Non-Destructive Evaluation of Rotary Kiln Refractory Lining Thickness

Assess rotary kiln lining with high efficiency using ground penetrating radar (GPR)

Ground Penetrating Radar (GPR) has become a valuable tool for non-destructive testing (NDT) and structural evaluation across various industries. This application note presents the use of GPR technology—specifically the Proceq GP8800 system—for assessing the condition of refractory linings in rotary kilns, which are critical components in cement production.

While measurements must be taken with the kiln offline and at ambient temperature for safety reasons, the system enables rapid, continuous data acquisition along the entire kiln, without the need for post-processing. This represents a significant improvement over traditional spot-check and destructive methods, reducing both intervention time and associated operational risks.

Challenge

Rotary kilns, essential in cement manufacturing (as exemplified by Monjos, del grupo GCPV), pose a major challenge in maintaining the integrity of their internal refractory linings. These linings are exposed to extreme operating conditions, including high temperatures and abrasive materials, leading to progressive wear over time.

Conventional inspection methods are typically invasive and localized, requiring extended kiln shutdowns that result in production losses and increased operational costs. In addition, these techniques may damage the lining and do not provide a continuous overview of the kiln's internal condition. As such, there is a critical need for a non-destructive testing method that can accurately, quickly, and continuously assess lining thickness and detect wear patterns in a reliable manner.

Solution

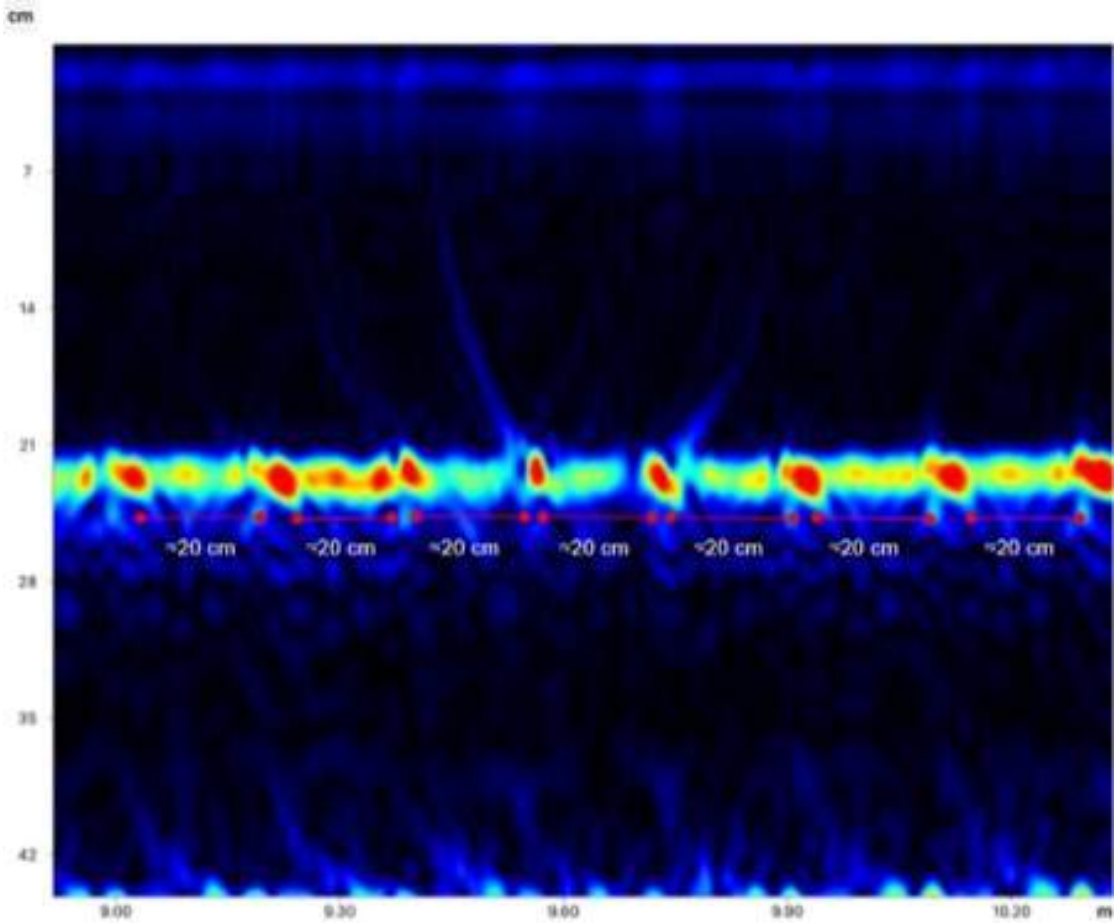
The Proceq GP8800 GPR system provides an effective response to this challenge. GPR is a non-destructive geophysical technique that uses electromagnetic waves to image subsurface structures and detect variations in material properties. In this case study, the GP8800 system with its stepped frequency continuous wave antenna, was deployed to assess the refractory lining of rotary kiln 4E at the Monjos plant of the GCPV group.

Data acquisition was fast, continuous, and required no post-processing, enabling a highly accurate assessment of the lining condition in minimal time. This capability is particularly valuable in contexts where inspection windows are short and interruptions must be minimized. The system works by transmitting short pulses of electromagnetic energy into the refractory material and measuring the time it takes for reflected signals to return. This travel time is directly related to the depth and thickness of the material. By analyzing the reflected waveforms, it is possible to identify thickness variations and detect internal defects or areas of wear.

During the demonstration, the GP8800 system was used to collect data along three 60-meter profiles inside the kiln. The results—visualized as radargrams—clearly revealed the interface between the refractory lining and the underlying steel shell, allowing precise, continuous thickness measurements along the inspection paths.

Key Results of the GPR Survey:

- Accurate and Continuous Thickness Measurement: The GP8800 system delivered a high-resolution, continuous thickness profile of the refractory lining along the full length of the kiln, identifying significant variations.
- Detection of Critical Wear Zones: Localized areas with material loss of up to 5 cm were detected, enabling targeted and prioritized maintenance actions.
- Digital Logging for Historical Monitoring: All acquired data was digitally stored in a structured format, allowing the creation of historical datasets. This traceability supports comparative analysis in future inspections, enhances predictive maintenance planning, and improves long-term wear monitoring.
- Structural Integrity Assessment: The survey also provided insight into the internal layout of the lining, including the regular spacing between brick segments (~20 cm), indicating a modular construction pattern.



Conclusion

The Proceq GP8800 GPR system proved to be a highly effective solution for the non-destructive evaluation of refractory linings in rotary kilns. Its ability to perform fast, continuous data acquisition with no post-processing enables accurate thickness characterization and detection of critical wear zones with a high level of detail.

In addition, the system's capability to store all inspection data digitally enables the establishment of a historical monitoring framework, offering an evolving view of the kiln's condition over time. This technology delivers significant value in preventive maintenance strategies by reducing downtime, minimizing operational costs, and supporting data-driven decision-making for planned interventions.

This application note was created in collaboration with Monjos, del grupo GCPV and Miquel Coll, GPR3D.com.

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