SEVEN REASONS TO INSTALL
PRIMETALS TECHNOLOGIES STAVES

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WELCOME

I'm Ed Long and I have one of the best jobs in the world! In my role I get to travel the world, meet knowledgeable people and visit numerous steel plants which never cease to impress me. But the most rewarding part is the chance to help blast furnace operators improve and optimize their operations. I get to solve problems with blast furnace cooling systems and develop innovative technical solutions which deliver real tangible benefits.

I'm often asked questions like "Where have you installed this technology before" and " how do you know your staves will last when others have failed" or "What is causing my staves to bend" so I thought I'd put together a short e-paper to answer some of these questions.

This collection of mini case studies highlights how my Primetals Technologies colleagues and I have worked with six different blast furnace operators to solve cooling difficulties they have had due to stave bending and stave wear. Our technologies have enabled them to compete full campaigns, reduce costs and eliminate maintenance.

I hope you enjoy reading."

Ed Long
Blast Furnace Cooling Expert, Primetals Technologies

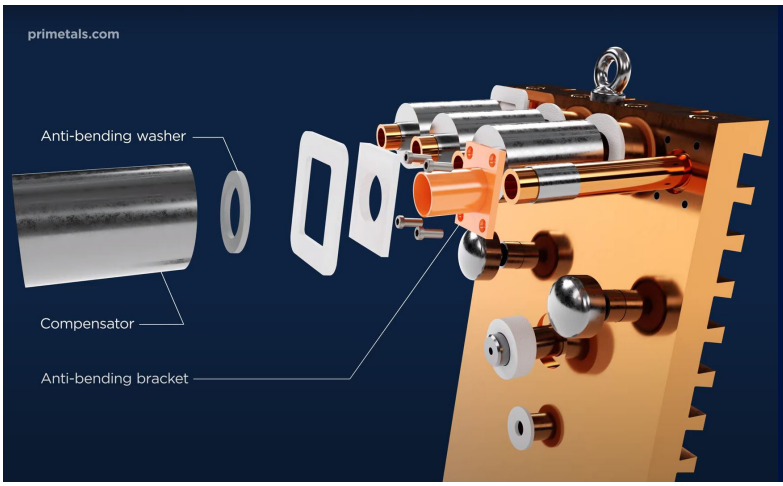
Seven reasons why you should use Primetals Technologies proven range of stave technologies:

- Prevents common causes of failure
- Reliable operation
- Prolonged campaign life
- Maintenance free
- Reduced operating costs
- Fast payback period
- Resistant to low quality burden materials

Primetals Technologies are renowned for helping blast furnace operators replace failing blast furnace cooling systems with longer lasting solutions. Bend and wear resistant technologies prevent the two most common failure mechanisms of copper staves. The following case studies highlight where both these solutions have been applied to solve problems faced by operators.

Case study content

CASE STUDY 1
BEND RESISTANT STAVES PROVIDE RELIABLE OPERATION



This stave technology was so successful the operator re-ordered the same solution for their next campaign.

PROBLEM

A blast furnace in Central Europe began facing issues with copper stave bending leading to failure of the water pipe connections.

The operator did not want to repeat these failures but also did not want to make changes to the furnace shell openings.

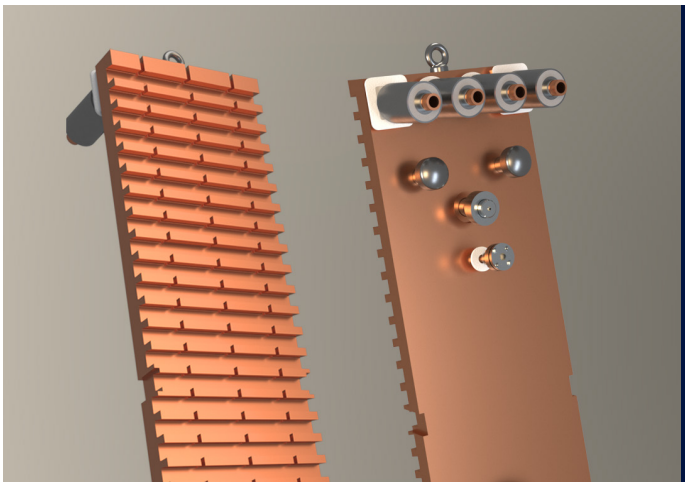
SOLUTION

Primetals Technologies was awarded the contract to install bend resistant copper staves in order to provide dependable cooling to increase operating reliability. The use of the patented bend resistant technology meant that no changes were required to the furnace shell openings to adopt this design.

RESULT

The customer operated their blast furnace for 15 years until the condition of the hearth required a further blast furnace reline. The staves were replaced in kind during this repair in order to provide another furnace campaign free of stave bending issues.

CASE STUDY 2
SOLVING STAVE BENDING DUE TO LOW QUALITY BURDEN MATERIAL



Bend-resistant technology provides maintenance free operation.

PROBLEM

A blast furnace operator in Northern Europe began experiencing copper stave bending which led to failure of the water pipe connections.

