ENVIRONMENTAL PRODUCT DECLARATION
as per ISO 14025 and EN 15804

Owner of the Declaration | Porextherm Dämmstoffe GmbH
Programme holder          | Institut Bauen und Umwelt e.V. (IBU)
Publisher                 | Institut Bauen und Umwelt e.V. (IBU)
Declaration number         | EPD-POR-20140214-IBC1-EN
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Vakuum-Isolations-Paneele
Vacupor® NT-B2-S / Vacuspeed®
Vacupor® PS-B2-S / Vacupor® XPS-B2-S
Vacupor® PIR-B2-S / Vacupor® BIT-B2-S
Vacupor® RP-B2-S / Vacupor® TS-B2-S
Vacupor® MW-B2-S / Vacupor® Roof

Porextherm Dämmstoffe GmbH

www.bau-umwelt.com / https://epd-online.com
1. General Information

Porextherm Dämmstoffe GmbH
Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Vacuum Insulation Panel
Owner of the Declaration
Morgan Advanced Materials
Porextherm Dämmstoffe GmbH
Heisinger Straße 8/10
D-87437 Kempten (Allgäu)

Internet: www.porextherm.com

Declaration number
EPD-POR-20140214-IBC1-EN

Declared product / Declared unit
This EPD refers to 1 m² vacuum insulation panel with and without sheathing.

Scope:

It involves a specific Environmental Product Declaration which is valid for the respective product.

This document is translated from the German Environmental Product Declaration into English. It is based on the German original version EPD-POR-20140214-IBC1-DE. The verifier has no influence on the quality of the translation. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification
The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/

Internally
Externally

Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)

Dr. Burkhart Lehmann
(Managing Director IBU)

Dr.-Ing. Wolfram Trinius
(Independent verifier appointed by SVR)

2. Product

2.1 Product description
Vacuum insulation panels comprise a core, made of fumed silica, infrared opacifiers and cellulose fibres which is heat-sealed under vacuum into a metallised high-barrier film.

For certain applications such as insulating floors, flat roofs, walls etc., functional layers can be applied to vacuum insulation panels on one or both sides.

efficient thermal insulation on building walls, roofs, ceilings and base plates.

As vacuum insulation panels can not be cut to size on site, an installation plan for thermal insulation needs to be drawn up with an exact list of panels to be produced before the order is placed.

Floor applications:

Wall applications:

**Roof applications:**

### 2.3 Technical Data

The technical data refers to the products Vacupor® NT-B2-S and Vacuspeed®. Possible layers of the vacuum insulation panels is not taken into consideration here. The data sheets for the individual products can be viewed at www.porextherm.com/de/produkte/vakuumdaemmung.html.

#### Construction data

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perpendicularity acc. DIN EN 824</td>
<td>&lt;= 0.6</td>
<td>%</td>
</tr>
<tr>
<td>Deviation from the nominal measure acc. DIN EN 822 bzw. 823</td>
<td>+/- 5</td>
<td>mm</td>
</tr>
<tr>
<td>Gross density acc. DIN EN 1602</td>
<td>170 - 210</td>
<td>kg/m³</td>
</tr>
<tr>
<td>Compressive stress at 10% compression acc. DIN EN 826</td>
<td>&gt;= 180</td>
<td>kPa</td>
</tr>
<tr>
<td>Dimensional stability at 70 °C, 90% relative humidity acc. DIN EN 1604</td>
<td>&lt;= 1</td>
<td>%</td>
</tr>
<tr>
<td>Deformation at 40 kPa, 70 °C acc. DIN EN 1605</td>
<td>&lt;= 3</td>
<td>%</td>
</tr>
<tr>
<td>Tensile strength perpendicular to the panel surface acc. DIN EN 1607</td>
<td>&gt;= 30</td>
<td>kPa</td>
</tr>
<tr>
<td>Thermal conductivity (without ageing) acc. DIN EN 52612-1 / DIN EN 12667</td>
<td>&lt;= 0.0044</td>
<td>W/(mK)</td>
</tr>
<tr>
<td>Calculation value for thermal conductivity</td>
<td>0.007</td>
<td>W/(mK)</td>
</tr>
</tbody>
</table>

#### 2.4 Placing on the market / Application rules


The products require a Declaration of Performance on account of the ETA and CE marking.


