

PROMASIL®

Refractory constructions with
PROMASIL®-calcium silicate



PROMASIL® Refractory constructions with PROMASIL®-calcium silicate

PROMASIL® 1000 and 1100 boards are mainly used as back-up insulation for refractory linings in various industrial furnaces.



PROMASIL®- calcium silicate is applied in particular as back-up insulation for refractory bricks and insulation bricks, lightweight refractory linings with a base of ceramic or bio-soluble fibres, refractory concrete, ramming, pouring and malleable mixes.



PROMASIL®1000 en 1100 calcium silicate boards have been developed in particular to reduce the high furnace temperature to an acceptable and secure level by means of a thin insulation layer. The surface temperature of the outside wall may not exceed 50°C or minimum 10% of the operational temperature of the furnace. The afore-mentioned temperature is also referred to as "economic

insulation thickness". The application temperature of PROMASIL® 1000 and 1100 depends on the shrinkage behaviour of the board. At the classification temperature of 1000°C or 1100°C of the boards, the shrinkage after 12 hours may not exceed 2%. For security reasons, PROMASIL® boards which are used as continuous back-up insulation, may not be exposed to more than 900°C for PROMASIL® 1000 and 1000°C for PROMASIL® 1100.

In order to compensate strains as a result of shrinkage, we recommend to apply several layers where a thicker insulation layer is necessary. The boards should be placed with overlapping joints.

The standard boards (1000x500 mm) are glued to the wall and anchored together with the refractory front insulation. The anchoring should be executed according to the standard format of the boards, f.e. with an anchor distance of 500x500 in case of ramming mixes, refractory concrete and malleable mixes and a anchor distance of 1000x1000 mm in case of insulation bricks, provided that the bricks are laid by means of refractory glue. When respecting these distances, the boards can be pressed between the anchors and don't need to be rough-drilled or cut-to-size.

The assembly can be facilitated by using ALSIFLEX® 1000 glue, which has an excellent adhesive strength, in particular when used on steel. The glue will become rock hard and the connection will be ruptured eventually, as a result of the big difference in expansion between the steel board and the glue. PROMASIL® boards are hydrophilic and can be treated with a water-resistant coating in order to prevent them from absorbing the moisture of the refractory concrete.

Exemple of a multilayer wall-system

When long-term use is aimed at, the front side of the wall-system should consist of a ceramic fibre blanket with a density of 128 kg/m³ resp. a PROMAGLAF® HTI board with a density of 200 kg/m³. A possible second layer of PROMAGLAF® HTI can be executed in blankets with a density of 96 kg/m³.

Light-weight systems can only be applied though on a metal sheeting. When the system doesn't fit up directly with the metal sheeting, but is fixed on a steel structure f.e., the combustion gases can penetrate through the fire-resistant wall and corrode the PROMASIL®-calcium silicate partition behind it.

The displacement of air should not exceed 10 m/s when using a system, which is composed of blankets and 20 m/s for systems, which are composed of boards.

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screw thread and matching fasteners. These anchorage systems can also be used to assemble heavy constructions, in case they are not integrated directly in the brickwork/concrete.

Thicker PROMASIL®-calcium silicate insulation systems should be composed of several layers, taking into account that the boards have to be placed with staggered seams. It is important to use a very thin layer on the side of the heat source and use thicker boards for the next layers. This way the board with the lowest thermal load will endure the lowest temperature fluctuations and unidirectional tensions as a result of shrinkage of the insulation layer will be compensated.

If required the standard boards can be cut to size or cut into different shapes on request. These shapes can also be supplied with bevelled edges for the insulation of cylindrical containers with large bores.

PROMABLOCK® 900 and PROMASIL® 1000 boards have a density of approx. 250 kg/m³, which results in a solid, porous structure.

PROMASIL®-calcium silicate does not contain any binding agents, which can degas and cause shrinkage of the insulation.

The refractory system will last considerably longer when PROMASIL®-calcium silicate boards are applied. Furthermore they provide the PROMAGLAF® HTK blankets with a pressure-resistant coating, which enables an optimum tightening of the anchoring.

