Introduction

The demand for super thermal insulation materials has risen considerably over the last few years. This is due to increasingly strict statutory requirements on energy efficiency in buildings, tightened fire regulations, steadily rising energy costs and the demands of architects and builders for slimmer construction.

Evonik has met these market requirements with the development of the new CALOSTAT® high-performance thermal insulation board. CALOSTAT® is a mineral insulation material with unique properties and a thermal conductivity of only 0.019 W/(m K). Apart from its excellent thermal insulation properties, CALOSTAT® is distinguished mainly by its non-combustibility, vapour diffusion permeability and core hydrophobization. This allows the development of entirely new and more efficient insulation systems arising from the combination of CALOSTAT® material properties.

CALOSTAT® has already received approvals in many different fields of application such as facades, ceilings, roofs and flooring. CALOSTAT® is also used by system suppliers for high-performance and sustainable solutions. With its wide-ranging technical services, Evonik supports its partners and customers in developing new systems.

This brochure contains basic technical information on CALOSTAT® and its properties and handling. We would be happy to provide you with additional information at any time.

Should you have any queries, please contact us at www.CALOSTAT.de
CALOSTAT®: product information

Physical and technical description

CALOSTAT® is a purely mineral insulating material based on synthetic amorphous silica. This is also the reason for its excellent product properties, such as building material class A2 - s1, d0 combined with low thermal conductivity (λ = 0.019 W / (m K)). CALOSTAT® contains no fungicides, algicides or pesticides. It is unreactive towards other composite materials, resistant to environmental effects such as mould formation, remains free from fogging and, in contrast to most commercially available fossil insulating materials, is recyclable.

- Very good thermal insulation properties
- Vapour permeable
- Hydrophobic
- No permeability to liquid water
- Mineral insulating material
- Non-combustible
- Recycling possible

Properties

Hydrophobization makes a material water-repellent. In the construction industry this effect has long been known in connection with surface coatings, e.g. on natural stone or brickwork. Thanks to core hydrophobization combined with optimal pore structure, condensate formation in the interior of CALOSTAT® insulating material is effectively minimized, as has been shown by studies at the Fraunhofer IBP Holzkirchen. This also means that the insulating material remains absolutely dimensionally stable in contact with water. Thus no water condenses in the material, nor, for gap-free assembly, in any adjacent water-impermeable building material. Destruction of the building component by ice formation is therefore also ruled out.

The core hydrophobization of CALOSTAT® gives it high tolerance to moisture. In case of leakage in the structure, for example at a roof edge, facade insulation with CALOSTAT®, in contrast to conventional construction, requires no extra costs for replacement of the insulation. The advantages of core hydrophobization are particularly evident in, for example, a warm tropical climate and for sauna construction applications.

Registration

<table>
<thead>
<tr>
<th>CALOSTAT®</th>
<th>Approved for</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN EN 13101</td>
<td>Construction material class A2-s1, d0</td>
<td>non-combustible</td>
</tr>
<tr>
<td>DIN 4102</td>
<td>Construction material class A</td>
<td>non-combustible</td>
</tr>
<tr>
<td>DIBT 2-23.11-1926</td>
<td>D2, D3, D4, D4D, DAA, VA and WABA in accordance with DIN 4108-10</td>
<td></td>
</tr>
<tr>
<td>DIBT 2-23.12-1977</td>
<td>Core insulation with cavity wall</td>
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</table>

standard pallets CALOSTAT®

<table>
<thead>
<tr>
<th>Board thickness / mm</th>
<th>Boards per pallet / units</th>
<th>Volume per pallet / m³</th>
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<tbody>
<tr>
<td>20</td>
<td>48</td>
<td>0.576</td>
</tr>
<tr>
<td>30</td>
<td>32</td>
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<td>40</td>
<td>24</td>
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</tr>
<tr>
<td>50</td>
<td>19</td>
<td>0.570</td>
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</tbody>
</table>

Delivery mode

CALOSTAT® is available in the standard dimensions 1,000 x 600 mm with thicknesses of 20, 30, 40, and 50mm. Other dimensions are possible on request.

