A new method to test the resilience of a yarn for application in artificial turf

S. Rambour, S. Janssens, G. Schoukens, P. Kiekens, R. Verhelst, P. Verleysen, J. Degrieck
Overview

- introduction
- goal
- experimental setup
- results & discussion
- conclusion
Introduction

• artificial turf: widely used in tennis, hockey, rugby, …
• 3rd generation artificial turf:
  › increased use in football
  › full support by FIFA

• players & clubs still have prejudices because of the low quality turf in the past
• shortcomings of state-of-the-art turf:
  – sliding -> see presentation Rudy Verhelst
  – Ball roll/ resilience of fibres: this presentation
Introduction

- Joosten (2003): 77% players find ball speed and **ball roll** capacity high
- ball roll distance test (FIFA, UEFA):
  - good on newly installed pitches
  - too long (>10m) already after short time: degradation in quality
- problem with measurement: sensitive to wind, slope, brushing, wet/dry conditions
Introduction

• FIFA/UEFA test for degradation of quality of a field: Lisport apparatus
  ‣ measures wear & tear
    durability
    fibrillation
    amount of detached fibres
  ‣ drawbacks for fibre analysis
    qualitative for aspect of carpet
    cause of degradation (fibre, infill)?
    turf sample of 0.8m by 0.4m needs to be produced
    impossible to quantify the effect of the (visually observed) degradation on ball roll (10m needed)
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Goal

• **a quick method** to give the yarn producers feedback on the resilience of their yarn

• **quantify** the degradation of quality of the artificial turf fibre over time
  ‣ one very fast method on one filament
  ‣ one method to measure directly the degradation in ball roll.
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Experimental setup 1 – Cantilever resilience test

- cyclic flexing test on a single filament
- filament is flexed 300 times (100mm/min)
- 1 repetition = 40min; 1 test = min 4 repetitions

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Experimental setup 1 – Cantilever resilience test
Experimental setup 1 – Cantilever resilience test

- force measurement: hysteresis force-displacement loops

- resilience = max force of the 300th flexing/max force of the first flexing
Experimental setup 2 – 12m-Lisport

• evaluate degradation of ball roll behaviour after use on large scale
• samples: 12m by 1m
• 2 studded rolls
  ‣ 100kg
  ‣ 1m wide
• speed: 0.25m/s
• 40% slip between rolls
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Results: Cantilever resilience test

- max force measured for each cycle
Results: Cantilever resilience test

• relative $F_{\text{max}}$ measured for each cycle

<table>
<thead>
<tr>
<th>Number of flex cycles</th>
<th>Filament L</th>
<th>Filament X</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 cycles</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>100 cycles</td>
<td>48%</td>
<td>61%</td>
</tr>
<tr>
<td>300 cycles</td>
<td>46%</td>
<td>&lt;57%</td>
</tr>
</tbody>
</table>

Filament X is more resilient
Results: 12m-Lisport test

- ball roll behaviour
- samples of 12m by 1m
  - yarn L: tufted and woven
  - yarn X: woven
  - sand and SBR rubber infill
  - 15mm free pile length
Results: 12m-Lisport test

- ball roll distance

![Graph showing ball roll distance over number of cycles for X (woven) and L (tufted) resilience tests.]

resilience: $X$ (57%) > $L$ (46%)

Difference tufted-woven
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Conclusion: Cantilever resilience test

- cyclic bending test
- measures resilience of 1 filament
- can discriminate between different types of yarn
- test resilience at very early stage
- no threshold pass/fail value yet
Conclusion: 12m-Lisport test

- measures degradation in ball roll behaviour
- can discriminate between different turf samples
- confirm resilience test
- further tests needed
- very time consuming test method
Acknowledgements

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Vandewiele NV
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