PROMASIL®-calcium silicate boards are vibration-resistant.

PROMASIL® boards are not only used in light-weight systems as described before, but can also be applied in standard refractory constructions behind brickwork and concrete.

These systems combine the high durability of heavy refractory materials and the excellent insulation characteristics of the lightweight PROMASIL® boards. This combination of PROMASIL® boards and traditional brickwork will lead up to light partitions or less loss of heat Q (W/m²) and a lower outside temperature of the partition. Especially in combination with ramming mixtures, PROMASIL®-calcium silicate boards have proven to have a high pressure-resistance.

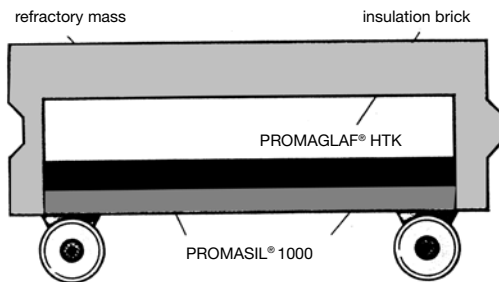
The large dimensions of the PROMASIL®-calcium silicate boards offer a lot of advantages for an easy application when compared to traditional insulation bricks.

PROMASIL®-calcium silicate boards can be worked easily by means of traditional woodworking tools and integrated in most of the existing fastening systems. Lightweight systems are assembled by means of the common anchor pins with bayonet catch and



Promasil in potcells

PROMASIL® Applications



PROMASIL®-calcium silicate for wagons used in tunnel furnaces

■ Objective

A manufacturer of ceramic materials needed to improve the bottom insulation of his tunnel wagons and at the same time reduce the fuel consumption of his installation. Initially the floor of these wagons simply consisted of a 50 mm thick insulation board, filled up with refractory material in order to achieve a total layer of 500 mm. When the temperature in the furnace reached 1350°C, the mathematic temperature at the bottom of the wagons ran up to 191°C. At that point there was a loss of heat Q of 1414 W/m² op. Because of the inside of the furnace being covered with brickwork with a total weight of 2221 kg, the heat content of the wagons after a normal cooling-off period still amounted to ca. 382 kW.

■ Result

When using PROMASIL®-calcium silicate, the bottom insulation of the wagons will be composed as shown below:

• Loss of heat Q	=	713 W/m ²
• Loss of heat per wagon	=	1.640 W
• Temperature of the furnace t_1	=	1.350 °C
• Ambient temperature t_a	=	50 °C
• Outside temperature of the wall t_1	=	131 °C
• Weight brickwork	=	1.380 kg
• Amount of heat	=	248.080 W

■ Result

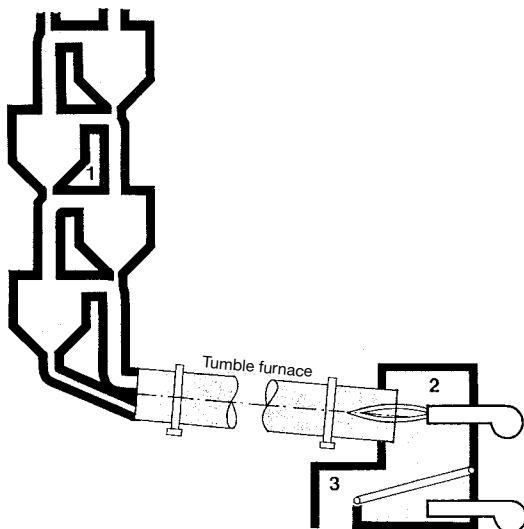
• Reduction in loss of heat	=	50 %
• Reduction in amount of heat	=	35 %
• Reduction in weight	=	38 %

In addition to the improvement of the values as listed above, the wagons have a higher wear-resistance thanks to the dilatation joints between the various layers.

