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Transforming Glass Furnace Management with Continuous Refractory Wear Monitoring

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Biography

Dr. Alexander Ruege is Vice President of Engineering at PaneraTech, Inc., specialized in developing technologies for digital management of refractory-based assets. PaneraTech today operates in over 40 different countries with employees on four continents. Dr. Ruege received his PhD from Ohio State University in Electrical Engineering program with a focus on electromagnetic-based non-destructive sensing.

Abstract

Modern industrial manufacturing management is evolving with the integration of data-driven tools enabling precise monitoring and proactive decision-making. Among these advancements, the ability to measure the rate of wear of glass contact blocks in real time provides unprecedented insights into furnace operations, transforming how wear is analyzed and acted upon.

Glass contact block wear is influenced by factors such as operational temperatures, pull rates, color changes, batch control, external cooling and refractory quality. Traditionally, assessing refractory wear relied on periodic inspections and operator experience, often leading to reactive maintenance and unplanned downtime. However, with the advent of radar-based thickness sensors, including permanently installed monitoring systems, wear rates can be continuously measured at key furnace locations. This enables a real-time, data-driven approach to furnace management, providing deeper insights into the operational factors driving wear rates and allowing for data-driven adjustments that optimize furnace performance. By tracking wear trends across different operational configurations, the data obtained from these sensors help optimize maintenance scheduling and broader furnace operations. They enable comparisons between historical and current performance, identifying operational changes that accelerate or ease wear. Cross-furnace analysis can also enhance best practices across multiple assets, uncovering deeper insights into the impact of varying conditions.

Traditionally, refractory wear assessments relied on intuition and visual inspections, making consistency dependent on individual expertise. With real-time sensor data, engineers at all experience levels can make informed, objective decisions, ensuring operational stability and knowledge continuity across generations of furnace operators.

This paper presents case studies where radar-measured data provide actionable insights into furnace operations. For example, real-time wear monitoring identified excessive refractory deterioration in a furnace operating at unnecessarily high temperatures. Analysis revealed that the elevated setpoint was not required for glass quality. By reducing the temperature by 50°C while maintaining product consistency, refractory wear was slowed, energy efficiency improved, and operational stability enhanced.

By correlating real-time refractory wear with process conditions, we demonstrate how manufacturers can extend furnace life, reduce downtime, and optimize production efficiency. The findings emphasize how a data-driven approach transforms furnace management, leading to improved furnace longevity, reduced maintenance costs, and greater process stability.