

COPPER STAVES BEND-RESISTANT TECHNOLOGY

The use of copper staves in higher heat and liquid zones of the blast furnace has proven successful in furnace cooling. Although reliable in protecting the structural integrity of the furnace shell, premature failure through stave bending (known as the 'banana' effect) persists.

The bend-resistant copper staves from Primetals Technologies prevents such failure. This leads to safer, stable furnace operations and longer campaigns.

STAVE BENDING

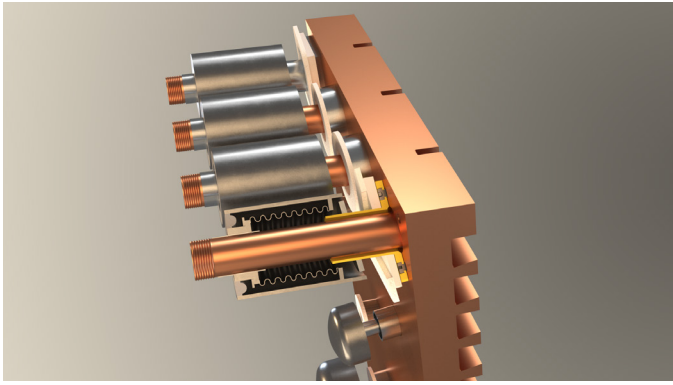
Rapid changes of temperature due to variations in furnace conditions cause the stave temperatures to cycle and deflect at points where it is least restrained.

Deflection at the corners of the staves allows burden material to get behind it. This forces the corners inwards into the furnace and allows dust to enter the compensators which restricts their movement.

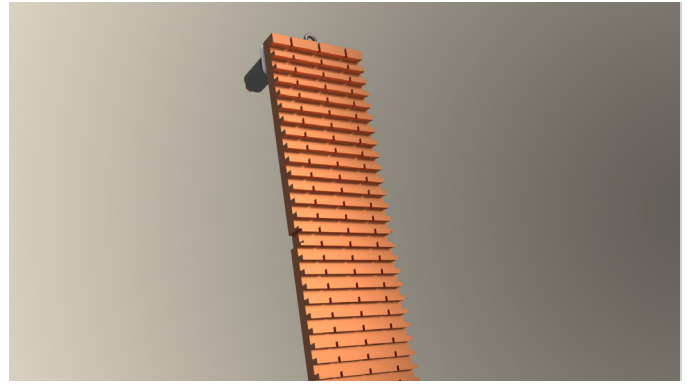
As thermal cycling continues, further bending occurs allowing more material to get behind the staves, eventually resulting in failure of the welded connection of the cooling water pipes and stave body.

If the water pipe is restrained by contact with the furnace shell, then the failure will be accelerated. Only Primetals Technologies anti-bending solution can avoid this.

SEVEN
REFERENCES
ZERO FAILURES



Rendered image of anti-bending bracket and compensators



Rendered image of copper stove hot face

BEND-RESISTANT TECHNOLOGY

The anti-bending solution from Primetals Technologies is patented. It prevents premature failure of the staves by allowing the cooling water pipes to move during thermal expansion but prevents any bending of the stove corners occurring.

Performing successfully throughout campaigns of 15 years without any failures, the key features of the patented anti-bending solution include:

- Compensator to enable thermal expansion of the stove
- Anti-bending bracket fixed to the back of the stove
- Anti-bending washer welded to the anti-bending bracket but not to the furnace shell

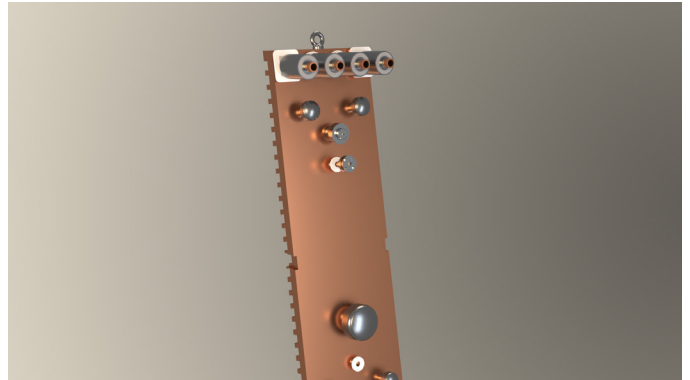
FIXATION AND GUIDING

The incorporation of the patented anti-bending solution in combination with other critical design features such as the correct positioning of the fixing bolts, fixed pin and guide pin (unique to Primetals Technologies) ensures that uncontrolled bending is not an issue with the Primetals Technologies copper staves.