PROMASIL®-calcium silicate in the cement industry

In the cement industry PROMASIL®-calcium silicate is used in following applications:

1. In cyclone heat exchangers and its accessory ducts: PROMASIL® 1000 segments
2. As ceiling and wall insulation of the main burner: PROMASIL® 1100 and PROMASIL® 1000
3. As ceiling and wall insulation of the clinker-cooler unit: PROMASIL® 1000 boards

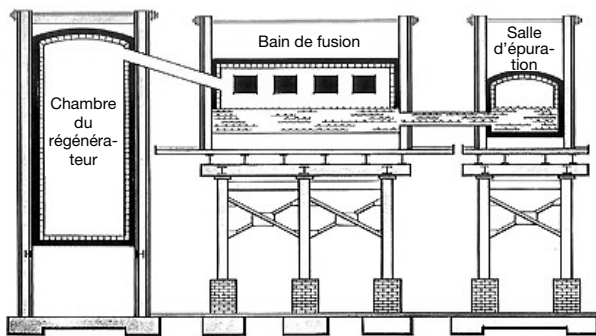


PROMASIL® Applications

PROMASIL®-calcium silicate in the glass industry

In the glass industry PROMASIL®-calcium silicate is being used in following applications:

1. As back-up insulation in the regenerator unit
2. As back-up insulation in the space above the fusion bath
3. As back-up insulation against radiant heat above the fusion bath
4. As back-up insulation in the space above the purification unit
5. As back-up insulation in the floatbath and cooling gallery



Inside view of a ethylene cracking unit with burners and penetrations



Insulation in fires and stoves

PROMASIL®-calcium silicate in the aluminium industry

In the aluminium industry PROMASIL®-calcium silicate products are used in various applications as back-up insulation in addition to refractory concrete or PROMATON® lightweight refractory bricks f.e. in melting and holding furnaces and in electrolysis cells.

We also refer to PROMASIL® in potcells and applications in the aluminium industry.

PROMASIL®-calcium silicate in fires and stoves

Promasil® calcium silicate is also being used as secure back-up insulation in fires and stoves in order to avoid that the temperature of the brick wall behind the fire rises too high.

We also refer to our brochure "Insulation in fires and stoves"

PROMASIL®-calcium silicate in the petrochemical industry

An oil refinery is a huge industrial complex, where crude oil is being converted into more than 2.000 different products. It contains furnaces, reactors and a complex network of ducts for cold and hot gasses.

PROMASIL®-calcium silicate is often used here as back-up insulation in the various furnaces and cracking units, as well as insulation for ducts, containers and appliances.



Hydrogen reformer

PROMASIL® Applications



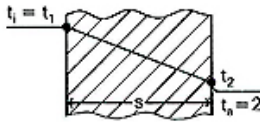
PROMASIL®-calcium silicate as strips, segments or shells for ducts and appliances

Shells, strips or segments with bevelled edges are used for the thermal insulation of cylinder-shaped surfaces. The dimensions are based on the diameter and required insulation thickness and can be calculated on the basis of the table below. Of course we can also provide you with segments for other diameters and thicknesses as well as cut-to-size segments in accordance with the curvature of the duct or appliance.

Temperature drop in PROMASIL®-calcium silicate boards

The table below contains the temperature on the cold side t_2 , determined for each of the inside temperatures t_i and insulation thicknesses s when PROMASIL®-calcium silicate is used. The ambient temperature is determined at $t_a = 20^\circ\text{C}$. The values are calculated by means of the formula below:

$$Q = \frac{t_i - t_a}{\frac{1}{\alpha_i} + \frac{s}{\lambda} + \frac{1}{\alpha_a}}$$



Since PROMASIL®-calcium silicate boards are used as back-up insulation, the t_i -temperatures are also the contact temperatures t_1 . These calculations of the degree of heat transmission don't take into account the heat transmission coefficient α_i . The heat transmission coefficient on the outside is determined by means of the formula $\alpha_a = 12 \text{ W/m}^2\text{K}$. The thermal conductivity coefficient α for the average temperatures $t_m = (t_1 + t_2)/2$ is determined by means of the data, which are listed in the PROMASIL®-calcium silicate technical data sheet.

