

Billet Rhomboidity

Question

What is the formula for determining % billet rhomboidity and what are some of causes and solutions to this problem? G.W. USA

Answer

To determine % billet rhomboidity, measure and record the two diagonal distances, d_1 and d_2 .

$$\% \text{ Billet Rhomboidity} = ((d_2 - d_1) / ((d_2 + d_1) / 2)) \times 100.$$

Primarily, billet rhomboidity starts with non-uniform shell solidification in the mold. Inconsistent mold cooling due to an uneven gap between the water jacket and the mold outside surface can cause irregular heat transfer. Poor mold water quality may cause "plating" of non-metallic compounds on the outside of the copper tube. This will greatly impede heat transfer. Other mold related factors include mold taper and wear. Steel chemistry, starting with the peritectic grades up through the high carbons, can also greatly contribute to billet rhomboidity. The billet will emerge from the bottom of the mold essentially square, but the uneven internal chill zone solidification structure will quickly force a rhomboid shape just below the mold. In many shops, billet rhomboidity at or over 4% will lead to billets twisting in the roughing stands of the rolling mill.

Evaluation can be done by looking at a billet macro etch sample for an uneven chill zone solidification. Many casters prevent rhomboidity through the use of footrolls below the mold. Footrolls hold the newly formed billet square in the mold to allow for a uniform internal chill zone. The disadvantage of footrolls is that they add to the complexity and cost of the mold structure and take time to clean out after a breakout. Footrolls must also be accurately adjusted and continually monitored for wear. Some operators may change to a different tapered mold depending on the grade of steel. Mold water quality may need to be monitored and improved.

If rhomboidity starts suddenly during a cast, it is usually due to a blocked or misaligned spray nozzle(s) just below the mold. Some operators correct this problem by selectively increasing the water flow on the sides of the billet, however this is usually effective only for a short period of time. An old Steelmaker likened this method of correction to fixing a front-

end misalignment of a car by tying a rope around the steering wheel to prevent the car from pulling in one direction. The steering problem is temporarily solved but it quickly wears out the tires. If possible, the best way to correct suddenly occurring rhomboidity is to stop the strand, check and clean blocked upper spray nozzles and/or change the mold.

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