Note: The technical approval process is currently underway for Vacupor® BIT-B2-S, Vacupor® PIR-B2-S, Vacupor® MW-B2-S and Vacupor® Roof as a supplement to Technical Approval no. Z-23.11-1662. Until such a time as General Technical Approval is available, individual approvals must be applied for these products.

#### 2.5 Delivery status

Depending on the respective application, the declared products can vary in size and shape. As vacuum insulation panels can not be cut to size on site, an installation plan needs to be drawn up with an exact list of panels to be produced before the order is placed. An exception is represented by Vacuspeed® which is exclusively available in defined standard sizes.

The standard dimensions of vacuum insulation panels range from 250 × 250 mm to 1200 × 1000 mm with unsheathed panel thicknesses of 10 to 50 mm (in steps of 5 mm).

Special sizes and thicknesses deviating from the standard sizes are possible on request.

#### 2.6 Base materials / Ancillary materials

The essential raw materials used in Vacupor® NT-B2-S / Vacuspeed® vacuum insulation panels are amorphous silicon dioxide (fumed silica) with a share of 60–90% by mass and silicium carbide with a share of 10–40% by mass. Add to this max. 5% by mass viscose fibres (rayon).

The VIP core comprising the above base materials is wrapped in a polypropylene fabric before being heat-sealed under vacuum in a metallised plastic composite film applied to the outside by means of an inflammable coating.

Sheathing materials used with the declared products:

- Vacupor® RP-B2-S: Rubber granulate mat
- Vacupor® XPS-B2-S: Extruded polystyrene panel
- Vacupor® TS-B2-S: Polyester fibre panel
- Vacupor® BIT-B2-S: Bitumen roof lining
- Vacupor® PIR-B2-S: Polyisocyanurate hard foam panel
- Vacupor® PS-B2-S: Expanded polystyrene panel
- Vacupor® MW-B2-S: Mineral wool panel
- Vacupor® Roof: Polyisocyanurate hard foam panel on top side, rubber granulate mat on underside

#### 2.7 Manufacture

As raw materials, fumed silica, silicium carbide and rayon are combined in the corresponding composition and pressed to form a panel in a hydraulic press. The base plates are then cut to size. The panels are then dried at a temperature of between 60 °C and 150 °C and wrapped in a fabric before the metallised plastic composite film is wrapped around the core. In a vacuum chamber, the interior is evacuated via the plastic composite film still open on one side and then finally sealed once the corresponding pressure range has been reached. The vacuum insulation panels (Vacupor® NT-B2-S / Vacuspeed®) thus manufactured have an internal pressure (pressure within the plastic composite barrier film) of less than 5 mbar.

Manufacture of covered products involves applying the corresponding sheathing material on one or both sides of the Vacupor® NT-B2-S and Vacuspeed® basic variants in a further production step.

Compound dust incurred during production is extracted and redirected to the material circuit. The same process is applied to panel waste incurred during cutting to size. It is crushed and added to the raw mixture.

Porextherm applies a Quality Management System in accordance with ISO 9001 and an Environmental...
Management System in accordance with ISO 14001. The declared products are subject to external monitoring in accordance with the General Technical Approval no. Z-23.11-1662. Compliance with the quality and test guidelines of the RAL-GZ 960 quality assurance entitled Porextherm to mark the declared products with the Güteschutzgemeinschaft Hartschaum e.V. VIP quality symbol which is recognised and protected by RAL.

2.8 Environment and health during manufacturing

All components and raw materials for manufacturing Vacupor® are physiologically safe.

