RHI MAGNESITA

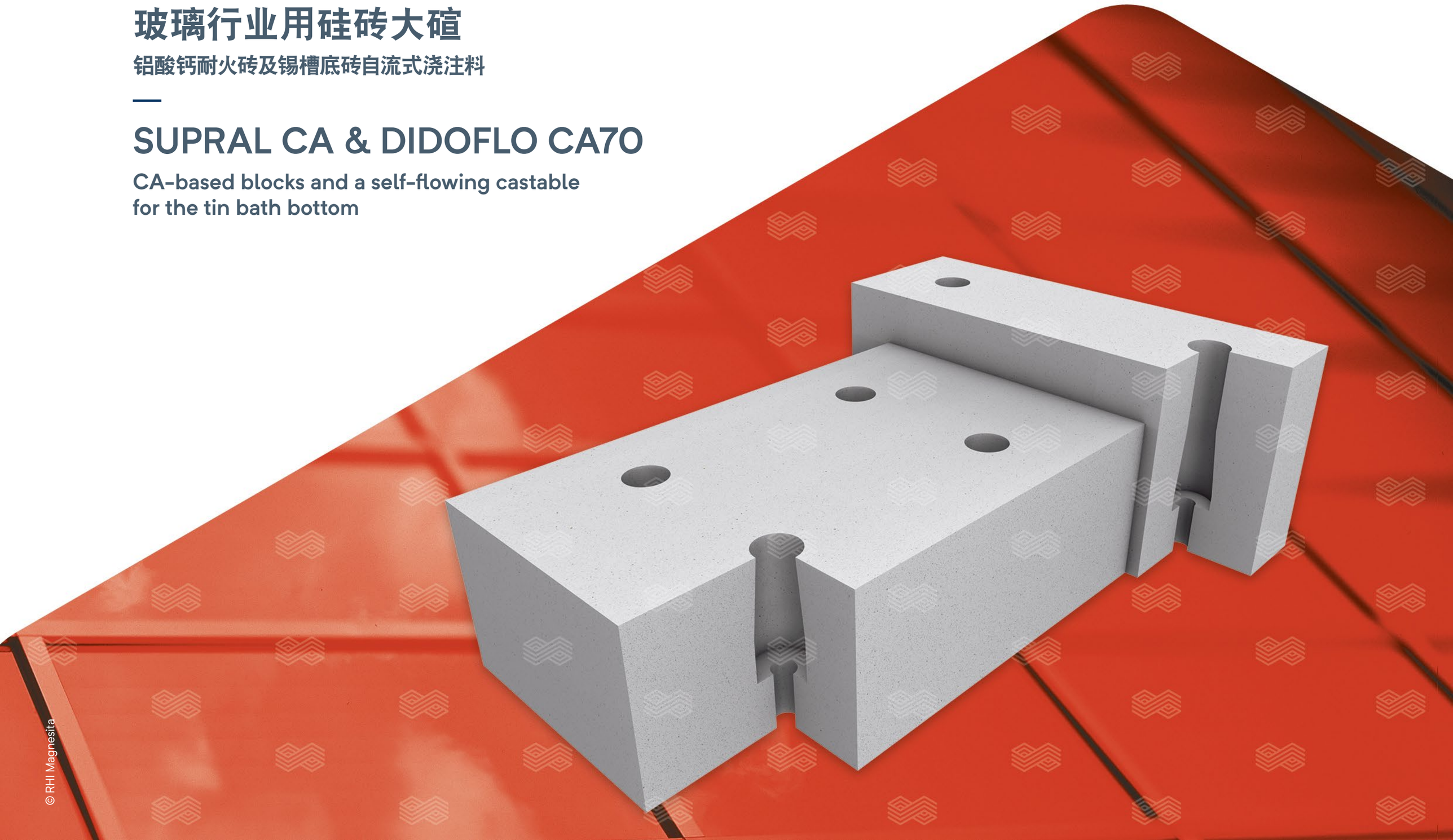
GLASS / SUPRAL CA & DIDOFLO CA70

玻璃行业用硅砖大碹

铝酸钙耐火砖及锡槽底砖自流式浇注料

SUPRAL CA & DIDOFLO CA70

CA-based blocks and a self-flowing castable for the tin bath bottom



There for you, wherever you need us

RHI MAGNESITA

The more closely we work with our customers, the greater the impact we can make for them. So a global network of offices, research centers, and production sites is important to us, and to them. We are continuously extending our global reach to be closer to even more customers.

