EVONIK INDUSTRIES

CALOSTAT®

Technical Information 1404

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Contents

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.

Figure 1
Charecteristic physico-chemical data

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

Registration

CALOSTAT®	Approved for	Application
DIN EN 13501	Construction material class A2-s1, d0	non-combustible
DIN 4102	Construction material class A	non-combustible
DIBT	Z-23.11-1926	DI, DEO (dg), DAD, DAA, WI and WAB in accordance with DIN 4108-10
DIBT	Z-23.12-1977	Core insulation with cavity wall

Standard pallets CALOSTAT®

Board thickness / mm	Boards per pallet/units	Volume per pallett/m³
20	48	0.576
30	32	0.576
40	24	0.576
50	19	0.570

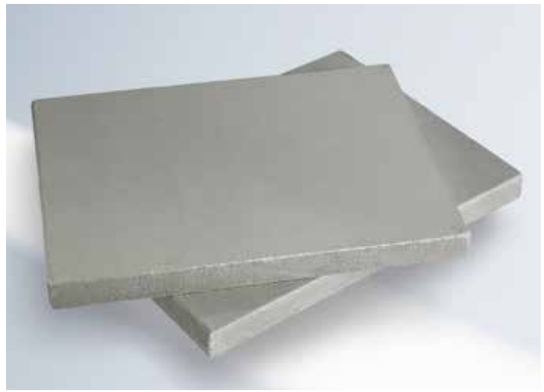


Figure 2
CALOSTAT®, high-performance thermal insulation panels based on synthetic amorphous silica

Properties

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

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

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.

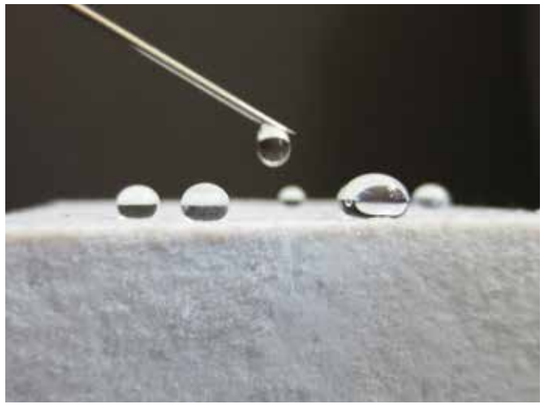


Figure 3
Beading effect of hydrophobization

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

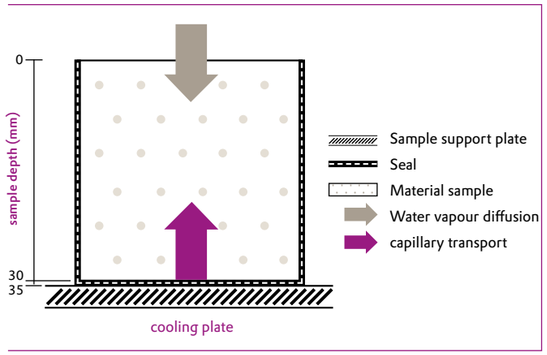


Figure 5
NMR spectra: Collection of moisture between CALOSTAT® and the surrounding glass cuvette, where the joint is not gap-free

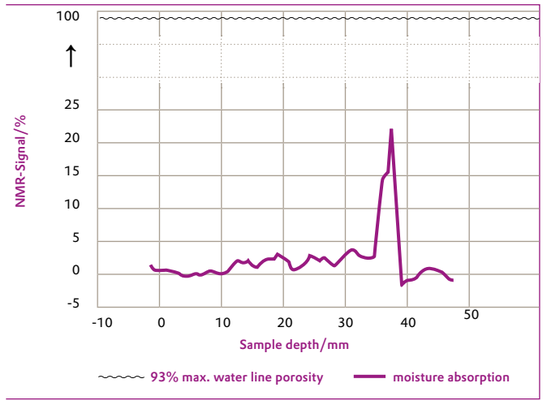
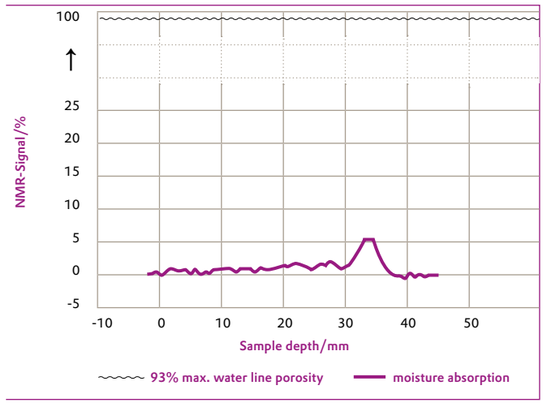


Figure 6
NMR spectrum: Almost gap-free embedding of CALOSTAT® in epoxy resin indicates only small amounts of moisture



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.

