Market drivers for the development and use of new building airtightness products

Tightvent

Filip Van Mieghem
Senior Product Manager

12th of January, 2016
General: (product) standards, test methods
Sealants
PU-foams
Combination of products
Innovation
Soudal in numbers

- Founded in 1966 by current owner
- HQ in Belgium
- 100% privately owned
- 2,200 people – €565 million in 2014
- 44 affiliates – export to 130 countries
- Annual R&D budget > EUR 5 mio
R&D is part of Soudal’s DNA

- R&D is our core business
  - > 250 R&D projects p.a.
  - 50% product modifications
  - 50% new products
    - Patents
    - Vertical upstream integration
- Products meet many internat. standards
Typical jointing products: Sealing and bonding

Outside

Middle

Inside
Construction joints & jointing products

- Function/issues:
  - Weather sealing / water tightness
  - Cosmetical
  - Thermal insulation (thermal bridges)
  - Fire proofing
  - Acoustics
  - Burglar resistance
  - Airtightness
  - Vapourtightness
- And mostly a combination thereof…
- Important unimportance!
Construction joints and airtightness

- Care for detail and awareness are needed to improve airtightness – quality of the works.
Airtightness of constr. materials: standards?

- **Foams, sealants, adhesives:**
  - Airtightness not covered in (inter)national product standards (if any)

- **Precompressed (expanding) tapes:**
  - DIN18542: airtight = BG-R (↔ BG1 = water tight icw 600 Pa windpressure)
  - NF 85-570 and NF 85-571 (Classe 1)

- **Membranes, tapes, vapour barriers, ...**
  - Membranes and flashing tapes: wide variety: laminated PE, butyl, etc
  - Vapour control barrier: flexible sheets, EPDM cladding (EN 13984)
  - Selfadhesive tapes: wide variety (carrier, adhesive)

  $\Rightarrow$ Vapour tight = airtight (the opposite is not necessarily true)

- $S_d = \mu \times m$
- Estimate: $S_d > 1m$ is sufficient
Airtightness of constr. materials: test methods

- EN 12114: Air permeability of building components and building elements (laboratory test method)
  - a-value: $\leq 0.1 \text{ m}^3/\text{h.m at 1 daPa}^{2/3}$
- EN 1026: Windows and doors - Air permeability – Lab test method
  - Classification: EN 12207 (4 classes)
- MO-01: ift directive (Institut für Fenstertechnik)
  - Test on construction element: window-wall – combination of products
  - Airtightness (EN 12114) + watertightness (EN 1027)
  - Before and after ageing
- Sd-value: determination of water vapour transmission properties
  - EN ISO 12572: Hygrothermal performance of building materials and products
  - EN 1931: Flexible sheets for waterproofing (membranes)
EN 12114

- Air permeability of building components/elements
- Laboratory test method
- Procedure:
  - 3 pulsations and then gradual steps; both positive and negative pressure
  - 50 Pa to 500 Pa (or even 1000 Pa) in logarithmic steps
Test method for air permeability of windows and doors

- Up to 600 Pa in steps of 50 Pa
- Sometimes referred to for sealing products from m² to m: divided by 4

Classification (EN12207)

- **Class 4**: 0.6 m³/hm² at 10 Pa
  - = 1.89 m³/hm² at 50 Pa
  - = 0.47 m³/hm at 50 Pa
- **Class 5**: 0.18 m³/hm² at 10 Pa
  - = 0.76 m³/hm² at 50 Pa
- **Class 6**: 0.05 m³/hm² at 10 Pa
  - = ± 0.38 m³/hm² at 50 Pa
Combination of products
Ift directive MO-01/1

- Window to wall connection
- Voluntary
- Airtightness (EN 12114) + water tightness (EN 1027) before and after ageing
- Ageing
  - Temperature (+60°C / -15 °C, 10 cycles)
  - Functionnality of window (open / tilt, 10,000 cycles) (EN 1191)
  - 3 pulsations both positive and negative pressure (1,000 Pa, 200 cycles) (EN 12211)
Measuring equipment

Typical window test rig
Lindab LT600 in lab mode
Emission: VOC

- Indoor air quality is getting more of a concern with growing airtightness levels
- Sustainability: Leed, Breeam, ...(VOC content)
- France: mandatory emissions class labelling
  - All construction products used indoors
  - Highest class is A+
  - Measured after 28 days
- Germany: Emicode - voluntary
  - GEV: origin: adhesives for floor coverings
  - EC1(R), EC1 Plus are the highest classes
    - Measured after 10 or 3 /28 days
    - Harder to achieve
Sealants

- Silicone: AC / Alcoxy / Oxime
- Acrylics
- Polyurethane
- Polyisobutylene
- Bitumen
- Fire rated sealants
- Fast curing
- Primers & tools
Sealants and airtightness