Insulation thickness	t_2	Q	Insulation thickness	t_2	Q	Insulation thickness	t_2	Q	Insulation thickness	t_2	Q	
mm	°C	W/m ²	mm	°C	W/m ²	mm	°C	W/m ²	mm	°C	W/m ²	
100	25	35,3	134,5	30	33,3	115,2	40	30,7	89,6	50	28,9	73,3
200	30	50,2	298,0	40	44,4	230,7	50	40,5	188,4	65	36,6	147,8
300	40	59,0	405,4	50	53,0	330,5	65	46,9	258,9	75	43,9	226,3
400	50	66,4	501,2	65	58,0	392,2	75	54,0	342,6	100	47,0	260,4
500	65	69,9	549,0	75	64,7	479,3	100	55,7	364,1	125	49,9	293,6
600	75	76,1	637,7	100	65,1	484,1	125	57,8	390,2	150	52,7	326,9
700	100	75,0	621,1	125	66,4	500,4	150	60,1	419,2	175	55,4	360,8
800	100	85,5	775,9	125	75,2	625,2	150	68,1	523,4	200	58,2	395,1
900	125	84,7	764,8	150	76,4	640,2	175	70,1	550,7	200	64,9	483,4
1000	150	85,1	770,5	175	78,0	662,4	200	72,2	581,1	250	63,8	466,7

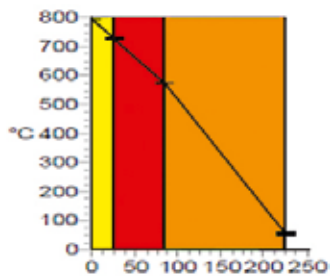
PROMASIL® Applications

Composition of a partition in Promat HTI-materials and heat transmission

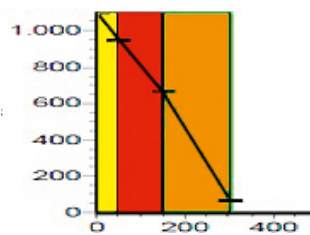
The drawing below shows an exemple of how to determine the temperature on the cold side t_4 and the loss of heat Q for each inside temperature t_1 and insulation thickness s in case of a partition, which is composed of three layers. The ambient temperature is set at $t_a = 20^\circ\text{C}$. The values are calculated by means of following formula:

$$Q = \frac{t_1 - t_a}{\frac{1}{\alpha_i} + \frac{s}{\lambda} + \frac{1}{\alpha_a}}$$

	PROMAGLAF® HTI Board S_1 mm	t_2 °C	Promasil 1000 S_2 mm	t_3 °C	Promalan HT 150 S_3 mm	t_4 °C	Total thickness S mm	Q W/m ²
400	10	355,0			60	53,5	70	338,1
500	20	420,0	25	351,0	65	50,9	110	306,8
600	25	509,0	25	429,0	80	55,0	130	354,4
700	25	621,0	50	481,0	100	54,6	175	350,4
800	25	728,0	60	578,0	140	55,1	225	357,5



■ 25 mm PROMAGLAF® HTI board
■ 60 mm PROMASIL® 1000
■ 140 mm PROMALAN® TH 150



■ 50 mm PROMAGLAF® HTI board
■ 100 mm PROMASIL® 1000
■ 150 mm PROMABLOCK® 900

	PROMAGLAF® HTI Board S_1 mm	t_2 °C	Promasil 1000 S_2 mm	t_3 °C	Promablock 900 S_3 mm	t_4 °C	Total thickness S mm	Q W/m ²
900	25	821,0	75	608,0	140	61,5	240	436,9
1000	40	878,0	90	623,0	140	62,9	270	455,9
1100	50	951,0	100	669,0	150	65,2	300	484,6

All data in this document are based on our present knowledge and reported in good faith. We are always at your disposal for further advice. We decline any responsibility for the suitability of our products according to the required application standards for specific applications and for the entirety of our advice. Moreover we decline any responsibility for a possible restriction of the patent right of third parties, caused by the use of our products.

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