Lab testing results of various cladding materials

Ine De Vilder

Cladding and Fixing conference
September 3-4, 2014
Outline

Centexbel

S(P)EEDKITS

Tent materials

Shade nets

Conclusion
Centexbel

Collective research and technical centre

Membership organisation

Belgian textile producing companies
Associated member companies and organisations

Staff

150 skilled and highly educated men and women
Centexbel

Recently acquired:

Research/testing department dealing with plastics
Centexbel

ISO 17025

Microbiological tests

Chemical analyses

Physical analyses

Burning behaviour

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Centexbel

- Certification
- Training
- Standardisation
- Consultancy
Testing of emergency relief items

- Wide range of emergency relief items is textile-based:
  - Sleeping mats
  - Insecticide nets
  - Family tents
  - Thermal fleece blankets
  - Sanitary cloths
  - Tarpaulins in sheets/rolls
  - Semi-collapsible jerry cans
Outline

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S(P)EEDKITS is ...

- ... a 4 year European FP7 project

- ... a consortium of research, industry and humanitarian partners

- ... dealing with emergency kits:
  - For shelter, watsan and infrastructure
  - Considering their packaging & deployment

- ... combining SPEED and SEED:
  - SPEED for rapid deployment
  - SEED for sustainable development
Concept and objectives

• Development of speedkits...
  – Transportability maximised: easy to handle, light weight, adaptable...
  – Tools/Software for deployment/tracking
  – Various time crucial domains: medical infrastructure, water & sanitation kits, shelters,...

• ... and seedkits... (figurative meaning!)
  – Useful for long term sustained self recovery of local people
  – E.g. shelters, energy generation, debris recuperation...
Shelter

- Type 1: Clever roof
- Type 2: Multipurpose unit
- Type 3: Progressive house unit
- Type 4: Mobile Modular 120 m² Unit

Material development

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Outline

Centexbel
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Some basic textile comprehensions

Woven fabric

Coated fabric

Finished fabric
Comparison tent fabrics

<table>
<thead>
<tr>
<th>PES/CO 50/50 'polycotton'</th>
<th>PVC coated PES</th>
<th>Tarpaulin 'PE-sheet'</th>
<th>Camping materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 200 g/m²</td>
<td>• 240 g/m²</td>
<td>• LDPE/HDPE 160 g/m²</td>
<td>• PU coated PES 56 g/m²</td>
</tr>
<tr>
<td>• 350 g/m²</td>
<td>• 340 g/m²</td>
<td></td>
<td>• Siliconized PA 53 g/m²</td>
</tr>
<tr>
<td>• 440 g/m²</td>
<td>• 450 g/m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 650 g/m²</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Comparison tent fabrics

Breathability
- Air permeability
- Water vapour permeability

Strength
- Tensile
- Tear

Waterproofness

Ageing
- UV
- Micro-organisms/soil
Breathability

Air permeability

ISO 9237 (1995)
Breathability

Water vapour permeability

\[ g/(24\text{h.m}^2) \]

\begin{itemize}
  \item Polycotton 200
  \item Polycotton 350
  \item Polycotton 440
  \item PVC/PES 240
  \item PVC/PES 340
  \item PVC/PES 450
  \item PVC/PES 650
  \item PE-sheet
  \item PU/PES
  \item Sil/PA
\end{itemize}

\[ \rightarrow \text{Below IFRC requirement of 2000 g/(24h.m}^2\text{)!} \]

ASTM E96 (1995)
ISO 13934-1 (1999)
Tear

ISO 9073-4 (1997)

Strength

Weft direction
Warp direction
**Waterproofness**

EN 20811 (1992)

- Waterproofness

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**Graph:**
- **Pa**
- **100,000**
- **50,000**
- **0**

- Polycotton 200
- Polycotton 350
- PVC/PES 240
- PVC/PES 340
- PVC/PES 450
- PE-sheet
- PU/PES
- Sil/PA

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2014 / 09 / 03
→ Ageing by means of heat, light and condens
  – 1500 hours ~ 6 months exposure in the field
  – Alternating light and condens
  – UVB (313 nm)
  – Temperature 60°C

ISO 4892-3 (2006)
UV-resistance

→ Same observations for weft direction!

ISO 9237 (1995)
Ageing by means of micro-organisms
- 56 days
- Soil temperature of 28°C
- Humidity >95%

BS 6085-2 (1992)
Soil burial

→ Same observations for warp direction!
→ Only staining on PES/CO
Summary

Polycotttons:

• large difference in strength in warp & weft direction

• After ageing: polycotttons do not comply with specifications of IFRC → strength loss >50%

• Only material affected by micro-organisms
Summary

• Waterproof → fully coated fabric like **PVC coated PES** but not breathable → tent design: ventilation!

