Pressure allocation under forest tires - static and dynamic examination and rutting process in field tests
Structure

1. Overview of the overall project
2. Pressure allocation under forest tires – static and dynamic
3. Rutting process in field tests
4. Conclusion/outlook
5. Discussion/time for questions
1. Overview of the overall project

Main points

• Joint research project consisting of 3 participants from science and economy with support of government funding

• Four subprojects dealing with different methods and research interests
  1. contact pressure of tires and different kind of tracks
  2. rutting process
  3. soil physics
  4. development engineering
2. Pressure allocation - static measurement

Materials & methods: Tire test stand

Figure 1: Tire test stand - static measurement

Figure 2: Schematic drawing (front view)
2. Pressure allocation - static measurement

Materials & methods: Measurement system

- 2,288 measuring cells per sensor

\[ 435.9 \text{ mm} \times 368.8 \text{ mm} > 2,288 \text{ measuring cells per sensor} \]

\[ > 13,728 \text{ measuring cells on the whole area (0.96 m}^2) \]

Figure 3: Foil sensor Teckscan Map 3150 (Ebel 2006)

Figure 4: Measuring surface (schematic drawing)
2. Pressure allocation - static measurement

Materials & methods: Test series

Figure 5: Configurations of testing

Test series
- 600 mm Nokian Forest King F
- 600 mm Olofsfors Magnum
- 600 mm Felasto Pur
- 710 mm Nokian Forest King F
- 710 mm Olofsfors Magnum
- 710 mm Felasto Pur

1. rep
- 30 kN
- 2.5 bar

2. rep
- 45 kN
- 3.5 bar

3. rep
- 60 kN
- 4.5 bar
2. Pressure allocation - static measurement

Results: Factors that influence the mean contact pressure

<table>
<thead>
<tr>
<th>Step</th>
<th>Regressor</th>
<th>R²</th>
<th>ΔR²</th>
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<tbody>
<tr>
<td>1</td>
<td>Wheel load</td>
<td>58.5 %</td>
<td>58.5 %</td>
</tr>
<tr>
<td>2</td>
<td>Felasto Pur</td>
<td>79.3 %</td>
<td>20.9 %</td>
</tr>
<tr>
<td>3</td>
<td>Olofsfors Magnum</td>
<td>92.5 %</td>
<td>13.1 %</td>
</tr>
<tr>
<td>4</td>
<td>Tire width</td>
<td>97.9 %</td>
<td>5.4 %</td>
</tr>
<tr>
<td>5</td>
<td>Tire pressure</td>
<td>98.2 %</td>
<td>0.3 %</td>
</tr>
</tbody>
</table>

Table 1: Influencing factors (mean contact pressure)
### 2. Pressure allocation - static measurement

Results: Influence of tracks

#### Table 2: 710 mm tire width 2,5 bar tire pressure

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>30</td>
<td>1.31</td>
<td>0.98</td>
<td>25.19</td>
<td>0.91</td>
<td>30.53</td>
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<tr>
<td>45</td>
<td>1.72</td>
<td>1.40</td>
<td>18.60</td>
<td>1.23</td>
<td>28.49</td>
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<td>60</td>
<td>2.04</td>
<td>1.75</td>
<td>14.22</td>
<td>1.50</td>
<td>26.47</td>
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</table>

#### Table 3: 710 mm tire width 4,5 bar tire pressure

<table>
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<tbody>
<tr>
<td>30</td>
<td>1.38</td>
<td>1.01</td>
<td>26.81</td>
<td>0.92</td>
<td>33.33</td>
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<tr>
<td>45</td>
<td>1.83</td>
<td>1.41</td>
<td>22.95</td>
<td>1.25</td>
<td>31.69</td>
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<tr>
<td>60</td>
<td>2.18</td>
<td>1.78</td>
<td>18.35</td>
<td>1.55</td>
<td>28.90</td>
</tr>
</tbody>
</table>
2. Pressure allocation - static measurement

Discussion - What’s the point?

• The tested bogie tracks led to a reduction of the contact area pressure and increased the total contact area (regardless of the material).

• There was a higher reduction using FELASTEC® bogie tracks compared to the tested steel tracks.

• The positive effect of the FELASTEC® bogie tracks can also be achieved by reducing the tire pressure down to 2.0 bar.

• All these datasets are based on static measurements. Therefore dynamic influences can not be completely deduced.
2. Pressure allocation - dynamic measurement

Outlook - What’s new?

Figure 6:
New test stand - dynamic forces
3. Rutting process in field tests

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Figure 7: Test stand - rutting process
3. Rutting process in field tests

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Figure 8: Rottne F14 Solid with tires and different track configurations
3. Rutting process in field tests

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Figure 9: Breaking winch and scanning unit
3. Rutting process in field tests

First results

Figure 10: First scans, illustrated with CloudCompare
3. Rutting process in field tests

First results

Figure 11: Top view of 2 scans (before 1st and after 8th crossing)
4. Conclusion and outlook

Further steps need to be done

- Sample size - do more replications to assure the results
- Further tests under different soil conditions (types)
- Examination and evaluation of the different configurations
- Model development → Prediction of expectable rut depth and contact pressure under given circumstances (humidity, soil type, machine type)