Being closer to customers doesn't just mean we can be more responsive to their needs. It also helps us to listen better — to understand their concerns, cultures and ways of working. It makes us alert to new ways of thinking and ideas that enable us to deliver even better advice, services, and solutions.

Our exceptional resources and expertise extend far beyond making and selling products. We provide solutions to customers worldwide for cover projects, material specifications, thermal studies, numerical simulations, follow-ups and technical support in application of minerals, and maintenance and electromechanical services for refractory equipment.

35
Main production and raw material sites

70
Sales offices

180
Countries shipped to worldwide

We are RHI Magnesita

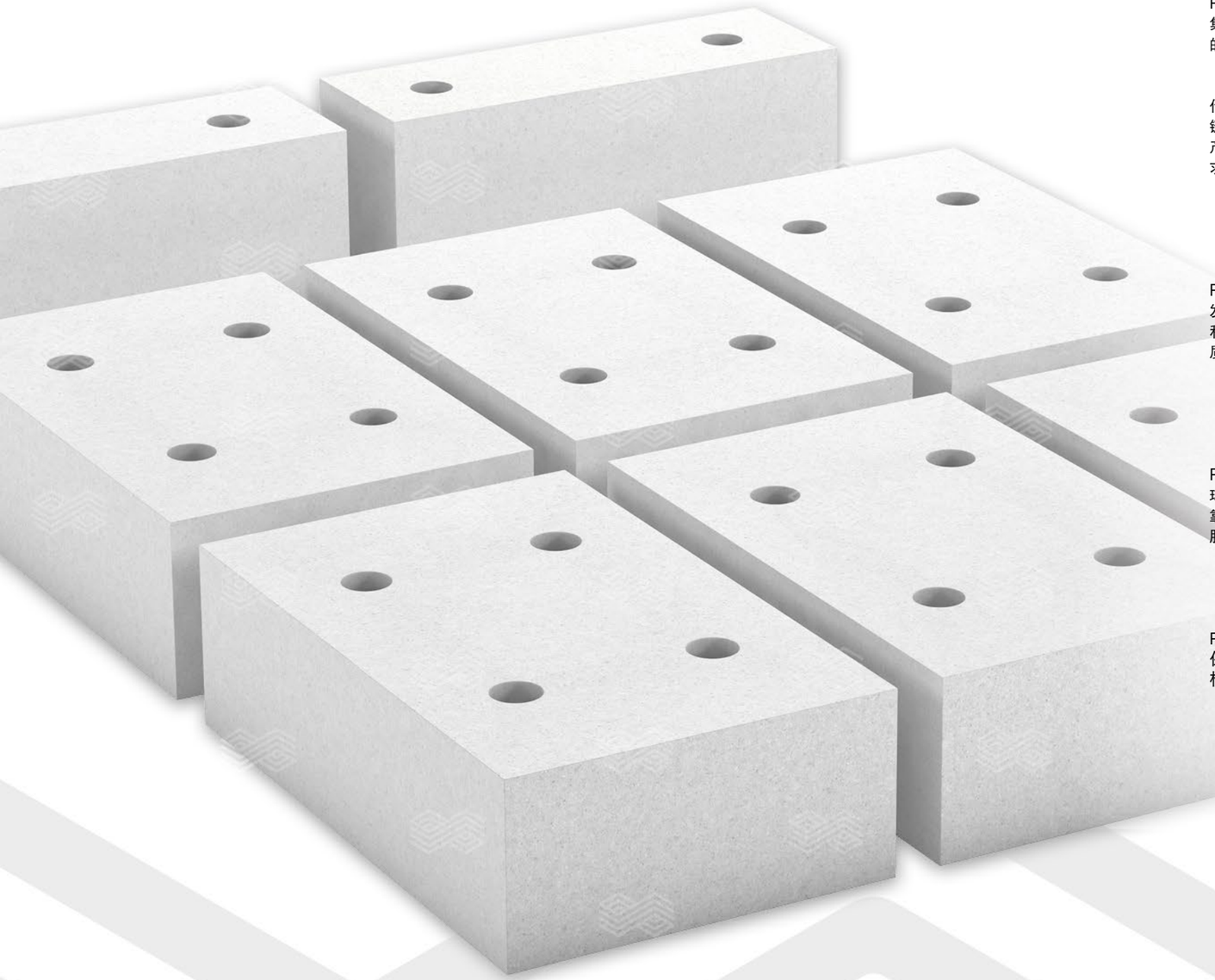
An innovative and reliable partner of the glass industry

