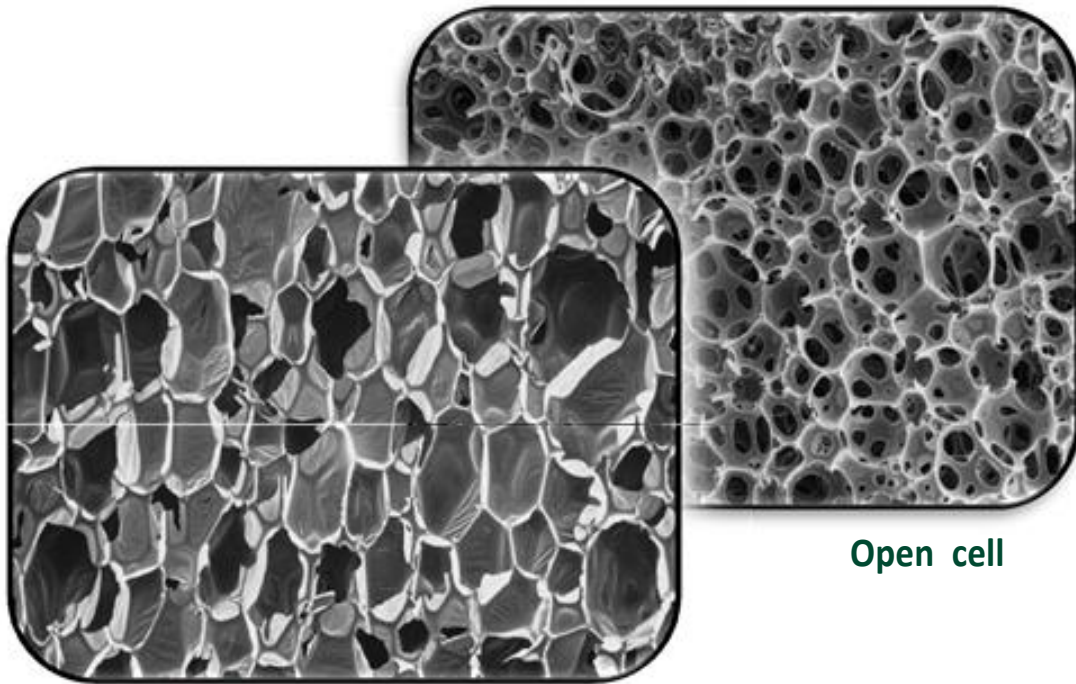


Spray Polyurethane Foam

Closed Cell vs. Open Cell systems

Similar appearance, different performance



Closed cell

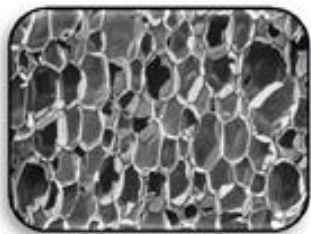
Open cell

Closed cell vs. Open cell systems

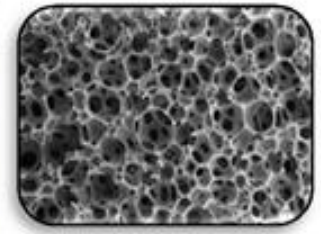
Similar appearance, different performance

Spray polyurethane foam as insulating material has traditionally been closed celled. However, in recent years open celled products are being placed on the market. Although both types of foams may look similar, they should be considered as two different products, since their properties and performance are completely different.

The distinguishing characteristic is **Closed Cells Content (CCC)** which directly affects relevant foam properties such as thermal conductivity, water absorption/tightness or water vapour permeability.



