Förbehandling av textil för en mer skonsam rivning

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Master thesis work

- Namuga, Catherine. (2017) Old To Become As Good As New

Hypotheses

- Friction between fibres and fibres & machine during shredding causes fibres to break and loose some of their original length.

- Lubrication of textile decrease friction during shredding, thereby decreasing fibre length loss.

- Prediction of friction during shredding with the use of a new method to measure inter fibre friction.
Fibre length

- Important factor in processability of fibres
  - Carding
  - Too short not possible to spin alone
  - Longer fibres results in wider usage; stronger yarn

- Shredding process shortens the fibres
  - Mix with new fibres
  - Low value products

- How to increase the value of shredded fibres?
  - Maximize fibre length
Fibre friction

- Friction
  - irregularities & adhesion
  - static & kinetic
  - cause deformation and heat

- Inter fibre friction test
Fibre friction

- Necessary in yarns and fabrics

- Managed parameter during fibre and yarn manufacturing
  - low fibre-to-fibre friction facilitate fibre separation during carding
  - too low friction during carding cause fibre slippage and uncontrolled process

- High fibre friction during textile shredding cause
  - fibre length loss
  - melting of polymeric fibres

Fibre friction: Lubricant treatment

- Decrease fibre friction

- Polyethylene glycole (PEG)
  - Lubrication, decreases friction
  - Water soluble
  - Non-toxic, eco-friendly
Research Questions

- Does treatment with polyethylene glycol (PEG) 4000 of fabric improve the shredding process?
- Decreased fibre length loss?
- Is it possible to spin yarn from 100% recycled fibres?
Friction test

- Carded web of fibres
- Pulled apart in tensile test
- Result shows static and kinetic friction
- PEG 4000
  - 0.1-1.0 %wof

Namuga (2017)
Result: Friction test

Namuga (2017)

Sjöblom (2018)
Shredded textiles

- **Cotton**
  - Untreated
  - Conditioned with PEG 4000
    - 0.1 %wof
    - 0.29 %wof

- **Polyester**
  - Untreated
  - Conditioned with PEG 4000
    - 0.2 %wof
    - 0.79 %wof
Cotton: shredded fibres

Untreated  PEG 4000 0.1 %wof  PEG 4000 0.29 %wof
Result: Neps & threads in shredded material

<table>
<thead>
<tr>
<th>Material</th>
<th>Pre-treatment</th>
<th>Neps and threads weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>Untreated</td>
<td>23.2 %</td>
</tr>
<tr>
<td></td>
<td>0.1 %wof PEG 4000</td>
<td>21.2 %, -9%</td>
</tr>
<tr>
<td></td>
<td>0.29 %wof PEG 4000</td>
<td>18.4 %, -21%</td>
</tr>
<tr>
<td>Polyester</td>
<td>Untreated</td>
<td>44.4 %</td>
</tr>
<tr>
<td></td>
<td>0.2 %wof PEG 4000</td>
<td>41.2 %, -7%</td>
</tr>
<tr>
<td></td>
<td>0.71 %wof PEG 4000</td>
<td>22 %, -50%</td>
</tr>
</tbody>
</table>

multifilament
Cotton: shredded fibres

- Untreated
- PEG 4000 0.1 %wof
- PEG 4000 0.29 %wof
Result:
Fibre length after shredding

<table>
<thead>
<tr>
<th>Material</th>
<th>Pre-treatment</th>
<th>Fibre length (mm)</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>Untreated</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1 %wof PEG 4000</td>
<td>11.9</td>
<td>+31%</td>
</tr>
<tr>
<td></td>
<td>0.29 %wof PEG 4000</td>
<td>13.4</td>
<td>+47%</td>
</tr>
<tr>
<td>Polyester</td>
<td>Untreated</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.2 %wof PEG 4000</td>
<td>15.1</td>
<td>+94%</td>
</tr>
<tr>
<td></td>
<td>0.71 %wof PEG 4000</td>
<td>17.2</td>
<td>+121%</td>
</tr>
</tbody>
</table>
Polyester: shredded fibres

- Untreated
- PEG 4000 0.2 %wof
- PEG 4000 0.79 %wof
Result:
Rotor spun yarn

- **Cotton**
  - Stronger with higher percentage treatment (when washed off)

- **Polyester**
  - Treatment needed for spinnability
  - Stronger yarn with higher percentage treatment

- Remove treatment after spinning for increased yarn strength
Result: Rotor spun yarn

- **Cotton**
  - Stronger with higher percentage treatment (when washed off)

- **Polyester**
  - Treatment needed for spinnability
  - Stronger yarn with higher percentage treatment

- Remove treatment after spinning for increased yarn strength
Conclusions

- PEG 4000 treatment made the shredding more efficient
  - Higher degree of shredded fibres
  - Increased fibre length, especially for polyester
  - Lower friction during shredding

- Multifilament yarn are more difficult to shred than staple fibre yarn

- It is possible to predict the fibre length reduction in shredding process by measuring friction between fibres
Future continuation

- Find lubricant for every textile material
  - Lubricant
  - Percentage

- Develop fibre friction measurement method

- Find value added applications
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