</td>
<td>Every 8 hours</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>CARDING</strong></td>
<td>Moisture content</td>
<td>Every 4 hours</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>VM content (vis)</td>
<td>Every 4 hours</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Nep content (vis)</td>
<td>Every 4 hours</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Silverweight</td>
<td>Every 4 hours</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>PREPARATION</strong></td>
<td>Silverweight</td>
<td>Every 4 hours</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>moisture control</td>
<td>Every 4 hours</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>COMBING</strong></td>
<td>Production/romaine control</td>
<td>xx combs / shift</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>VM content (vis)</td>
<td>xx combs / shift</td>
<td>+/-</td>
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<td>Nep content (vis)</td>
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<td><strong>FINISHING</strong></td>
<td>Micron</td>
<td>Every 2500 kg</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>hauteur</td>
<td>Every 2500 kg</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>VM content (vis)</td>
<td>Every 2500 kg</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Nep content (vis)</td>
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</tr>
<tr>
<td></td>
<td>Colour</td>
<td>Every 2500 kg</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Silverweight</td>
<td>Every 2500 kg</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Top weight</td>
<td>Every 2 hours</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Top size</td>
<td>Every 2 hours</td>
<td>+/-</td>
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**Note**
The above plan represents an example only of how such a system may be designed and operated. The tolerances have not been filled in as the client mill must decide on these.
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