Each pipe failure required the blast furnace to be temporarily shut-down to fix the pipe connection to the stave. By the time Primetals Technologies replaced the staves in 2015, a significant number of leaks had been located and temporarily repaired.

Primetals Technologies had engineered the rebuild of the blast furnace so knew the furnace and operators well. The cause of the stave bending was due to the use of poor-quality imported coke. The steelmaker was forced to use this material due to coke oven repairs and economic pressures.

Ultimately this led to the copper staves seeing unusually high temperatures during operation causing the stave corners to bend away from the furnace shell. This caused material to enter between the furnace shell and stave, preventing the stave from relaxing back to the original position.

Eventually, the stave bent enough to stress and then break the welded connection between the water pipe and the back of the copper staves, resulting in water leaking from the cooling system into the blast furnace.

SOLUTION

Primetals Technologies were awarded a contract to supply a new set of copper staves which incorporated our anti-bending solution and oversee the blast furnace repair. This technology was first installed in 2004 at another European facility and by studying the existing stave fixing arrangement, no shell modification was required in order to solve the stave bending problems.

RESULT

The Customer has now been operating their blast furnace for six years without a single reported water leak. The new staves are maintenance free and support a prolonged furnace campaign life. This installation proves the effectiveness of the Primetals Technologies bend resistant technology.

CASE STUDY 3
PREVENTING STAVE WEAR TO DELIVER THE EXPECTED CAMPAIGN LIFE

Wear-resistant solution used to overcome poor internal furnace line design.

PROBLEM

A blast furnace in South America began to suffer from excessive copper stave wear after only three years of operation.

The blast furnace had been converted from plate to stave cooling and relined by another OEM. However, significant compromises had been made to the furnace profile which encouraged copper stave wear. This wear led to the puncture of the stave internal water channels which resulted in water leaks into the blast furnace. The bosh area of the blast furnace was the worst affected, although wear also led to leaks in the belly and lower stack. A total of 84 stave channels were isolated to prevent water entering the blast furnace.

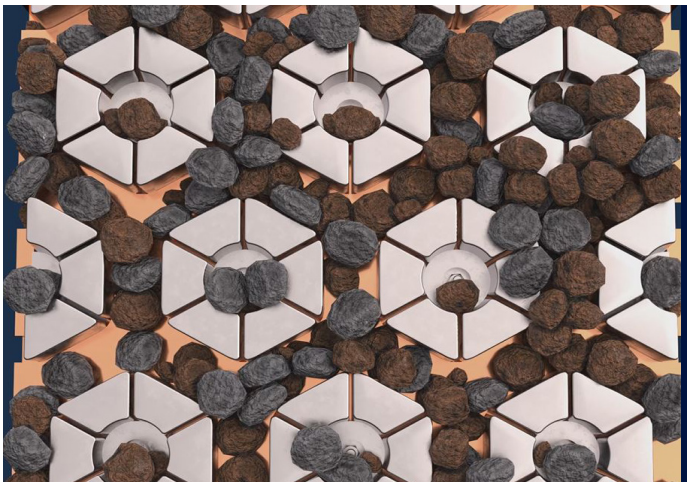
SOLUTION

Primetals Technologies were awarded the contract to replace the copper staves in a fast repair. By studying the furnace lines and operator guidance, Primetals Technologies determined that the furnace lines, particularly in the bosh and belly region, were not well designed. A combination of silicon carbide and graphite refractories were used to protect the new copper staves from wear and the bosh staves were moved closer to the furnace shell and away from the predicted line of wear.

RESULT

The blast furnace has now been operating for eight and a half years without any failures due to stave wear. The staves provide a more reliable furnace operation and have increased the furnace campaign life. The new staves were also fitted with sensors to monitor the rate of wear, based on this data the staves are predicted to comfortably last to the end of the campaign. The solution used at this reference has since been developed into the wear-resistant technology available today.

CASE STUDY 4
WEAR RESISTANT STAVES REDUCE OPERATING COSTS



Wear-resistant technology reduces operating costs and delivers a fast return on investment.

PROBLEM

A blast furnace in Northern Europe switched from a mostly sinter burden to 100% pellet operation. Having previously trialed copper staves from several different manufacturers the operator awarded the contract for stave cooling on both of their blast furnaces to Primetals Technologies. Based on the performance of these staves the customer requested wear resistant staves be installed at the next reline.