SUPRAL CA: Calcium aluminate based blocks

DIDOFLO CA70: A Self-Flowing Castable for Studhole Filling

Tin Bath Bottom

Example of Application



我们是
奥镁

玻璃行业的可靠创新型合作伙伴

RHI Magnesita是全球耐火材料领军企业，凭借其遍布四大洲的密集销售和服务网络以及35个主要生产基地，成为玻璃行业超越百年的可靠合作伙伴。

作为全球领先的耐火材料生产商，RHI Magnesita参与到整个产业链从研发、精心挑选原材料到最高质量标准的现代制造、以及技术产品和工艺技术等各个方面。 RHI Magnesita可以根据特定客户需求提供优质耐火产品和服务。

RHI Magnesita在四大洲设立研发和研究中心，拥有业内最大的研发团队，研发人员数量达到250多名。RHI Magnesita每年在产品和服务创新方面的投资远超任何其他竞争对手，从而保证最高产品质量和持续创新能力，满足玻璃行业不断增长的需求。

RHI Magnesita的工业项目工程事业部专注于全球玻璃业务，其全球销售和服务网络以及专业技术员工能为客户提供业内最佳和最可靠的服务，可根据客户需求定制解决方案，并为客户提供紧急情况服务支持。

RHI Magnesita通过为客户提供资源友好型生产和节能配置，为保护环境做出积极贡献。RHI Magnesita在全球设立的工厂都严格按照ISO认证的环境和质量保证标准进行生产。

We are
RHI Magnesita

An innovative and reliable partner of the glass industry

RHI Magnesita is the global leader in refractories. With the densest sales and service network and 35 main production sites on four continents, the Group has been the reliable partner of the glass industry for far more than 100 years.

As the globally leading refractory producer, RHI Magnesita covers all steps along the entire value chain, ranging from research and development and its own, carefully selected raw materials to modern manufacturing based on the highest quality standards, and technical product and process know-how. RHI Magnesita offers premium refractory products and services for specific customer needs from one source.

With more than 250 employees in research and development and research centers on four continents, RHI Magnesita has the largest research team in the industry. Every year, RHI Magnesita invests more than any other competitor in product and service innovations, thus guaranteeing the highest product quality and continuous innovation in order to meet the increased requirements of the glass industry.

RHI Magnesita concentrates its worldwide activities for the glass industry in the BU Industrial Projects. The global sales and service network and employees with excellent technical know-how provide the best and most reliable service in the industry and are always available to develop solutions for special customer requirements and to support them in urgent cases.

RHI Magnesita makes a proactive contribution to protecting the environment through resource-friendly production and energy-efficient lining concepts for the customers. Our plants all over the world manufacture in accordance with ISO-certified environmental and quality assurance standards.