- Can generally contribute a lot to airtightness on 2 conditions:
  - **Cohesion**: no shear within the cured product
  - **Adhesion**: you also need an adhesion to the substrate(s)/supports
- **Movement capacity**: max % of total joint movement a sealant can permanently take without shearing (stretched)
- Some products are part of combined system test (MO-01/1)
- **Sd values**
  - Eg Acrylics: $\mu 10186$, Sd $31m$ (2,5 to 3mm)
- Some sealants meet EC1 or EC1 Plus

![Diagram of substrates and sealant](image)
New harmonised norm EN 15651 (CE marking)
- Mandatory since 1/7/2014
- EN15651-1: façade (interior and/or exterior): F
- EN15651-2: glazing: G

F-INT
- Min. requirements, elongation at break (CE system 4)

F-EXT-INT: 2 possibilities:
- Min requirements: no class (CE, system 4)
General rules of thumb

- Make sure supports are clean, free of dust and grease
- Which substrates?
  - Most sealants work better on specific substrates (adhesion spectrum)
  - Hybrid sealants work on a lot of surfaces, even wet
  - Typically problematic for all sealants: PE, PP, PTFE
- Prepare substrates if recommended (primer)
- Preferably use backing rod
- Check joint dimension and movement
- Watch application temperature and RH
- Respect curing time of product
Sealants: types

- **Hybrid sealants: permanently elastic**
  - Excellent adhesion on almost any substrate
  - Diverse, low modulus and high modulus
  - High movement capacity (20-25LM or HM – EN-ISO 11600)
  - No cracks under UV-radiation
  - Paintable
  - Adhesion on damp surfaces

- **Silicone sealants: permanently elastic**
  - Excellent adhesion on glass, metals.
  - Ideal for airtight glass sealing
  - High movement capacity (20LM – 25LM)
  - Very resistant to UV, excellent weatherability
  - Usually not paintable
Sealants: types

- PU
  - Excellent adhesion on mineral substrates (stone, cement)
  - High movement capacity (20-25%)
  - Mostly LM
  - Might crack under UV

- Acrylics
  - Mainly interior use/finishing
  - Paintable, "elastic and airtight extension of plaster"
  - Prevents cracks between window frame and plaster
  - New development: meets with ISO 11600 12,5E
  - Physical drying: shrinkage
Sealant profiles

PVC

GLASS

CONCRETE

ALUMINUM

low odor

environmental friendliness

gunnability

slump resistance

UV stability

Paintability

Staining

MS

PUR

SILICONE AC

BUILD THE FUTURE
Outside sealing
Inside sealing

- Airtightness in the proper sense
- Acrylic sealants
  - Mostly used (interior façade sealing) (F-INT)
  - Paintable
  - Limited movement capacity (mostly plastic, max 12.5%)
- Hybrid sealants
  - Inside and outside use (F-INT-EXT)
  - Large movement capacity (up to 25%)
  - Paintable (waterbased paints)
- Remark: paint is not flexible!!!
PU Foams

- Handheld / Gun / Click & Fix / Genius Gun
- Construction foam
- Insulation foam
- Sound proofing foam
- All season foam
- 2K-foam
- Zero % Isocyanate foam (SMX)
- Low monomeric
- PU mining foam
- Multi position foam
- Fire rated foam
- Arctic foam -25°C
- Sahara foam +40°C
Flexifoam = elastic foam
Flexifoam : airtight

- No product norm – but test methods issued by Feica
- Voluntary testing on airtightness at ift Rosenheim (EN 12114)
  - $A\text{ - value} \leq 0.1 \text{ m}^3/\text{hm} (\text{daPa}^{2/3})$ – joint 2 (width) x 6 cm (depth)

---

**Prüfung nach DIN EN 12114**

<table>
<thead>
<tr>
<th>Probekörpermaße</th>
<th>Breite</th>
<th>x</th>
<th>Höhe</th>
<th>Anzahl</th>
<th>x</th>
<th>Länge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fugen längs</td>
<td>1000</td>
<td></td>
<td>1000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fugenlänge</td>
<td>6</td>
<td>x</td>
<td>990</td>
<td>in mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fugenlänge</td>
<td>5.94 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DRUCK**

<table>
<thead>
<tr>
<th>Volumenstrom 1</th>
<th>Nullmessung (Fugen abgeklebt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pa</td>
<td>50</td>
</tr>
<tr>
<td>l/h</td>
<td>13,24</td>
</tr>
<tr>
<td>V in m³/h</td>
<td>0,0132</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volumenstrom 2</th>
<th>Fugen nicht abgeklebt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pa</td>
<td>50</td>
</tr>
<tr>
<td>l/h</td>
<td>14,76</td>
</tr>
<tr>
<td>V in m³/h</td>
<td>0,0148</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volumenstrom 2 - 1</th>
<th>Luftdurchlässigkeit Fuge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pa</td>
<td>50</td>
</tr>
<tr>
<td>$V_{\text{m}}$ in m³/h</td>
<td>0,0015</td>
</tr>
<tr>
<td>$V_{\text{o}}$ in m³/h</td>
<td>0,0015</td>
</tr>
<tr>
<td>längenbezogen in m³/hm</td>
<td>0,0002</td>
</tr>
</tbody>
</table>