PRIMETALS TECHNOLOGIES STAVES PORTFOLIO

As a leading supplier of blast furnace staves for over 40 years, Primetals Technologies recognizes that optimum furnace cooling design starts with understanding the profile of the furnace and the process conditions.

It is this understanding, along with the application of different materials, shapes and arrangements that has led to further copper staves developments including **wear-resistant copper staves**.



Rendered image of fixation and guiding system

MAIN BENEFITS

- Proven anti-bending solution prevents bending of the stove corners, eliminating premature failure of cooling pipe connections
- Fixed pin and unique guide pin with optimum positioning allows for stove thermal expansion without bending
- Standard and retro-fit solutions for new furnaces and furnace relines, with minimal installation and downtime requirements
- Significant reduction in unplanned maintenance - long campaign lifetime



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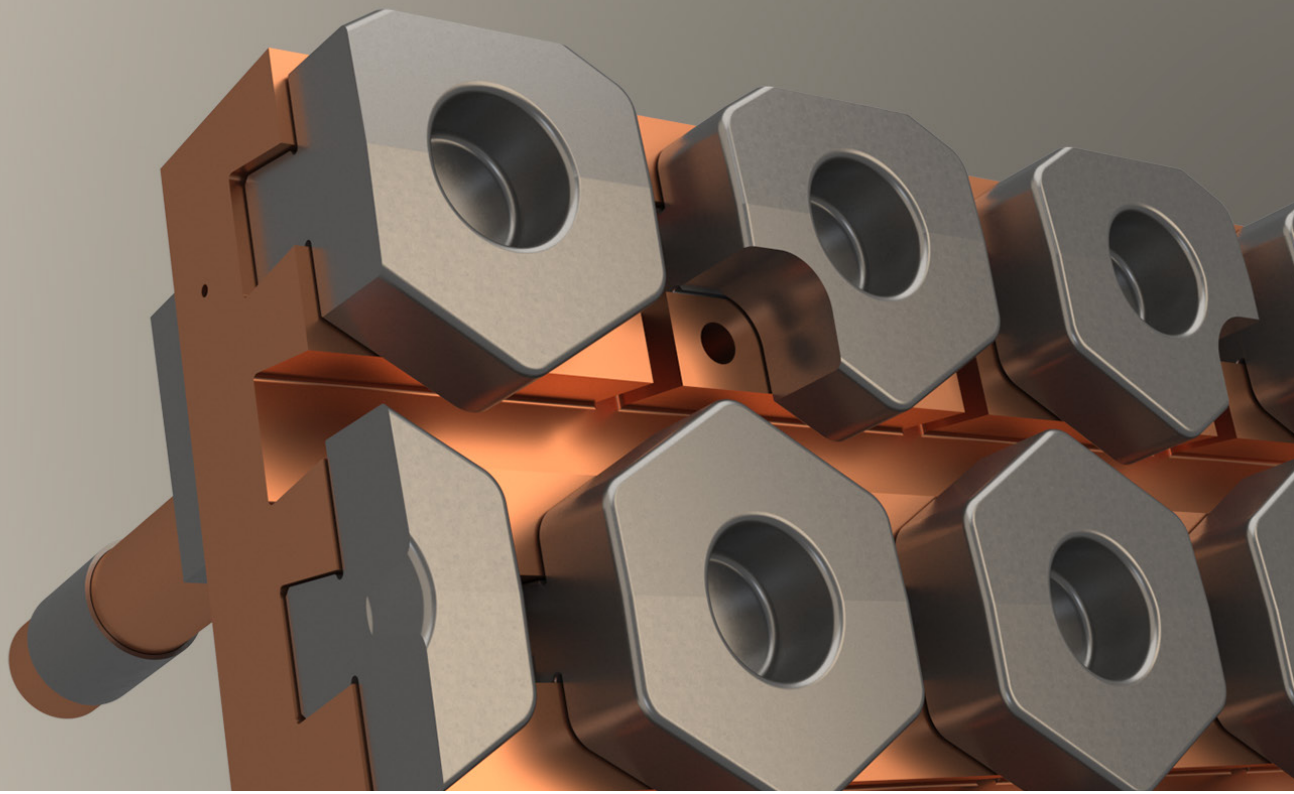
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COPPER STAVES WEAR-RESISTANT TECHNOLOGY

As furnace operators strive to achieve higher productivities and longer campaigns, copper staves must cope with ever more challenging conditions, particularly against excessive wear (abrasion on the hot face).

Wear-resistant copper staves from Primetals Technologies self-protect against excessive abrasion, ensuring extended campaigns regardless of operating and burden conditions.

STAVE WEAR

Copper stave wear is a phenomenon experienced by many blast furnace operators globally. The wear is caused by relatively cold, abrasive materials being present at the furnace walls, together with excessive forces from the descending burden.