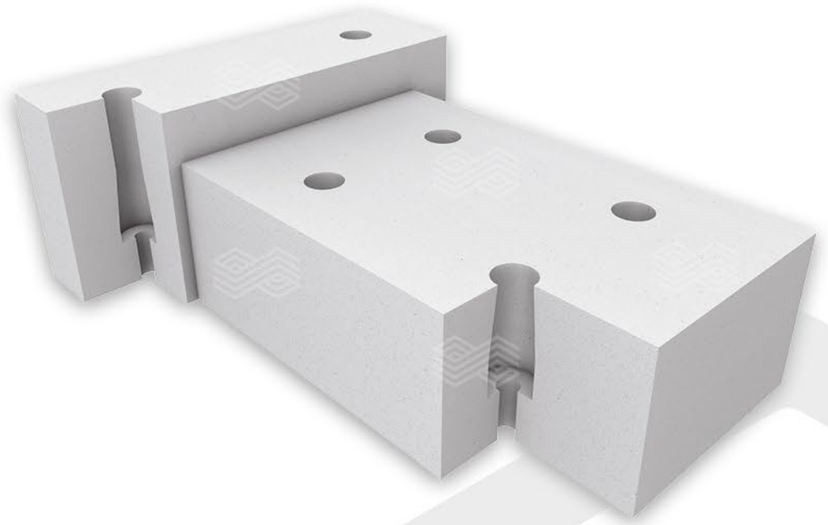
SUPRAL CA & DIDOFLO CA70

背景

锡槽是浮法玻璃生产线的核心部分。自20世纪80年代初，已开始采用氧化铝含量达到38-40%（重量）的耐火粘土锡槽底砖，但是长期运行后，会出现霞石剥离（$Na_2O{\cdot}Al_2O_3{\cdot}2SiO_2$）现象。

此外，今天用于填充底块螺柱孔的捣打料具有诸多缺点，因为手工捣打劳动量较大。而且捣打料容易出现霞石剥离现象。

为防止出现上述问题，RHI Magnesita研发了铝酸钙底砖（SUPRAL CA）和铝酸钙自流式浇注料（DIDOFLO CA70）。



SUPRAL CA & DIDOFLO CA70

Background

The tin bath is the core of every float glass line. Fireclay tin bath bottom blocks with an alumina content of 38—40% by weight have been used since the beginning of the 1980s. Nepheline peeling ($Na_2O{\cdot}Al_2O_3{\cdot}2SiO_2$) can occur during a long campaign.

In addition, the ramming mixes used today to fill the stud holes in the bottom blocks have disadvantages because hand ramming requires significant manual labor. Furthermore, these mixes also have a nepheline peeling tendency.

To circumvent the aforementioned problems, RHI Magnesita developed calcium aluminate based bottom blocks (SUPRAL CA) and a calcium aluminate based self-flowing castable (DIDOFLO CA70).

SUPRAL CA:
铝酸钙耐火砖

SUPRAL CA主要采用铝酸钙制作，能够满足以下各种重要锡槽底砖要求：

- 不会与锡发生化学反应
- 不会与锡槽中的碱溶液发生反应
- 不影响锡槽中的还原气体
- 热膨胀率与耐火粘土砖相等。因此，如采用SUPRAL CA替换耐火粘土砖，则不需要修改伸缩缝设计。
- 与耐火粘土材料相比，其导热率更低。
- 应用温度高达1200 °C，而当温度达到1100 °C时氧化铝含量38-40%的耐火粘土砖就会发生蠕变。
- 氢渗透性 – 某些浮法玻璃生产商的“热发散”工艺需要较低水平的氢渗透性。

在2005年，SUPRAL CA首次安装用于锡槽。从那时起，SUPRAL CA已被安装于30多个锡槽。到目前为止，尚未观察到霞石剥离问题。

迄今为止，几家世界主要浮法玻璃制造商均已采用SUPRAL CA锡槽底砖。

通过将样品底砖安装在锡槽热间使用三年，已经证明SUPRAL CA与碱之间几乎不会发生反应。该底砖的化学分析显示不存在任何明显碱吸收，并且整体外观也无明显反应迹象。该现场测试结果可以证实以下实验室碱吸收测试结果。

SUPRAL CA:
Calcium aluminate based blocks

SUPRAL CA consists mainly of calcium aluminate and fulfills all the important requirements of tin bath bottom blocks including:

- No chemical reaction with tin
- No reaction with alkalis dissolved in the tin bath
- No influence of the reducing atmosphere present in the tin bath
- Thermal expansion comparable to fireclay blocks. Therefore, the design of the expansion joints need not be modified in the case of replacing the fireclay with SUPRAL CA.
- Thermal conductivity is lower compared to fireclay material.
- Application temperature up to 1200 °C, whereas fireclay with 38—40% Al_2O_3 starts to creep at 1100 °C.
- The hydrogen diffusivity — a characteristic that is required by some float glass producers due to so-called “thermal transpiration” process — is at a low level.