All production employees can avail of ear protection (e.g. ear muffs, ear plugs) against any increased noise levels caused by the production machinery.

Compound dust incurred during production is collected and extracted by state-of-the-art extraction plants and redirected to the material circuit. The same process is applied to panel waste incurred during cutting to size. It is crushed, ground and added to the raw mixture.

The waste air incurred during the generation of compressed air required production is used for providing hot water. Buildings are heated via district heat. Electricity is generated entirely from hydro power.

An Environmental Management System in accordance with ISO 14001 is applied.

2.9 Product processing/Installation

Vacuum insulation panels can not be cut to size on site which is why an installation plan needs to be drawn up with an exact list of panels to be produced before the order is placed for thermal insulation.

In accordance with General Technical Approval no. Z-23.11-1662, VIP elements may only be installed by qualified personnel availing of sufficient experience in careful handling of the products.

Attention is also drawn to the "Vacupor® - Product and Processing Information" information sheet which can be requested from Porextherm or downloaded from the homepage (www.bau-vip.de).

When processing/applying vacuum insulation panels in accordance with the generally recognised rules of technology, no special industrial hazard measures under public law are required in order to ensure the protection of health.

No environmental pollution is triggered by processing/applying vacuum insulation panels in accordance with the generally recognised rules of technology. No special measures need to be taken to protect the Environment.

2.10 Packaging

Vacuum insulation panels are delivered packed in boxes (EWC 15 01 01). Depending on the type of box, they comprise between 50% and 85% recycled paper. A layer of foam (EWC 15 01 02) is inserted between the individual panels (for Vacupor® NT-B2-S / Vacuspeed®) to protect them from damaging each other. Any space left after filling the boxes is filled with air cushions (polyethylene / polyethylene composite) to prevent from the products from sliding (EWC 15 01 02).

The boxes can be recycled by paper factories. Any residual packaging materials can be disposed of by material recycling companies.

2.11 Condition of use

The components are not subject to any changes if processed/applied correctly.

If the vacuum insulation panels are not damaged during their service life (e.g. drilled), the rated value and therefore the insulation effect is retained for a period of 30 to 50 years at a mean internal pressure increase of 1 to 3 mbar per year (depending on the size).

If the declared products display full vacuum loss, the vacuum insulation panels still display a very low thermal conductivity value of 0.020 W/(m × K).

2.12 Environment and health during use

No health impacts are known where processed/applied/used as designated.

2.13 Reference service life

When the vacuum insulation panels are used as designated, a useful life of at least 30 to 50 years can be assumed.

2.14 Extraordinary effects

Fire

The declared products comply with the requirements of construction product class B2 – normally flame-resistant to DIN 4102 and are regarded as non-burning falling/dripping.

Water

The declared products are not corroded by water. No components which are hazardous to water are washed out.

Mechanical destruction

If the declared products display full vacuum loss caused by mechanical damage to the barrier film, the vacuum insulation panels still display a very low thermal conductivity value of 0.020 W/(m × K).

No other effects can be anticipated as a result of mechanical damage.

2.15 Re-use phase

Re-use:

The declared products can be re-used if deconstructed non-destructively.

Further use:

In the event of full vacuum loss in the declared products, they can still be used as insulating material with a thermal conductivity value of 0.020 W/(m × K).

Recycling:

The vacuum insulation panel core support is fully recyclable. When returned to the manufacturer, the core support is crushed, ground and added to the material circuit for the production of new core supports.
The fabric is added to thermal recycling while the metallised plastic composite film is directed to material recycling.

The sheathing is re-used via material recycling.

**Further use:**
If contaminated core supports make it impossible to recycle them at the manufacturer's, the material is also suitable for filling in engineering and road construction.