• Lightweight **camping materials** not suitable → not resistant against UV and poor strength

• **PE-sheet**
  → great differences in quality!
  → needs stabilisers to protect against ageing
  → also not breathable
Field case: Philippines

Roof sample family tent
PES/CO 50/50
350 g/m²

6 months use

Hot & humid climate

Influence on tent properties?
Field case: Philippines
Field case: Philippines
# Field case: Philippines

<table>
<thead>
<tr>
<th>Polycotton 350 g/m²</th>
<th>Warp direction</th>
<th>Weft direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Philippines / unused fabric</td>
<td>Philippines / unused fabric</td>
</tr>
<tr>
<td><strong>Tensile strength</strong></td>
<td>720 N</td>
<td>720 N</td>
</tr>
<tr>
<td></td>
<td>New: 2300 N Aged: 840 N</td>
<td>New: 1500 N Aged: 600 N</td>
</tr>
<tr>
<td><strong>Elongation</strong></td>
<td>16%</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td>31%</td>
<td>16.5%</td>
</tr>
<tr>
<td><strong>Tear strength</strong></td>
<td>19 N</td>
<td>26 N</td>
</tr>
<tr>
<td></td>
<td>163 N</td>
<td>67.4 N</td>
</tr>
<tr>
<td><strong>Water vapour permeability</strong></td>
<td>Philippines: 1250 g/m².day / unused: 1410 g/m².day</td>
<td></td>
</tr>
</tbody>
</table>
Field case: Philippines

Effects of use in the field:

- Water vapour permeability not much affected
- Loss of tensile strength
- Fabric tears easily

• Anti-fungi treatment on cotton
• Use another fabric
Field case: Philippines

Good correlation

artificial ageing  field situation

Estimation of long term behaviour possible!
Outline

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Shade nets

Results of comparison of 28 shade nets:

• Lots of differences in weight (43 up to 275 g/m²) and shade factor (30% - 75%)

• Big variations in tensile strength (33N - 1905N), even between length and width direction of the net!

• Resistance to UV-ageing dependant on shade net!

→ Beware of the quality you purchase!
Tensile strength shade nets

![Bar chart showing tensile strength of different shade nets.](image)
Influence on tent temperature?
Some physics

- Incident radiation
- Heat reflection
- Shade net
- Absorption
- Heat transmission
- $\Delta T$ in volume
Measurements

Optical

Transmission

Reflection

Heat

Transmission

Reflection

$R^2 = 0$: no correlation; $R^2 = 1$: perfect correlation

$R^2 = 0.97$

$R^2 = 0.95$

EN 410 (1998)
Measurement of temperature rise
Measurement of temperature rise

\[ \Delta T \ (^\circ C) \]

Time (minutes)

- Mesh 6514007 - black
- Mesh 6514004 - green
- Mesh 6514001 - white
- no shade net
Correlation heat phenomena with temperature rise?

Measured on each shade net:

- Temperature rise in volume
- Reflection of heat
- Transmission of heat and light
No correlation between heat reflection and temperature rise!

\[
R^2 = 0.05
\]

Heat reflection (%) vs. \(\Delta T\) in volume (°C) for white and aluminium surfaces.
Correlation between heat transmission and temperature rise

\[ R^2 = 0.79 \]
No perfect correlation between light transmission and temperature rise

\[ R^2 = 0.66 \]

Shade factor = 1/light transmittance
Good correlation between light transmission and temperature rise for a series of shade nets

Shade nets need to consist out of identical material!

\[ R^2 = 0.91 \]
Summary

- The performance of the shade net is dependant on the heat transmission, not the reflection!

- A black shade net performs very well, but need for a ventilation gap since it absorbs a lot of heat!

- The lower the weight of the net, the lower the tear strength
Vegetal mats

Woven reed mat

Palm leave

Reed mat

Catral Heather screen
## Performance

<table>
<thead>
<tr>
<th>Material</th>
<th>Shade factor (%)</th>
<th>ΔT in box (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No shade net</td>
<td>0</td>
<td>6.5</td>
</tr>
<tr>
<td>Catral Heather screen</td>
<td>32</td>
<td>2.8</td>
</tr>
<tr>
<td>Palm leave</td>
<td>17</td>
<td>2.7</td>
</tr>
<tr>
<td>Reed mat</td>
<td>6</td>
<td>1.5</td>
</tr>
<tr>
<td>Woven reed mat</td>
<td>100</td>
<td>1.3</td>
</tr>
</tbody>
</table>
Vegetal mats

- Multiple palm leave on top of each $\rightarrow$ higher light blockage $\rightarrow$ better thermal performance

- Reed mat same efficiency as black shade nets (SF~70%) but total light blockage

- Can be used to keep the temperature under control
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Conclusion

Pay attention when you buy materials, it may look the same but the quality differences can be enormous!
“There are two big forces at work: internal and external. We have very little control over external forces, such as tornadoes, earthquakes, floods, disasters, illness and pain. What really matters is the internal force. How do I respond to those disasters?”

- Leo Buscaglia -