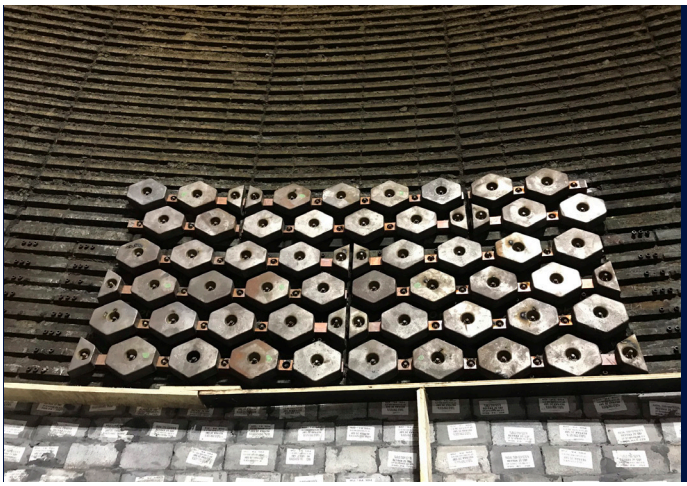
SOLUTION

Primetals Technologies supplied their innovative pocketed type hexagonal insert stave to the customer. By monitoring the performance of this design against traditional designs of staves, it has been proven that the hexagonal inserts reduce heat losses from the blast furnace process which reduces fuel rate.

RESULT

The hexagonal inserts not only reduce stave wear but also blast furnace operating costs by lowering fuel consumption. As the customer has operated with inserts for almost 2 years, they have already recovered the cost of the inserts themselves.

CASE STUDY 5
RETRO-FITTING WEAR RESISTANCE TO PROLONG CAMPAIGN LIFE



A novel solution which enabled wear-resistant inserts to be installed on existing staves.

PROBLEM

A blast furnace in South America was stopped due to economic reasons. As market conditions improved, the customer began to prepare to restart the blast furnace. But they discovered that the copper staves in the bosh area had begun to suffer from wear. As the budget and schedule for the restart had already been agreed, the customer could not afford to replace the full row of copper staves.

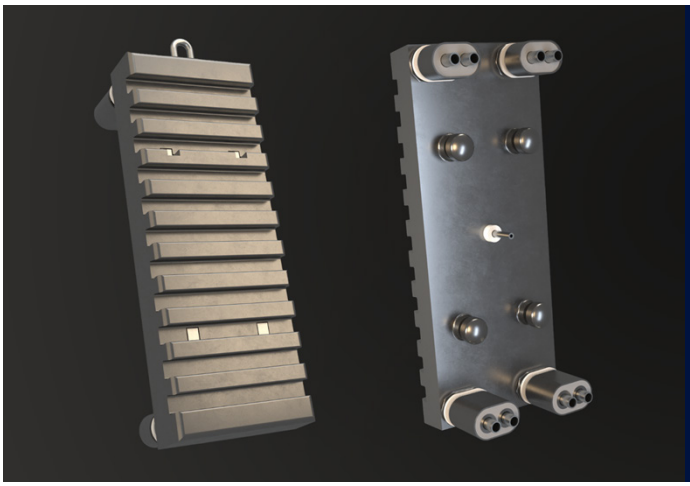
SOLUTION

Primetals Technologies were asked to provide wear resistant inserts for the copper staves already installed in the blast furnace. By adapting the design used on new staves, a combination of parts was developed to allow the inserts to be installed and held in place securely. Due to COVID-19 travel restrictions Primetals Technologies were unable to have an installation supervisor on site. Instead, a highly detailed installation manual was issued and regular communications took place to identify and solve any issues. The blast furnace is now back in operation and the customer is providing regular updates on the insert condition. To date this feedback shows no deterioration of the inserts.

RESULT

The customer has been operating their blast furnace for 8 months now without any risk of stave failure due to wear. The inserts increase the lifetime of the stave and therefore prolong the blast furnace campaign life.

CASE STUDY 6
AVOIDING STAVE BENDING TO PROVIDE MAINTENANCE FREE DESIGN



New fixing design for cast iron staves to increase the campaign life of the furnace.

PROBLEM

An operator was experiencing many cast iron stave pipe failures after only 6 years of operation. By isolating the leaking channels, the remaining areas of the staves were getting hotter and encouraging further water leaks.

The extent of the water leaks meant that the carbon hearth refractory condition also started to deteriorate.

Primetals Technologies identified the root cause of the failures to be the fixing arrangement between the staves and the furnace shell, other plant providers had cited the furnace operators as being the root cause. The original design (not provided by Primetals Technologies) has a known weak point in the stave fixing. This means that any misalignment during installation will cause excessive stresses to quickly build up within the bolt connection leading to eventual failure. Once the bolt fails the weight of the stave will rest on the water pipes, eventually causing them to also fail and hazardous coolant to enter the blast furnace. This problem was further exacerbated by the high temperatures the staves saw in the belly and lower stack areas.

SOLUTION

Primetals Technologies are currently supplying five new rows of staves with an improved fixing arrangement – our standard. By utilizing bolts which pass through an overly large hole in the stave we allow more stave movement than in the original design. By coupling this with flexible hoses between stave rows and compensators in high heat zone areas we allow the stave to expand without damaging the fixing arrangement.

RESULT

The new staves with their improved fixing design will result in maintenance free staves and increase the campaign life of the blast furnace.

THANK YOU
FOR DOWNLOADING

Contact the expert

If you have any questions or blast furnace cooling challenges that you would like to discuss then please contact our expert Ed Long

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primetals.com/webinar/staves

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