### 2.16 Disposal
The waste code number for the metallised plastic composite film is 150 102.

**The waste code number for all products added to thermal utilisation is 200 301.**

In the event that the damaged VIPs are not returned to the manufacturer, they can be disposed of as mixed building and demolition rubble (EWC 17 09 04) once all components and raw materials for the manufacture of thermal insulation products have been designated physiologically safe.

### 2.17 Further information
Further information on Porextherm and the declared products is available on the company Web site: www.porextherm.com.

### 3. LCA: Calculation rules

#### 3.1 Declared Unit
The Declaration refers to the manufacture, recycling and/or disposal of 1 m² unsheathed VIP with a typical thickness of 25 mm and a weight of 4.5 kg. Average density is 181 kg/m².

The sheathing environmental profiles are depicted in section 5 and in the Annex.

<table>
<thead>
<tr>
<th>Declared Unit</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammage</td>
<td>4.5</td>
<td>kg/m²</td>
</tr>
<tr>
<td>Conversion factor to 1 kg</td>
<td>0.222</td>
<td>-</td>
</tr>
<tr>
<td>Thickness</td>
<td>0.025</td>
<td>m</td>
</tr>
</tbody>
</table>

Furthermore, sheathing environmental profiles are calculated based on the following specifications:

<table>
<thead>
<tr>
<th>Sheathings</th>
<th>kg/m² (1 side)</th>
<th>kg/m² (2 sides)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS, 10 mm</td>
<td>0.15</td>
<td>0.30</td>
</tr>
<tr>
<td>EPS, 20 mm</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>XPS, 3 mm</td>
<td>0.096</td>
<td>0.192</td>
</tr>
<tr>
<td>Rubber granulate, 3 mm</td>
<td>2.88</td>
<td>5.76</td>
</tr>
<tr>
<td>Polyester fibre, 3 mm</td>
<td>2.4</td>
<td>4.8</td>
</tr>
<tr>
<td>Polyester fibre, 4 mm</td>
<td>3.8</td>
<td>7.6</td>
</tr>
<tr>
<td>Bitumen lining, 2 mm</td>
<td>2.3</td>
<td>4.6</td>
</tr>
<tr>
<td>PIR hard foam panel, 20 mm</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Fabric tape</td>
<td>0.141</td>
<td>0.282</td>
</tr>
<tr>
<td>Rock wool panel, 30 mm</td>
<td>2.1</td>
<td>4.2</td>
</tr>
<tr>
<td>Material mix for Vacuopor Roof</td>
<td>PIR + fabric tape on one side + rubber granulate mat on one side 4.3 kg/m²</td>
<td></td>
</tr>
<tr>
<td>Generally required:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adhesive for sheathing (2C PU)</td>
<td>0.38</td>
<td>0.76</td>
</tr>
<tr>
<td>PP adhesive tape, 0.085 mm</td>
<td>0.08</td>
<td>0.16</td>
</tr>
</tbody>
</table>

The sheathing environmental profiles are always calculated for application on both sides using the same sheathing material and including adhesive and adhesive tape. Furthermore, the environmental impact of the special material mixture for Vacuopor Roof is calculated as indicated in the chart above.

#### 3.2 System boundary

**Type of EPD:** cradle to plant gate – with options

The LCA takes consideration of the raw material and energy supply, actual product manufacturing (Modules A1-A3), transport to recycling/disposal (Module C2), waste processing (Module C3), waste disposal (Module C4), and credits and loads beyond the system boundaries (Module D).

#### 3.3 Estimates and assumptions
The following End-of-Life scenarios were considered:

**Scenario I:** Following the transport of waste to Porextherm, the individual components of the VIP are separated mechanically. The sheathing system is then thermally recycled. The core support can be added directly to production where it replaces primary raw materials. The “grinding” step is monitored.

**Scenario II:** Waste transport is followed by incineration of the entire VIP (100%). The energy recovery is taken into consideration in line with the allocation principle outlined in section 3.8. The mineral components are landfilled after incineration (approximation: without mass loss).