Thermal insulation in summer

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.

Figure 7

Temperature-dependent thermal conductivity of various insulating materials

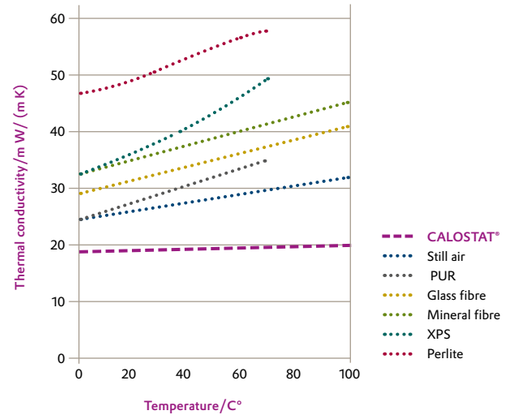


Figure 8

Results of measurements of the thermal conductivity of CALOSTAT®[1]

Mean temperature / °C	Thermal conductivity / W (m K)[1]
10.0 ± 0.4	0.0193 ± 0.0010
60.0 ± 0.6	0.0231 ± 0.0012
110.0 ± 0.9	0.0238 ± 0.0012

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.

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.

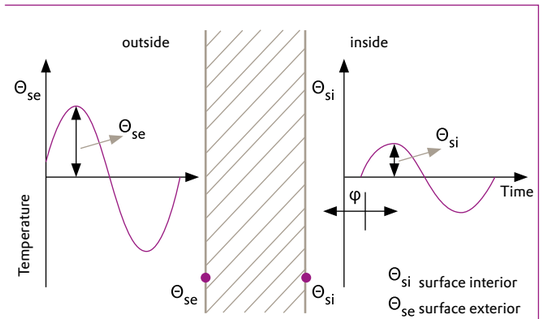
Studies at the “Bayerisches Zentrum für Angewandte Energieforschung (ZAE) in Würzburg, Germany, have shown that CALOSTAT® has a favourable TAR compared to other materials. Temperature transmission through the component to the surface of a CALOSTAT® insulated wall is complete after 8 – 12 h, that is, 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 9

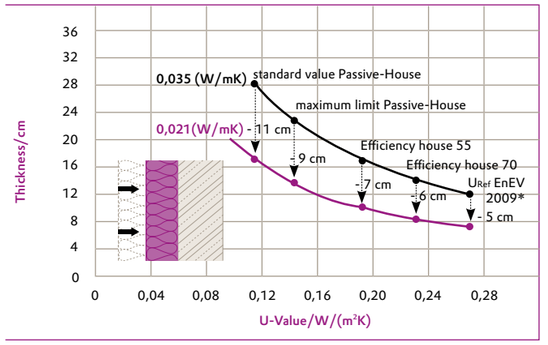
The temperature amplitude ratio (TAR), the result of complex interaction between specific heat-storage capacity, the density of the insulating material and its thermal conductivity



Thermal insulation in winter

Figure 10

The geometrical advantage with CALOSTAT®, as shown by the example of external insulation of a solid wall structure

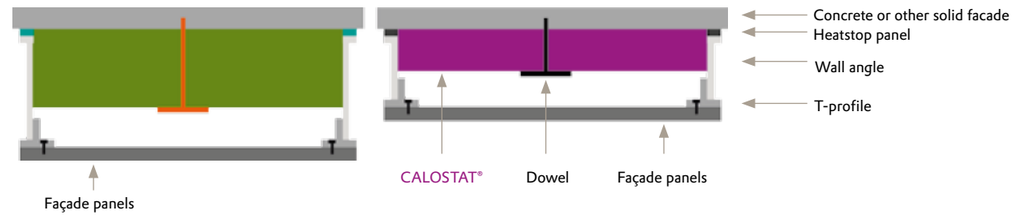


*Energy Efficiency Standard 2009

A thermal conductivity of only 0.019 W/(m K) allows reductions in insulation thickness of up to 50% compared with conventional mineral insulating materials. This in turn opens up additional design options for planners and architects.

Figure 11

Wall thicknesses in a comparison of mineral wool and CALOSTAT® in a solid wall structure



Fire protection

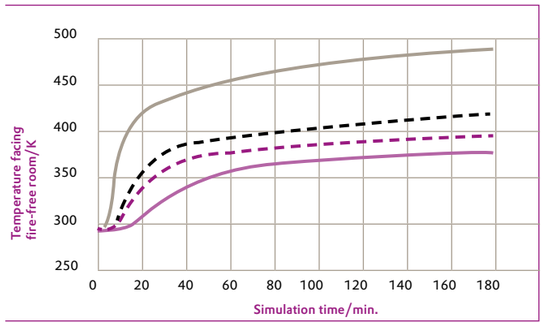
Fire protection requirements for buildings have become more stringent. As a result, stricter requirements are placed on the construction materials themselves as well as on the buildings and their construction.