Hydrophobization

Figure 1
Characteristical physico-chemical data

<table>
<thead>
<tr>
<th>Properties and test methods</th>
<th>Unit</th>
<th>Value</th>
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<tbody>
<tr>
<td>Color</td>
<td></td>
<td>gray</td>
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<tr>
<td>Bulk density</td>
<td>kg/m³</td>
<td>165</td>
</tr>
<tr>
<td>Thermal conductivity (λ)</td>
<td>W/(m K)</td>
<td>0.019</td>
</tr>
<tr>
<td>Thermal conductivity rating</td>
<td></td>
<td>021</td>
</tr>
<tr>
<td>Vapor diffusion resistance (μ)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Water absorption</td>
<td>kg/m²</td>
<td>≤ 0.1</td>
</tr>
<tr>
<td>Moisture absorption</td>
<td>M-%</td>
<td>≤ 1.0</td>
</tr>
<tr>
<td>Dimensional stability</td>
<td></td>
<td>≤ 1 / 1 / 2</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>kPa</td>
<td>&gt; 90</td>
</tr>
<tr>
<td>Elastic recovery/recovery reversible</td>
<td>%</td>
<td>≤ 10</td>
</tr>
</tbody>
</table>

Figure 2
CALOSTAT®, high-performance thermal insulation panels based on synthetic amorphous silica

Figure 3
Beading effect of hydrophobization

Figure 4
CALOSTAT® is placed on a cooling plate under defined ambient conditions (test set-up).

Figure 5
NMR spectra: Collection of moisture between CALOSTAT® and the surrounding glass cuvette, where the joint is not gap-free

Figure 6
NMR spectrum: Almost gap-free embedding of CALOSTAT® in epoxy resin indicates only small amounts of moisture
Section 4.3 of DIN 4108-2, titled “Thermal insulation in summer”, considers for opaque components in particular the heat storage capacity. Building materials of low density, such as insulation, are thus virtually disregarded in this standardized consideration, resulting in the thermal insulation (U-value) playing a subordinate role when it comes to protection from summer heat. One reason for this is that the thermal conductivity of conventional insulating materials is temperature dependent: Their insulating performance decreases with increasing temperature.

In the summer, metal and dark surfaces are heated up to 100 °C; particularly in lightweight construction, this leads to heating of adjacent spaces. The consequences are overheating of the rooms or high costs for an adequately dimensioned air conditioning system.

The temperature amplitude ratio (TAR) is the result of complex interplay between specific heat-storage capacity, the density of the insulating material and the thermal conductivity. The TAR represents a phase shift of the temperature maxima in heat transfer through an external wall.

Studies at the “Bayerisches Zentrum für Angewandte Energieforschung (ZAE) in Würzburg, Germany, have shown that CALOSTAT® has a favourable TAR compared to other materials. Temperature transmission through the component to the surface of a CALOSTAT® insulated wall is complete after 8 – 12 h, that is, at night. This supports a comfortable indoor environment in summer.

The combination of low thermal conductivity and favourable TAR allows with CALOSTAT® a slim wall construction that offers optimal protection at high as well as at low temperatures.

In its report ZAE 2-114-06 of May 7, 2014, ZAE Würzburg attests to the excellent properties of CALOSTAT®, referring to “the very low insulation thickness required, due to low thermal conductivity, compared with the other insulating materials studied” as well as the material’s “good heat resistance and low temperature dependence of thermal conductivity.”¹

Figure 7 shows that for mineral wool, for example, a temperature increase of 90 K reduces the insulating effect by about 30%. The results clearly demonstrate the very low, almost temperature-independent thermal conductivity of CALOSTAT® compared with conventional insulating materials.

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Fire protection

Fire protection requirements for buildings have become more stringent. As a result, stricter requirements are placed on the construction materials themselves as well as on the buildings and their construction.

In the new 2012 edition of DIN EN 1363-1, Fire Resistance Tests, the test set-up has been slightly altered with regard to the arrangement of the sensors. This effectively results in stricter requirements for insulation of barriers such as doors. The use of CALOSTAT® here allows insulation thicknesses to be systematically maintained and even reduced, so that various designs appear to be possible only by using CALOSTAT®.

Figure 12 shows the simulation of a typical fire test: A standardized fire is placed against the side of the fire-protection door facing the fire and the temperature increase is measured on the other side of the door. The door is classified according to the time that elapses until a limiting temperature is exceeded. The tightening of the classification particularly affects outer doors because these must provide good fire protection (they must withstand fire for 90, 120 or 180 minutes to be classified as T90, T120 and T180 respectively) as well as meet the requirements for good thermal insulation.