The correct furnace internal profile is important to avoid this problem as an incorrect profile can contribute to excessive wear. Other events such as furnace process disturbances, changes in position of the cohesive zone, high rates of reductant injection, errors in furnace charging patterns and poor burden quality can also contribute to the occurrence of wear.

Excessive stave wear can lead to exposure of the stave cooling water channels, leading to water leaks into the furnace, followed by the loss of staves. Without significant and costly intervention this can ultimately lead to furnace shell damage.

5KG/THM
COKE RATE
REDUCTION

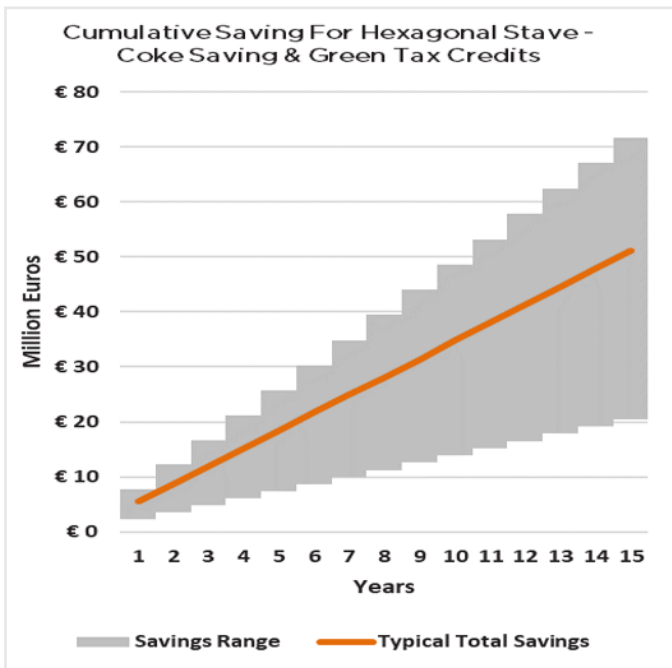
WEAR-RESISTANT TECHNOLOGY

The wear-resistant copper staves from Primetals Technologies is patent pending. It incorporates cast iron hexagonal inserts which protrude beyond the hot face of the copper stove body that serves two functions:

- To create a “stone box” effect trapping in the unreduced materials when they are present
- To create a surface that encourages an accretion layer when liquidous materials are present that reforms during process excursions, self-protecting against wear

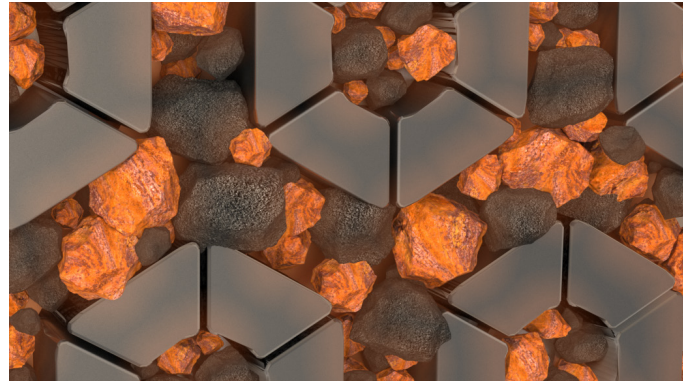
REDUCTION IN COOLING SYSTEM HEAT LOSS

Staves with hexagonal inserts are better insulated from wear and process temperatures. This results in lower heat losses to the cooling system and a 5 kg/tHM reduction in coke rate.



BEND-RESISTANT TECHNOLOGY

Copper staves from Primetals Technologies also feature as standard the patented anti-bending solution which prevents premature failure of the staves by allowing the cooling water pipes to move during thermal expansion but prevents any bending of the stove corners from occurring.



Rendered image of material trapped between wear resistant inserts

PRIMETALS TECHNOLOGIES STAVES PORTFOLIO

As a leading supplier of blast furnace staves for over 40 years, Primetals Technologies knows that optimum furnace cooling design starts with understanding the profile of the furnace and the process conditions.

With such know-how Primetals Technologies optimizes furnace stove design to best match the varying conditions within the furnace, resulting in long-life, trouble-free operation.

MAIN BENEFITS

- Hexagonal inserts provide a “3-point lock” mechanism which retains the burden material between inserts
- Hexagonal inserts provide additional stiffness, further minimizing stove bending
- More stable insulating layer formed on stove face which reduced heat losses and fuel rate by 5kg/tHM
- Standard and retro-fit solutions for new furnaces and furnace relines, with minimal installation and downtime requirements
- Significant reduction in wear and unplanned maintenance – long campaign lifetime



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