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]

Figure 12
Heat transfer of CALOSTAT® on its own or in (sandwich) composites



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.

Figure 13
Lifting

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.

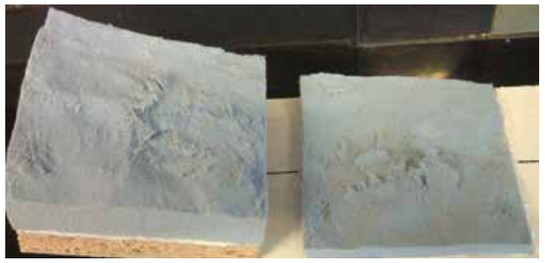
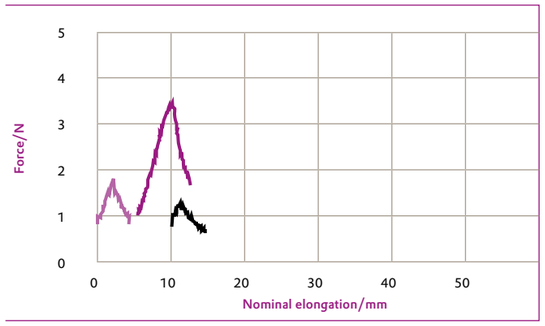


Figure 14
Bonding

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

Figure 15
Force-elongation graph; with the surface adhesive 645 from Ramsauer, for example, the strength achieved is higher than the maximal tensile strength of CALOSTAT®.



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.

Figure 16 a
Apply adhesive filler to the wall over the full area

Figure 16 b
1st layer of CALOSTAT®: bonded

Figure 16 c
2nd layer of CALOSTAT®: pre-boring of dowel holes

Figure 16 d
2nd layer of CALOSTAT®: placing of the dowels

Figure 16 e
CALOSTAT®: applied in a double layer

Machining

CALOSTAT® can be milled with, for example, a 6-mm double-edged carbide cutter.

CALOSTAT® can be sawed with any commercially available saw with a standard saw blade for wood. However, a better result is obtained with a saw blade for carbides.

If a blade or cutter is used, a guide track should be created. Good results for machining of CALOSTAT® are also obtained with a water jet cutter. Adequate dust extraction is necessary when drilling, milling or sawing.

Figure 17
Milling

Figure 18
Sawing

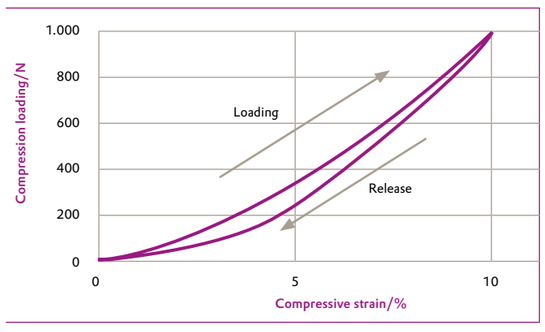
Figure 19
Water jet cutting

Mechanical loading

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.

Figure 20
Cyclic loading of CALOSTAT®



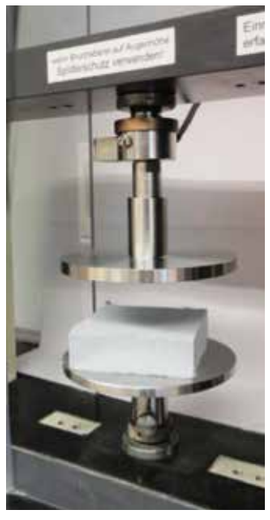


Figure 21
Compression loading

FAQs

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.

In the presence of high dust concentrations a dust mask with P1 particle filter should be worn (see safety data sheet)

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

Packaging and transport

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

[1] ZAE Bayrisches Zentrum für Angewandte Energieforschung, ZAE 2-114-06, report of May 7, 2014

[2] DIBt Deutsches Institut für Bautechnik, Z-23.11-1926, certification of February 12, 2014

[3] Fraunhofer I BP Holzkirchen, SI BP-PR00313052807570, test report of May 28, 2014.

Picture credits

[1] Lüftungs- und Brandschutztechnik Möhnesee GmbH, Spitälerholz 3, D-59519 Möhnesee-Wippringsen

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