CALOSTAT® is classified according to DIN 13501 as A2 - s1, d0. This means that the insulating material is non-combustible, is classified in the lowest smoke-emission category, and does not produce burning droplets or particles as defined in the European standard. It also satisfies the requirements for the fire shaft test as specified in DIN 4102-1 and can therefore be treated as a building material of class A of the German test instructions.²

Bonding

Bonding of CALOSTAT® is possible with, for example, adhesives based on two-component acrylic resins (such as FK-fix® C from FK-Chem GmbH & Co. KG), or with silane-modified polymers (such as Flächen-Kleber (surface adhesive) 645 from Ramsauer) or single-component hybrid adhesives that contain no water or solvent. After thermal activation of the surface at about 600 °C, CALOSTAT® can also be bonded using water glass adhesives.

As a general rule, the mechanical load in the CALOSTAT® insulating material must be kept low in the bonded structural element.

It is recommended that the bonded joint is regarded as only an aid to assembly.

Mechanical attachment

Dowels with large dowel plates are suitable for mechanical attachment of CALOSTAT®. Appropriate recommendations from EJOT Baubefestigungen GmbH and Hilti Deutschland AG are available on request.

When working with CALOSTAT®, any commercially available drill can be used. Provided that the insulating material is resting on a solid, plane underlay, it can even be easily pierced with a pointed object.

A double-layer assembly of CALOSTAT® is recommended to minimize heat bridge effects in the joint areas of the boards. For attachment to a vertical surface, the lower layer of CALOSTAT® can first be bonded to the wall to aid assembly and the second layer then fixed mechanically with dowels.

Handling CALOSTAT®

Lifting

CALOSTAT® can withstand surface pressure loads. Tensile loads arising from lifting are to be avoided. It is therefore recommended that a suitable support, such as a plane vacuum suction device or a solid support plate, be used when moving individual panels.

Lifting of CALOSTAT®
According to its DIBt certification, CALOSTAT® reaches a compressive strength of at least 65 kPa as measured by DIN EN 826. CALOSTAT® is also optimal for flooring with relatively low load capacity, such as cavity floors. In addition to good heat insulation, the insulating material also satisfies the high fire-protection requirements.

How does the handling of CALOSTAT® differ from that of classical insulating panels?

Except for the low strength of the material and the full-surface support required for manual movement of individual boards, the handling of CALOSTAT® is not different from that of other insulating panels. The material is easily cut, or drilled with a sharp object.

In what configurations can CALOSTAT® be used?

The insulating panels are produced in standard thicknesses of 20, 30, 40 and 50 mm. CALOSTAT® is approved for double-layer mounting up to a total thickness of 100 mm.

Is dust generated when CALOSTAT® is processed?

The cutting and processing of mineral insulating panels produces dust. As in handling other dust-producing materials, this can lead to a feeling of dryness on the skin and irritation of the eyes and respiratory tract.

The person affected should move into fresh air. To prevent the feeling of dryness resulting from skin contact, CALOSTAT® should be washed off with water and cream then applied to the skin.

What protective measures should be taken while processing the material?

For processing of CALOSTAT®, we recommend that the protective clothing customarily used at construction sites be worn. Work such as cutting of panels that is associated with particularly high dust generation should be carried out only with a suitable dust extraction system.

What other measures should be considered when processing CALOSTAT®?

The main component of CALOSTAT® is synthetic amorphous silica, which is non-combustible. Dust explosion of pure SiO2 is unlikely.

More detailed information is available from the technical specification at www.CALOSTAT.de

The manufacturer supplies the insulating panels on wooden pallets. The pallet loading pattern depends on the panel thickness. The panels are protected for transport by cardboard packaging. Multiple-use wooden pallets may be handed in to the supplier of construction materials (where the deposit on them is refunded).

They are then returned to the building products manufacturer and put back into the production process. CALOSTAT® is not a dangerous good within the meaning of the transport regulations.

References


Picture credits

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Evonik Resource Efficiency GmbH
Thermal Insulation
Rodenbacher Chaussee 4
63457 Hanau (Wolfgang)
Germany
PHONE +49 6181 59-5200
FAX +49 6181 59-75200
calostat@evonik.com
www.evonik.com

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