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Recent Advances in Refractory-Maintenance and Safety for Steel Plants with the help of 3D-Laser-Scanning, Digitalization and Gunning-Robot-Systems

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Steel producers face increasing pressure to cut costs, lower CO_2 emissions, and enhance safety amid evolving economic and production landscapes. This paper highlights recent advances in measurement technology and digitalization that optimize safety, yield, and refractory performance in hot metallurgical vessels. Key innovations include fully automatic repair systems for electric arc furnace (EAF) refractory linings, rapid hot-condition inspection of torpedo ladles and a Steel Production Assistance System (SPAS) leveraging laser-based measurement data.

Central to these improvements is the deployment of state-of-the-art 3D laser scanning technology, capable of capturing over 10 million data points within seconds. This high-resolution data enables highly accurate assessment of refractory wear, which is then used to guide automated gunning robots for precise, targeted repairs. As a result, repair materials are applied only where needed, reducing overall refractory consumption and minimizing downtime by shortening "Power Off"periods for maintenance.

These digital solutions also support the "no person on the floor"safety philosophy, significantly improving operational safety by reducing human exposure to hazardous environments. Furthermore, integrating real-time measurement data into Industry 4.0 frameworks allows for predictive maintenance, optimized resource utilization, and continuous process improvement. Collectively, these advancements drive increased furnace availability, lower costs, reduced emissions, and enhanced competitiveness for steel producers in a rapidly changing industry.

Keywords: Laser Profile-Measurement; Refractory-Maintenance; Gunning-Robot; Safety Measures; Digitalization-Industry 4.0

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