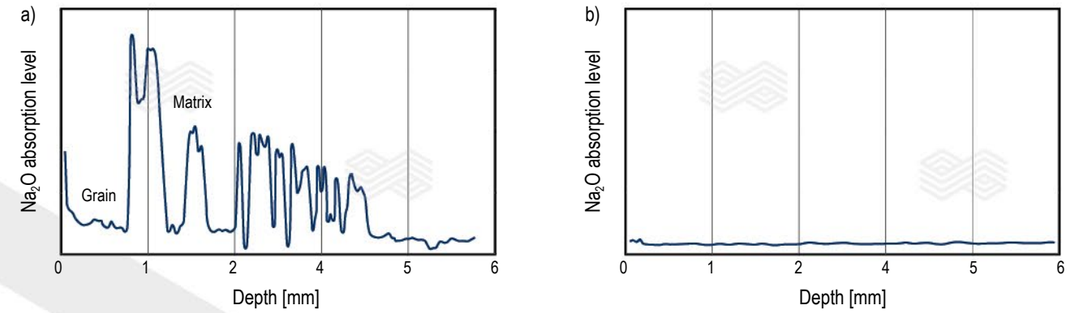
The first start-up of a tin bath equipped with SUPRAL CA was in the year 2005. Since then, SUPRAL CA has been installed in more than 30 tin baths. Problems regarding nepheline peeling have so far not been observed in any of those cases.

By now, several leading float glass makers around world regularly operate with SUPRAL CA tin bath bottom blocks.

The low reaction potential between SUPRAL CA and alkalis has been proven on a sample brick, which was installed in the hot bay of a tin bath for three years. The chemical analysis of this brick does not show any significant absorption of alkalis and the macroscopic appearance is inconspicuous as well. This field test confirms the lab test regarding the alkali absorption below.

Na_2O吸收曲线
(a) 耐火粘土砖
(b) SUPRAL CA

Na_2O absorption curve
(a) Fireclay blocks
(b) SUPRAL CA



Grade	Al_2O_3	SiO_2	Fe_2O_3	CaO	MgO	BD	AP	CCS
	%	%	%	%	%	g/cm³	vol.%	MPa
SUPRAL CA	68.0	5.0	0.1	24.4	1.3	2.36	18.0	80

AP 显气孔率 / Apparent porosity
BD 体积密度 / Bulk density
CCS 常温抗压强度 / Cold crushing strength
Depth / 深度
Grade / 牌号
Grain / 粒度
Matrix / 基质
Na_2O absorption level / Na_2O-吸收水平

DIDOFLO CA70:
填充螺柱孔的自流式浇注料

目前使用硅酸锆捣打料填充锡槽螺柱孔。人工捣打螺柱孔费时费力。此外，由于在捣打过程中会产生振动，无法进行其他安装工作。为解决以上困难，RHI Magnesita研发了自流式浇注料来填充螺柱孔。

DIDOFLO CA70可以安装用于两种常见锡槽底砖（耐火粘土或铝酸钙耐火砖）。

产品

DIDOFLO CA70产品是采用铝酸钙、氧化铝和氧化锆莫来石制作的低水泥浇注料耐火砖，其化学成分可参见下表。

在研发过程中，我们注意适应锡槽底砖材料的热膨胀，避免底砖和捣打料之间形成未密封的接缝。

DIDOFLO CA70: A Self-Flowing Castable for Studhole Filling

To fill the stud holes of a tin bath, ramming mixes based on zirconium silicate are currently used. Hand ramming each hole means a lot of effort. Furthermore, no other installation work is possible during the ramming procedure due to the vibration caused by the ramming machine. Due to these difficulties RHI Magnesita developed a self-flowing castable to fill the stud holes.

DIDOFLO CA70 can be installed with both commonly used types of tin bath bottom blocks (fireclay or calcium aluminate).