**Scenario for sheathings:** The sheathings are thermally recycled; inert components such as rock wool sheathings are landfilled after incineration.

No specific national data is available for the barrier film base materials. Material data sets with German marginal conditions are therefore used.

Thermal recycling of the combustible components of bitumen sheathings is estimated using the “Incineration of plastic waste” data set as the combustible shares in the bitumen lining display a similarly high calorific value of approx. 42 MJ. This estimate can be regarded as sufficient with regard to the impact categories and modules observed in this study. One problem with the use of bitumen is the emissions of polycyclic hydrocarbons (PAHs) during installation and maintenance (Modules B1 and B2 – not considered) when the linings are heat-sealed, for example.

The natural rubber binding CO2 in old tyres which is used as a recycling material in rubber sheathings is ignored.

#### 3.4 Cut-off criteria
All data from the operating data survey was taken into consideration, i.e. all starting materials used according to the formula, the thermal energy used as well as electricity. Accordingly, material and energy flows with a share of less than 1 per cent were also considered. No cut-off criteria are applied in this study. All data provided is integrated in the software model.
3.5 Background data
The GaBi software system for comprehensive analysis (GaBi 6 2013) developed by PE INTERNATIONAL AG was used for modelling the VIP life cycle. The data sets contained in the GaBi database are documented in the online GaBi documentation. The basic data in the GaBi database was applied for energy processes, transport, preliminary products and auxiliaries. The Life Cycle Assessment was drawn up for Germany as a reference area. This means that apart from the production processes under these marginal conditions, the pre-stages also of relevance for Germany such as provision of electricity or energy carriers are used. In line with Porextherm Dämmstoffe GmbH, 100% electricity from hydro power was used for manufacturing the core support in the plant in Kempten. The average German power mix was used for electrical energy in all other processes.

3.6 Data quality
The data quality can be regarded as high. The VIP analysis is based on manufacturing data supplied by Porextherm Dämmstoffe GmbH and dating from 2010. As the sheathings are bought by Porextherm and data surveys are not practical among the individual suppliers, the study in this area is largely based on generic data from the GaBi database (GaBi 6). The corresponding background data sets were available in the GaBi database for all of the relevant preliminary products used. The data used was last revised max. 4 years ago.

3.7 Period under review
Manufacturing data from 2010 serves as the data basis. The volumes of raw materials, energy, ancillary and operating materials used are average values over a 12-month period of analysis in the Porextherm Dämmstoffe GmbH plant in Kempten.

3.8 Allocation
Production waste which is used internally (the edge trims in production) is modelled as closed-loop recycling in Modules A1-A3. Production data on manufacturing the declared products is made available by Porextherm Dämmstoffe GmbH. The requisite volumes of raw materials are aligned to the VIPs accordingly. No other ancillary products are incurred in production.

During thermal recycling in an incineration plant, credits for electricity and thermal energy from Module C3 are taken consideration of in an input-specific manner in Module D and the elementary composition and calorific value are also taken into account. The credited processes relate to Germany on account of the production facilities located there. Module D also features a credit for material recycling of the VIPs.

3.9 Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

4. LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules or can be used for developing specific scenarios in the context of a building evaluation if modules are not declared (MND).

Transport to EoL (C2)
Transport by truck: EURO 5, 34-40 t total weight / 27 t useful load, 85% average utilisation capacity (by mass).

Reference Service Life

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference service life</td>
<td>30 - 50</td>
<td>a</td>
</tr>
</tbody>
</table>

End of Life (C3, C4)

Scenario I: Recycling the core support, thermal recycling of the sheathing system
Scenario II: 100% incineration of the VIP; the mineral components are landfilled after incineration

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collected as mixed construction waste</td>
<td>4.5</td>
<td>kg</td>
</tr>
<tr>
<td>Recycling (Scenario I: core support (C3))</td>
<td>4.275</td>
<td>kg</td>
</tr>
<tr>
<td>Landfilling (Scenario II: core support (C4))</td>
<td>4.275</td>
<td>kg</td>
</tr>
</tbody>
</table>