Closed cell.
Homogeneous structure



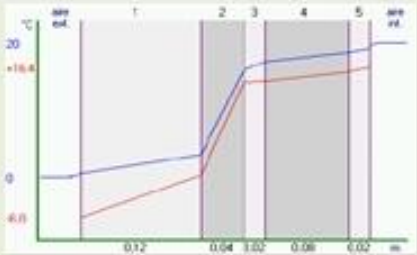
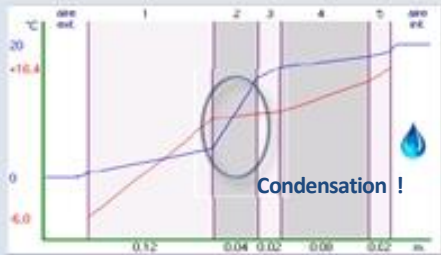








Open cell.
Irregular structure

<i>Characteristic</i>	<i>Closed cell</i>	<i>Open cell</i>
Closed cells content	≥ 90%	< 20%
Thermal conductivity (aged)		
declared value	≤ 0,028 W/mK	0,032 - 0,040 W/mK
value after water absorption test	≤ 0,028 W/mK	> 0,090 W/mK
Content inside the cells	Low thermal conductivity gases (HFC)	Air
Water vapour diffusion resistance factor (μ) (μ air = 1)	60 < μ < 150	μ < 20
Water tightness	watertight	Not watertight
Water absorption	< 2%	> 35%

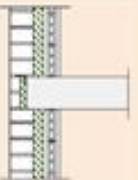


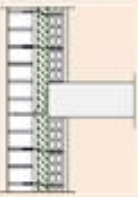


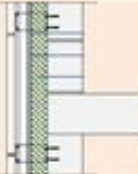








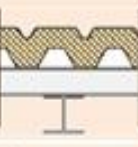


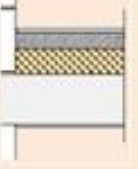


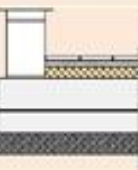


Closed cell vs. Open cell systems

Comparative analysis of performance

Characteristic	Closed cell	Open cell
Thermal conductivity - Equivalent thickness (EN ISO 6946)	 <p>Maximum thermal efficiency with the minimum thickness.</p>	 <p>For the same thermal resistance, between 15% and 40% more thickness is required.</p>
Water vapour resistance factor (EN 12086)	 <p>Minimum condensation risk in most construction methods and climate conditions.</p>	 <p>Water vapour barrier necessary due to higher risk of condensation.</p>
Water tightness (EN 1928)	 <p>Under 60 kPa pressure the dyed water does not pass through a 3 cm thick foam.</p>	 <p>Under 3 kPa pressure the dyed water can pass through a 4 cm thick foam and mark the indicator paper.</p>
Water absorption (EN 12087, with dyed water)	 <p>Low absorption (<2 %) and only on the surface.</p>	 <p>High absorption (>35 %) which penetrates the foam interior affecting the thermal properties.</p>
Compression strength (EN 826)	 <p>The closed cells rigid structure provides good mechanical resistance.</p>	 <p>The open celled foam has a lower mechanical resistance.</p>

Closed cell vs. Open cell systems

Feasibility of construction methods

Construction method	Closed cell	Open cell
 <p>Internal wall insulation</p>	 <p>Recommended in all cases</p>	 <p>Depending on the required level of water tightness, a water tight mortar layer, more insulation or a vapour barrier may be needed</p>
 <p>External insulation between masonry walls</p>	 <p>Recommended in all cases</p>	 <p>Depending on the required level of water tightness, a water tight mortar layer, more insulation or a vapour barrier may be needed</p>
 <p>Ventilated façade</p>	 <p>Recommended (taking into account additional requirements of protection against fire)</p>	 <p>Not recommended. The application is in direct contact with water</p>
 <p>Pitched roof - external insulation</p>	 <p>Recommended</p>	 <p>Not recommended. The application is in direct contact with water</p>
 <p>Pitched roof - internal insulation</p>	 <p>Recommended</p>	 <p>More insulation and in most cases a vapour barrier may be needed</p>
 <p>Lightweight industrial flat roof - ext. insulation</p>	 <p>Recommended with high compression strength foams</p>	 <p>Not recommended. The application is in direct contact with water</p>
 <p>Terrace / Walkable roof</p>	 <p>Recommended with high compression strength and high dimensional stability foams</p>	 <p>Not recommended. The application is in direct contact with water and poses settlement risk</p>
 <p>Floor</p>	 <p>Recommended with high compression strength and high dimensional stability foams</p>	 <p>Not recommended. Settlement risk</p>