The product

DIDOFLO CA70 is a low-cement castable based on calcium aluminate, alumina and zirconia mullite. The chemical composition is given in the table below.

In the development, attention was placed on adapting thermal expansion to that of the tin bath bottom brick material. Thus the formation of open joints between brick and mix is avoided.

Grade	Al_2O_3	SiO_2	Fe_2O_3	ZrO_2	MgO	CaO	GS	MR	FB 1000 °C	ML	AW	Bonding
	%	%	%	%	%	%	mm	kg/dm³	%		l/100 kg	
DIDOFLO CA70	70.0	5.0	0.1	9.2	1.2	14.0	0-3	2.65	0.1	H_2O	7.0-7.5	Hydraulic

Bonding / 粘结
Grade / 牌号
Hydraulic / 液压
AW 含水量 / Amount of water
FB 燃烧行为 / Firing behavior
GS 粒度 / Grain size
ML 混合液 / Mixing liquid
MR 材料要求 / Material requirement

安装

DIDOFLO CA70 必须在现场浆式搅拌机中与水混合。它可以直接浇铸到孔中而不会发生夯实，因为不需要致密化能量。

我们建议使用进料头来填充孔。之后可以使用适合的磨削工具轻松移除溢出物。

Installation

DIDOFLO CA70 has to be mixed with water in a paddle mixer on site. It can be cast directly into the holes without ramming as no energy for densification is necessary.

We recommend using a feeder head to overfill the holes. The overfill can later easily be removed with an adapted grinding tool.

固化

固化时间非常短，浇注料会快速硬化。

DIDOFLO CA70的粒度分布、细粉和外加剂可确保浇注料自流动、自流平和自脱气压实。浇注料固化后，DIDOFLO CA70的微观结构非常均匀致密。在固化过程中不会出现裂缝。

Setting

The setting time is very short — the castable hardens very quickly.

The grain distribution, fines and additives of DIDOFLO CA70 enable a self-flowing, self-leveling and self-degassing compaction. After setting, the micro-structure of DIDOFLO CA70 is very dense and homogeneous. No cracks occur during the setting process.

使用期间

耐锡渗透
在进行实验室杯试验（温度：1050 ℃，时间：4小时）后，未检测到锡渗透（见左下图）。

耐碱腐蚀
根据ASTM C987-88要求，采用碳酸钠在温度1200 ℃进行120小时的试验，样品显示出铝酸钙的典型行为：未发现裂缝、腐蚀或渗透现象（见右下图）。

使用温度
为模拟高温下产品特性，在温度1150 ℃和1250 ℃时对样品进行烧制。 完成烧制后，DIDOFLO CA70未发生收缩或膨胀。 由于其体积稳定，不会影响接缝或产生裂缝。 因此，DIDOFLO CA70也可安装用于比平时温度更高的锡槽。

参考数据
DIDOFLO CA70已自2011年起上市销售。

During application

Resistance to tin
After a cup test in the laboratory (1050 °C, 4 hours) no infiltration of tin was detected (see picture below left).