Thermal utilisation (Scenarios I and II: combustible components (C4)) | 0.225 | kg |
Thermal recycling (sheathings (C4)) | 1.1 - 9.0 | kg |

Module D
Module D includes the credits for electricity and thermal energy as a result of incineration with German marginal conditions. Furthermore, credits are calculated for material recycling of the core support and therefore savings of primary material.
5. LCA: Results

The environmental impacts and indicators for the Life Cycle Inventory Analysis are indicated below for an unsheathed vacuum insulation panel. Two possible disposal scenarios are presented. Scenario 1, visible in C3/1, C4/1 and D1, based on material recycling of the core support Scenario 2 (C3/2, C4/2 and D2) refers to thermal recycling of the combustible components of the VIP.

The environmental impacts and indicators for the Life Cycle Inventory Analysis for the various sheathings are indicated in the Annex. A formula is depicted in section 6 for calculating the sheathed vacuum insulation Panel.

### RESULTS OF THE LCA - RESOURCE USE: 1 m² VIP with a thickness of 25 mm

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>C2</th>
<th>C3/1</th>
<th>C3/2</th>
<th>C4/1</th>
<th>C4/2</th>
<th>D1</th>
<th>D2</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWP</td>
<td>[kg CO₂-Eq]</td>
<td>42.20</td>
<td>0.10</td>
<td>0.37</td>
<td>0.00</td>
<td>0.58</td>
<td>0.64</td>
<td>-40.77</td>
<td>-0.36</td>
</tr>
<tr>
<td>ODP</td>
<td>[kg CFC11-Eq]</td>
<td>4.22E-9</td>
<td>7.29E-14</td>
<td>2.97E-11</td>
<td>0.00E+0</td>
<td>6.98E-13</td>
<td>1.42E-12</td>
<td>-4.15E-9</td>
<td>-1.48E-11</td>
</tr>
<tr>
<td>AP</td>
<td>[kg SO₂-Eq]</td>
<td>1.46E-1</td>
<td>2.41E-4</td>
<td>6.00E-4</td>
<td>0.00E+0</td>
<td>1.42E-4</td>
<td>1.16E-4</td>
<td>-1.36E-1</td>
<td>-5.14E-4</td>
</tr>
<tr>
<td>EP</td>
<td>[kg (PO₄)₃-Eq]</td>
<td>1.54E-2</td>
<td>4.91E-5</td>
<td>8.48E-5</td>
<td>0.00E+0</td>
<td>1.13E-5</td>
<td>6.18E-5</td>
<td>-1.49E-2</td>
<td>-6.13E-5</td>
</tr>
<tr>
<td>POCP</td>
<td>[kg Ethen Eq]</td>
<td>1.27E-2</td>
<td>7.70E-5</td>
<td>4.98E-5</td>
<td>0.00E+0</td>
<td>7.70E-6</td>
<td>4.22E-5</td>
<td>-1.17E-2</td>
<td>-4.74E-5</td>
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<tr>
<td>ADPE</td>
<td>[kg Ib Eq]</td>
<td>2.30E-6</td>
<td>3.30E-9</td>
<td>7.00E-8</td>
<td>0.00E+0</td>
<td>0.31E-8</td>
<td>1.05E-7</td>
<td>-2.01E-3</td>
<td>-4.29E-3</td>
</tr>
</tbody>
</table>

### RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² VIP with a thickness of 25 mm

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>C2</th>
<th>C3/1</th>
<th>C3/2</th>
<th>C4/1</th>
<th>C4/2</th>
<th>D1</th>
<th>D2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERE</td>
<td>[MJ]</td>
<td>287.63</td>
<td>-</td>
<td>-</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-268.50</td>
<td>-0.57</td>
</tr>
<tr>
<td>PERM</td>
<td>[MJ]</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PERT</td>
<td>[MJ]</td>
<td>287.63</td>
<td>0.00</td>
<td>1.14</td>
<td>0.00</td>
<td>0.03</td>
<td>0.09</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PENRE</td>
<td>[MJ]</td>
<td>719.23</td>
<td>-</td>
<td>-</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PENRM</td>
<td>[MJ]</td>
<td>9.50</td>
<td>-</td>
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<td>PENRT</td>
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<tr>
<td>RSF</td>
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<tr>
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<td>0.00</td>
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<tr>
<td>FW</td>
<td>[m³]</td>
<td>4.31E-1</td>
<td>9.64E-6</td>
<td>1.54E-3</td>
<td>0.00E+0</td>
<td>1.42E-3</td>
<td>-9.65E-4</td>
<td>-3.59E-1</td>
<td>-7.67E-4</td>
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</table>

### RESULTS OF THE LCA - OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² VIP with a thickness of 25 mm

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>C2</th>
<th>C3/1</th>
<th>C3/2</th>
<th>C4/1</th>
<th>C4/2</th>
<th>D1</th>
<th>D2</th>
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<tr>
<td>HWMD</td>
<td>[kg]</td>
<td>6.51E-2</td>
<td>3.51E-6</td>
<td>1.66E-3</td>
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<td>3.51E-6</td>
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<td>NHWMD</td>
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<tr>
<td>RWD</td>
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<td>CRU</td>
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<td>-</td>
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<td>MFR</td>
<td>[kg]</td>
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<td>0.00</td>
<td>0.00</td>
<td>-</td>
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<tr>
<td>MER</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td>EEE</td>
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<td>EET</td>
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<td>0.00</td>
<td>0.00</td>
<td>2.68</td>
<td>2.78</td>
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</table>

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non fossil resources; ADPF = Abiotic depletion potential for fossil resources.

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials; PENRE = Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials; PENRM = Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials; PENRT = Total use of non renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non renewable secondary fuels; FW = Use of net fresh water.

The following table shows the results of the Life Cycle Inventory Analysis for the various sheathings.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>C2</th>
<th>C3/1</th>
<th>C3/2</th>
<th>C4/1</th>
<th>C4/2</th>
<th>D1</th>
<th>D2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paramter</td>
<td>Unit</td>
<td>A1-A3</td>
<td>C2</td>
<td>C3/1</td>
<td>C3/2</td>
<td>C4/1</td>
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</tr>
<tr>
<td>Paramter</td>
<td>Unit</td>
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<td>C2</td>
<td>C3/1</td>
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<td>C4/2</td>
<td>D1</td>
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### RESULTS OF THE LCA - BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES

<table>
<thead>
<tr>
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<th>C4/2</th>
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<th>D2</th>
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</thead>
<tbody>
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<td>C2</td>
<td>C3/1</td>
<td>C3/2</td>
<td>C4/1</td>
<td>C4/2</td>
<td>D1</td>
<td>D2</td>
</tr>
<tr>
<td>Paramter</td>
<td>Unit</td>
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<td>C2</td>
<td>C3/1</td>
<td>C3/2</td>
<td>C4/1</td>
<td>C4/2</td>
<td>D1</td>
<td>D2</td>
</tr>
</tbody>
</table>

The following table shows the results of the Life Cycle Inventory Analysis for the various sheathings.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>C2</th>
<th>C3/1</th>
<th>C3/2</th>
<th>C4/1</th>
<th>C4/2</th>
<th>D1</th>
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<tbody>
<tr>
<td>Paramter</td>
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<td>C2</td>
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<td>C3/2</td>
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<td>C4/1</td>
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<td>D1</td>
<td>D2</td>
</tr>
</tbody>
</table>

The following table shows the results of the Life Cycle Inventory Analysis for the various sheathings.
6. LCA: Interpretation

The following interpretation refers to the manufacture and disposal of unsheathed vacuum insulation panels. During manufacture (A1-A3), the VIP core has a significant influence on the environmental factors, making a contribution of 95-99% in all impact categories analysed. Among the VIP core raw materials, the provision of fumed silica is of outstanding importance making a 90-99% contribution depending on the impact category. The barrier film also has an additional influence, e.g. in the Photochemical Ozone Creation Potential (POCP) and Global Warming Potential (GWP) categories.