$V_{\text{o}}$: korrigierter Luftvolumenstrom unter Referenzbedingungen (20 °C / 50 % rel. LF / 101325 Pa Luftdruck)
# Airtightness testing at Ghent university

## Façade element

<table>
<thead>
<tr>
<th>Beschrijving opstelling</th>
<th>Flow at 50 Pa [m³/h/m]</th>
<th>underpressure</th>
<th>abs. dev.</th>
<th>overpressure</th>
<th>abs. dev.</th>
<th>average</th>
<th>Class</th>
<th>abs. dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>casing, empty</td>
<td></td>
<td>30,90</td>
<td>0,97</td>
<td>35,23</td>
<td>1,11</td>
<td>33,07</td>
<td>C</td>
<td>1,04</td>
</tr>
<tr>
<td>casing, mineral whool</td>
<td></td>
<td>2,61</td>
<td>0,13</td>
<td>3,31</td>
<td>0,15</td>
<td>2,96</td>
<td>C</td>
<td>0,14</td>
</tr>
<tr>
<td>casing, Flexifoam</td>
<td></td>
<td>0,95</td>
<td>0,09</td>
<td>1,59</td>
<td>0,12</td>
<td>1,27</td>
<td>B</td>
<td>0,10</td>
</tr>
<tr>
<td>casing, Flexifoam, Acryrub</td>
<td></td>
<td>0,01</td>
<td>0,06</td>
<td>0,00</td>
<td>0,08</td>
<td>0,00</td>
<td>A</td>
<td>0,07</td>
</tr>
<tr>
<td>plaster, profile, Acryrub</td>
<td></td>
<td>0,08</td>
<td>0,03</td>
<td>0,06</td>
<td>0,03</td>
<td>0,07</td>
<td>A</td>
<td>0,03</td>
</tr>
<tr>
<td>Plaster, SWS-foil, inside</td>
<td></td>
<td>0,08</td>
<td>0,03</td>
<td>0,27</td>
<td>0,03</td>
<td>0,18</td>
<td>A</td>
<td>0,03</td>
</tr>
<tr>
<td>Plaster, SWS-foil, side</td>
<td></td>
<td>0,08</td>
<td>0,03</td>
<td>0,24</td>
<td>0,03</td>
<td>0,16</td>
<td>A</td>
<td>0,03</td>
</tr>
<tr>
<td>Plaster, Flexifoam, dry</td>
<td></td>
<td>0,03</td>
<td>0,03</td>
<td>0,00</td>
<td>0,04</td>
<td>0,02</td>
<td>A</td>
<td>0,04</td>
</tr>
</tbody>
</table>

- <0,4 m³/hm (A)
- 0,4-2,5 m³/hm (B)
- >2,5 m³/hm (C)
PU-foams: airtight?

PU-foam can be/stay airtight!

- If used in the correct joint dimensions
- If used between 2 airtight building elements
- If correctly applied
- If flexible

... Thus combining insulation and airtightness

⇒ Thermal insulation: \( \lambda = 0,035 \, \text{W/m.K} \)
PU-foam : moisture curing!

Crucial for cell structure (insulation), adhesion and airtightness !!!

Without

With
Combination of products: SWS

Voluntary MO-01 test report for elastic foam and 2 sealants (hybrid and acrylic)
Innovation: liquid membrane

- Airtight “Liquid membrane”: application with brush
- Formula contains fibers to fill small cracks
- Window to wall: can replace membranes – ease of application
Liquid membrane

- Airtight liquid membrane applied with airless gun
- Floor to wall, wall to ceiling, etc
- Easy and fast!!
Soudatight LQ: test

- Test on construction site: 2 identical windows - façade not yet grouted - cavity wall - check reveal
  - Window with only foam filling (1);
  - Window with foam and Soudatight LQ (2)
Test according to EN 1026 and EN 12207
- Living room: underpressure of 50 Pa with Blower Door
- Result: 1,02 m³/hm: leaks at height of DPC foil
Soudatight LQ: test (part 2)

- Visual smoke test: Riosteam + DG700
Quality of the works?

- Manufacturer/supplier: ISO 9001 – ISO 14001
  - Support, service
- A-brands (cheaper seldom is better in the long run)
  - R&D
- Use the right product for your application
- Follow manufacturers instructions
  - Method, amount, temperature and humidity (during and after application), preparation,…
- CE marking
- Quality labels (voluntary)
- Technical approvals in case of more innovative products
- Easy of application and/or time saving:
  - Best market drivers, and better results
The sole responsibility for the content of this presentation lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EASME nor the European Commission are responsible for any use that may be made of the information contained therein.