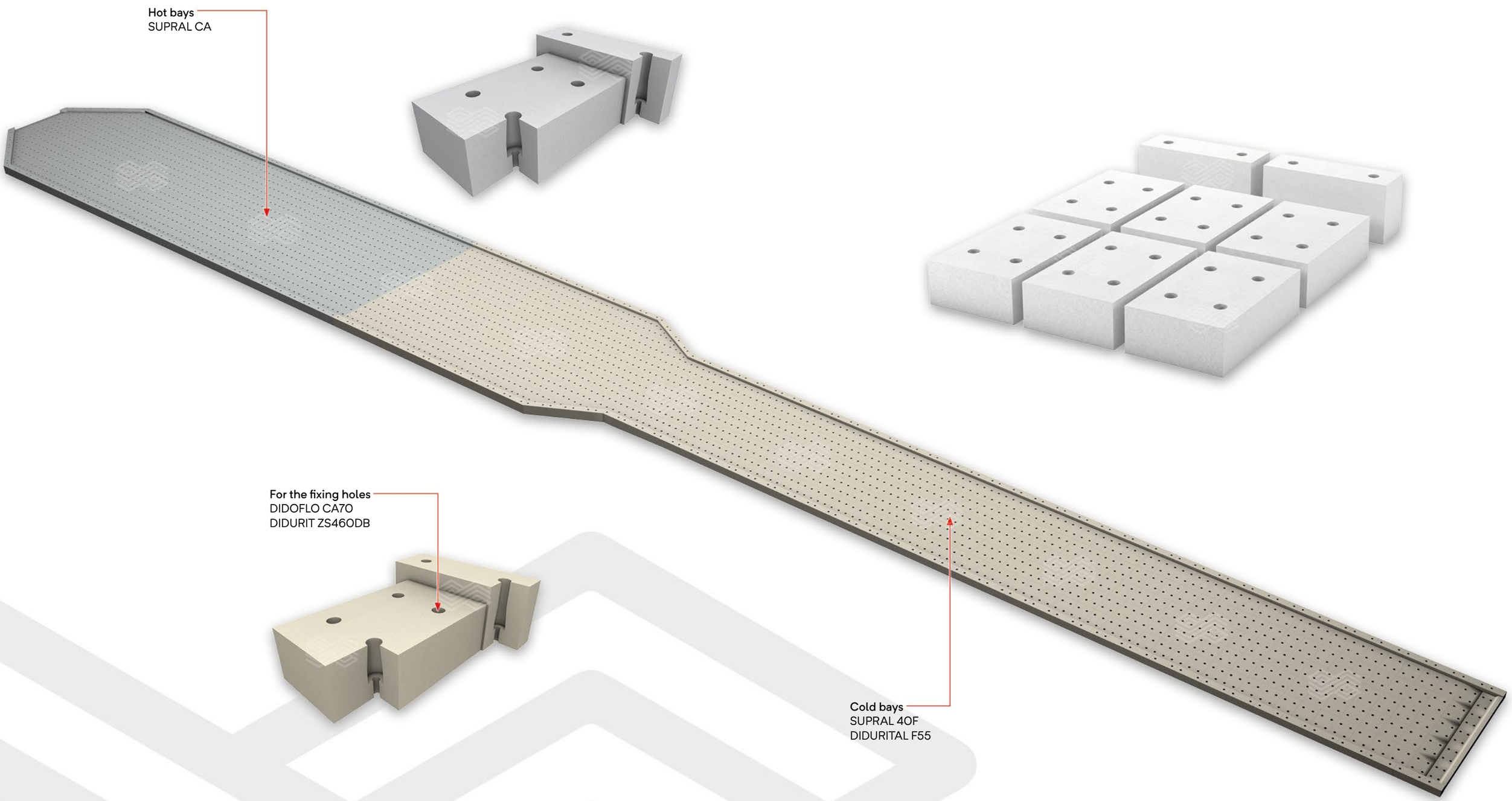
Resistance to alkali attack
In a second cup test with Na_2CO_3 at 1200 °C / 120 h according to ASTM C987-88, the samples showed typical behavior of calcium aluminate: No cracks were visible; neither corrosion nor infiltration was seen (see picture below right).

Service temperature
To simulate the behavior at high temperatures, samples were fired at 1150 °C and 1250 °C. After firing, DIDOFLO CA70 showed no shrinkage and no growth. Due to the volume stability no joints and no cracks occurred. DIDOFLO CA70 can therefore also be installed in tin baths operating at higher temperatures than usual.

Experience
DIDOFLO CA70 has been sold regularly since 2011.