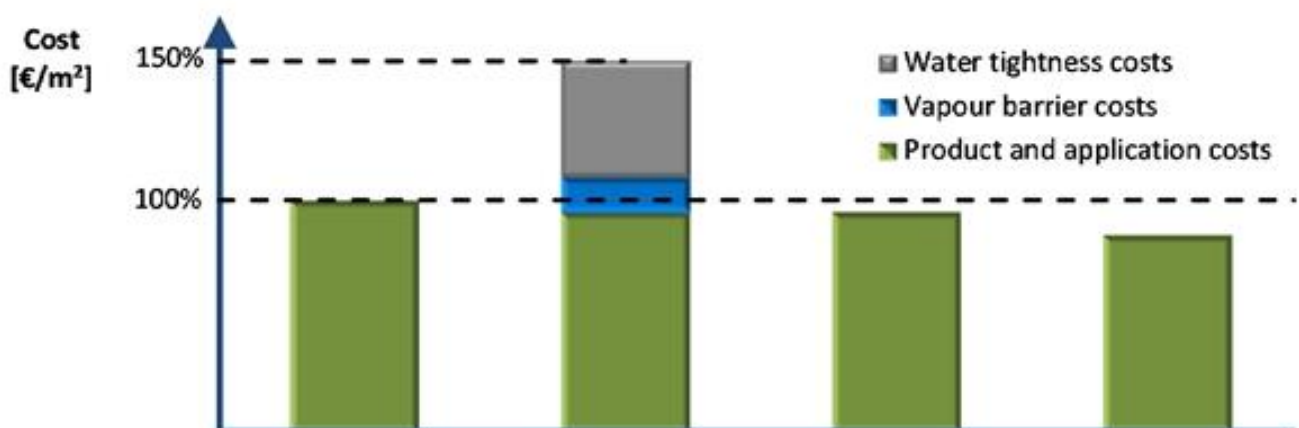
Closed cell vs. Open cell systems

Comparative costs analysis

Since open cell foams do not use low thermal conductivity gases, they tend to have an approximately 20 % lower raw material cost. Furthermore, due to a lower applied product density, the consumption per square meter is reduced between 15 % and 30 %.

Nevertheless, the application of the product on the construction site, in order to obtain the minimum project and building code requirements may involve additional costs.

	Case 1	Case 2	Case 3	Case 4
Scenario	Closed cell SPF Standard application	Open cell SPF Equivalent application	Open cell SPF Only compensation for thickness	Open cell SPF Direct substitution of closed cells foam
Thickness [cm]	5,00	6,25	6,25	5,00



	Case 1	Case 2	Case 3	Case 4
Compliance with Building Code	✓	✓	✗	✗
Same thermal insulation	✓	✓	✓	✗
Avoiding water penetration / condensation	✓	✓	✗	✗

Analysis considerations:

- Internal insulation between masonry walls
- Requirement of thermal resistance required for the insulation = 1,80 m²·K/W ●
- Moderate climate region and medium water tightness requirement
- Closed cell polyurethane 35 kg/m³ and □□ 0,028 W/(m·K)
- Open cell polyurethane 30 kg/m³ and □□ 0,035 W/(m·K)

Closed cell vs. Open cell systems

Conclusions

The application of an open cell spray polyurethane system as a direct substitute for a closed cell system, without the appropriate corrections (more insulation, water proofing layer, vapour barrier, etc.), may cause numerous problems:

- Non-compliance with project and/or building code
- Insufficient insulation and higher energy consumption
- Water absorption inside the insulation damaging the insulating properties ●

Humidity problems and formation of mildew

- Water filtrations

The manufacturer and the installer have the obligation to properly inform their customers about the properties of their product and its suitability for different construction methods.

Elastospray® - Quality in Insulation

March 2013



The closed cell BASF Elastospray® systems offer the best performance, allowing its application in simple and economic construction methods. All of this certified with a notified body.

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