Material recycling of the VIP core as calculated in EoL scenario I can contribute to major savings of environmental relevance thanks to the high influence of silica production. Non-renewable primary energy requirements (PENRT), for example, can be reduced by 95%. Although this consideration should clearly be regarded as a "best-case" analysis, it is obvious that even returning a mere 20% of VIPs installed would be an environmental success accounting for 19% savings in primary energy (approx. -130 MJ/m²). While EoL scenario II with landfilling inert components reveals only marginal savings potentials through incineration of the sheathing system with energy recovery.

Porextherm has been using electricity from hydro power in its plant in Kempten since 2013. This enables CO₂ savings of 16% over the average power mix.

Scalability

7. Requisite evidence

No evidence is required for vacuum insulation panels.

8. References

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Institut Bauen und Umwelt e.V., Königswinter (pub.): Generation of Environmental Product Declarations (EPDs);

General principles
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www.bau-umwelt.de

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DIN EN ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures
EN 15804

EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

PCR - Part B
Product Category Rules for vacuum insulation panels, Version 1.5, 2013

ISO 9001
Quality management systems - Requirements (ISO 9001:2008); trilingual version EN ISO 9001:2008

ISO 14001
Environmental management systems - Requirements with guidance for use (ISO 14001:2004 + Cor. 1:2009)

DIN EN 822
Thermal insulating products for building applications – Determination of length and width (EN 822:2013)

DIN EN 823
Thermal insulating products for building applications – Determination of thickness (EN 823:2013)

DIN EN 824
Thermal insulating products for building applications – Determination of squareness (EN 824:2013)

**DIN EN 826**
Thermal insulating products for building applications – Determination of compression behaviour (EN 826:2013)

**DIN EN 1604**
Thermal insulating products for building applications – Determination of dimensional stability under specified temperature and humidity conditions (EN 1604:2013)

**DIN EN 1605**
Thermal insulating products for building applications – Determination of deformation under specified compressive load and temperature conditions (EN 1605:2013)

**DIN EN 1607**
Thermal insulating products for building applications – Determination of tensile strength perpendicular to faces (EN 1607:2013)

**DIN 4102-1**
Fire behaviour of building materials and building components – Part 1: Building materials; concepts, requirements and tests

**DIN EN 12667**
Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance (EN 12667:2001)

**EWC 15 01 01**
European Waste Catalogue (EWC) in accordance with AVV (List of Wastes Ordinance) – Packaging made of paper and cardboard

**EWC 15 01 02**
European Waste Catalogue (EWC) in accordance with AVV (List of Wastes Ordinance) – Packaging made of plastic

**EWC 17 09 04**
European Waste Catalogue (EWC) in accordance with AVV (List of Wastes Ordinance) – Mixed building and demolition rubble with the exception of those covered by EWC 17 09 01, 17 09 02 and 17 09 03

**RAL-GZ 960: Vacuum Insulation Panels**
Quality assurance: Manufacture of vacuum insulation panels as insulation material for refrigerators and freezers, temperature-controlled packaging, logistics sector and construction

**General Technical Approval no. Z-23.11-1662**
Deutsches Institut für Bautechnik (DIBt), approval agency for construction products and designs, Technical audit office
Valid to 30 June 2015

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<thead>
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<th>Address</th>
<th>Phone</th>
<th>Fax</th>
<th>Email</th>
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<td>+49 (0) 831 57 53 63</td>
<td><a href="mailto:info@porextherm.com">info@porextherm.com</a></td>
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