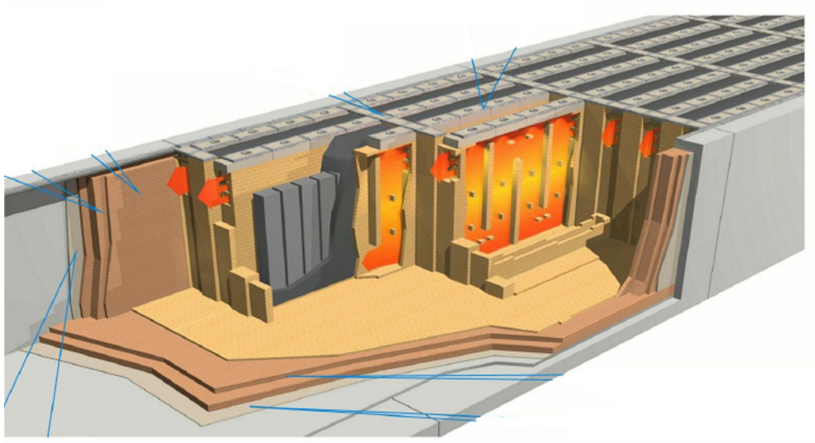
Case Study: Superwool® Prime for Expansion Joints in Anode Baking Furnace



Industry: Aluminium
Application: Expansion Joints
Product Solutions: Superwool Prime Blanket
Location: Europe

August 2021

The Challenge

A Primary Aluminium Producer, based in Europe is operating an Anode Baking Furnace (ABF) with standard operating temperatures of 1100 - 1200°C (2012°F - 2192°F) but able to increase to 1240°C (2264°F) as required.

These operating temperatures conventionally use high temperature insulation solutions like Refractory Ceramics Fibre (RCF) and >1300°C (>2372°F) rated Low Biopersistent Fibres (LBP) used as a packing material in the expansion joints.

Around the world, we are seeing countries moving away from using RCF fibres due to the environmental and health safety (EHS) concerns, opting for newer developed LBP fibres that are fit-for-purpose material solutions in these applications.

Regardless of chemistry, the key property of the fibrous insulation is resilience at high temperatures. An ability to withstand compression from the pit walls expanding and return to its original strength once the compression is removed. Often, materials will disintegrate and fall from the expansion joints, which obviously counts as a failure.

This Primary Aluminium Producer is currently using an over-specified solution to avoid the risk of failure at the expansion joints. This product is a Magnesium-Silicate, 13mm thick, 128kg/m^3 density blanket with a materials classification temperature of 1400°C (2552°F).

Application Overview

A European Primary Aluminium Producer annually makes on average 160,000 tonnes of aluminium ingot, slabs and coils. This Producer, like other primary aluminium companies use the open top Anode Baking Furnace (ABF) to fire graphite anode blocks for intended use in the pot-cell method of aluminium manufacturing.

Figure 1

The pit walls in the ABF (Figure 1) are manufactured from dense refractories and insulating bricks. Unfired anode blocks comprised of coke and pitch are lowered into the pits and completely covered with powdered coke.

The coke's purpose is to:

1. Prevent the anode blocks from oxidising
2. Create a negative pressure inside the pits which allows the heat to propagate from one section to the next through channels (Figure 1)

Dense refractories in the pit walls undergo thermal expansion upon heating; therefore, a gap is left where the refractories meet, e.g. the corners. To prevent thermal inefficiency and loss of negative pressure, respectively, fibre is conventionally packed into expansion joints. The width of joint varies but generally a 50mm width blanket is folded into a 'U' shape and inserted into a 20-25mm gap. This Primary Aluminium Producer performs regular maintenance manually, when the furnace is still warm.

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Thermal Ceramics is a business of Morgan Advanced Materials

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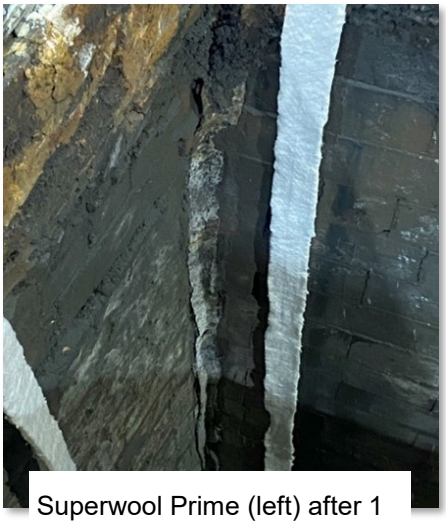
Operator handling Superwool Prime

Superwool Prime installed into expansion joints



Superwool Prime (left) after 1 baking cycle and a second layer (right)

The Solution

This Primary Aluminium Producer was approached by Morgan Advanced Materials to trial Superwool Prime Blanket as an alternative to their incumbent, Magnesium -Silicate Blanket.

Superwool Prime was recommended given its superior thermal conductivity and high tensile strength compared to the Magnesium-Silicate Blanket. The increased thermal performance of Superwool Prime will prevent less heat being lost between pit walls and the high tensile strength will allow for easier installation in the tight gaps without risk of tearing.

The Producer advised the insulation is used for a maximum of 2 baking cycles – equating to 880 hours or 36 days and never previously used further, regardless of the condition, due to the risk of coke impregnating the joints and damaging the refractory walls. Superwool Prime Blanket, 128 kg/m^3 density, 13mm thickness was installed in strips ranging from 20mm to 50mm on 5 August 2021.

On first impression, an operator shared,

> *"We were satisfied with the material quality and handling was also ok – no tearing while cutting or installing etc."*

Customer Impact

The Anode Baking Furnace was in operation for 18 days (1 baking cycle) before the first inspection performed on 23 August 2021. Our Customer shared these initial findings,

> ***"We couldn't see anything wrong to be honest. Material was holding tight in joints, it was not torn up. In some wide-opened joints we kept the original layer in the joints (if it was in good condition) and add another layer to insulate the joints to avoid any leaks".***

In this application, assessing thermal performance of a material is difficult, but in terms of success or failure, Superwool Prime Blanket withstood the expansion and was able to be reused for a second baking cycle in some areas. When asked if Superwool Prime Blankets works better or worse than the incumbent Magnesium-Silicate Blanket, the Customer stated,

> ***"I can only confirm that your material can withstand our baking cycle with results comparable to our currently used material."***

Superwool Prime has a far superior thermal conductivity compared to the incumbent Magnesium-Silicate 1400, 0.28 versus 0.43 W/m•K at 1000°C, 128kg/m^3 density.

With the successful trial, we are scheduling further transition to the Superwool Prime Blanket in H2 2022.

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