锡槽底砖

Tin Bath Bottom



应用示例

DIDOFLO CA70填充锡槽底砖的螺柱孔：

- 在螺柱孔顶部设置漏斗
- 完成混合后，将混合物浇注到螺柱孔中

等待30–70分钟后（根据工作温度）：

- 去掉漏斗
- 混合物均匀覆盖到锡槽底砖的工作面。

成品状况：

Example of Application

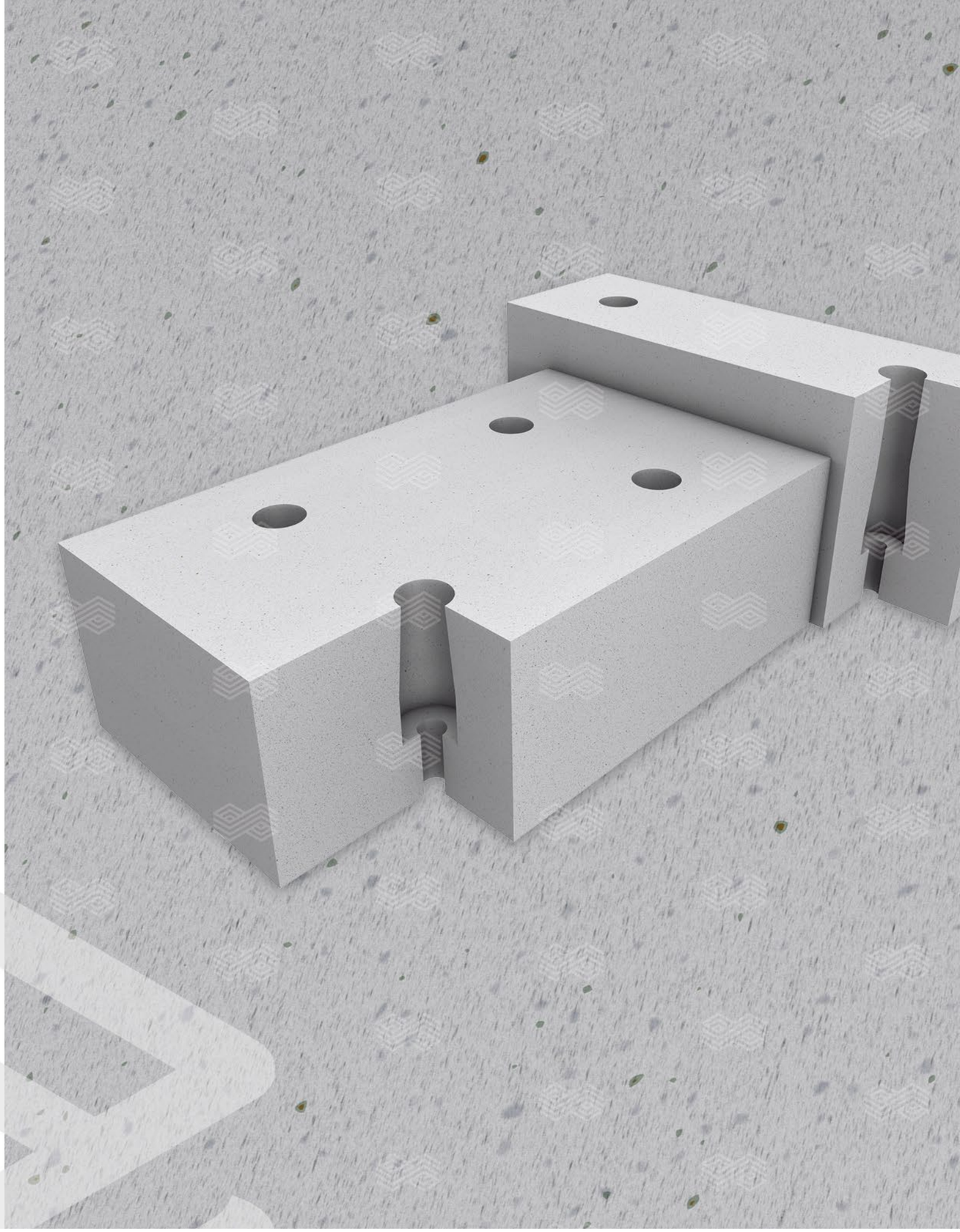
For filling the stud holes of the tin bath bottom blocks with DIDOFLO CA70:

- Set a funnel on the top of the stud holes
- After mixing, cast the mix into the stud holes

After a duration of 30—70 min
(depends on the working temperature):

- Remove the funnels
- Smooth the mix to the level of the working face of the tin bath bottom block.

Final situation:



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