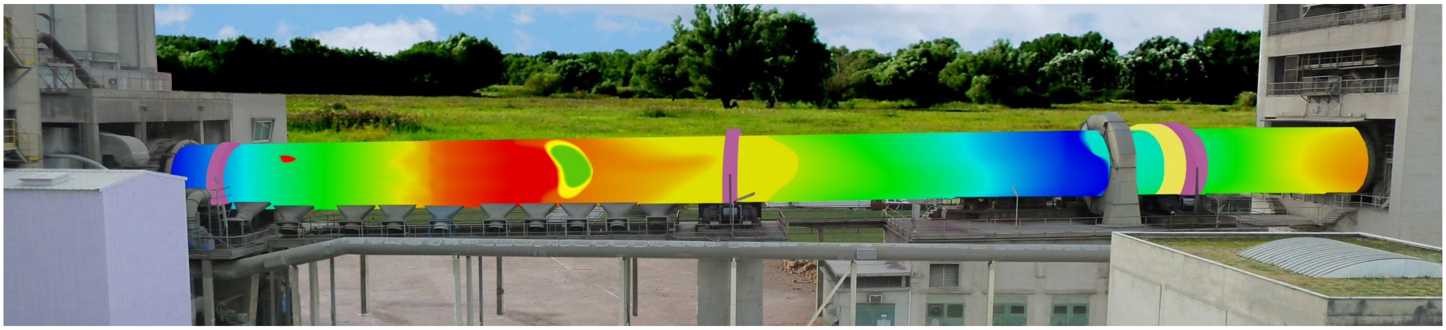
CASE STUDY **KILNSCAN**

INFRARED LINE SCANNER FOR ROTARY KILN SHELL TEMPERATURE MONITORING



OVERVIEW

Customer: Tianrui Group Cement company, a leading clinker and cement producer in China backed by US private equity group KKR & Co. The Xingyang plant is one of the world largest single kiln clinker production line with 12000 ton of cement produced daily.

Challenge: Tianrui Group needed to monitor their new 92m long rotary kiln to prevent any interruption in production due to hot spots and to control the burning process. Reliability, performance of equipment and industry experience were all considered in this highly visible project.

Solution: Two Electro Optical Industries' Kilnscans with merged imaging were selected to maximize kiln coverage and eliminate shadows.

Results: The plant management is delighted with the system, both simple to use and of remarkable image quality. The plant performs corrective actions and preventive maintenance based on the Kilnscans' spot on analysis. The plant had no kiln failure.

CUSTOMER

Privately owned Tianrui Group cement Co. is one of the 12 largest cement groups in China. The Xingyang plant, located in the Henan province, was commissioned in 2009 and is one of the world largest single-kiln production lines. The plant uses a suspension preheater kiln layout with a 6.2m x 92 m long kiln. The grate cooler has 13 cooling fans, and at the back, a waste heat power station.

CHALLENGE

From a design point of view, the Xingyang kiln had tertiary air ducts running along its sides and the supporting legs were in the field of view of the scanner system. This layout would generate shadows when installing a line scanner. The plant had to find a solution to insure that no obstruction would impair the monitoring process.

Kiln performance and reliability is centric to profitable plant operations. A kiln shell has to withstand harsh conditions. The steel and refractory lining structure was heated by a flame at 2000 degree Celsius. Outside surface was around 450 degree Celsius, using significant temperature gradients. The refractory lining prevents the shell from excessive heating, but as brick failure eventually occurs, thermal shocks become a serious concern. Any fall of a refractory brick could stop operations for few weeks and the associated loss in production would amount to more than a million dollars. The kiln scanner had to have the capability to provide a hot spot size detection size small enough not to miss a single brick fall. At greater distances, this aspect would become a challenge as the required sensor spatial resolution would have to be excellent.

The Xingyang kiln shell was a massive heavy hollow cylinder weighting thousands of tons and only supported by a few rollers, representing a few discrete point loads. With time, the shell would naturally deform under its own weight and flex along its longitudinal axis, exhibiting an oval cross-section. These distortions would increase constraints on refractory bricks and impact their operating life.

Mechanical tensions could also be induced by the inclination given to the kiln. When operating, the kiln shell would rotate with a speed up to 5 rpm and an angle of a few degrees, in order to move material slowly down from the preheater tower close to the flame for clinkerization. As the shell would only be lying on support rollers, the alignment would have to be adjusted slightly between the roller shafts and tyre axes to preserve the balance in the kiln axial thrust. In the long term, this small difference in the slopes between rollers and tyres would have serious impact on shell stability. A subsequent axial drift could damage stop blocks, generate overheating of bearings, jeopardize the kiln drive system or even cause cracks to the kiln. Kiln tyre slip monitoring would be required.

Energy savings and improvements in burning process were also considered when making a choice for a kiln monitoring system. If chosen carefully, the thermal scanner should not only provide notice in case of emergency but also extend the kiln lifetime and allow for increased production output.

Last but not least, the Chinese plant, as all cement plants, operated in a harsh environment and required ruggedized equipment.

SOLUTION

Two 90 degree field of view Kilnscans were installed. This enabled 100% elimination of the shadows caused by the existing structures to completely view the entire kilnscan. EOI staff performed an exact positioning; using an oscilloscope, to make sure the kiln scanner's field of view would encompass the whole kiln axis. One scanner was installed at the top of a 15 meter high tower and the other on the roof of a building covered by a canopy. The signal from each scanner was taken into a common signal processing unit via fiber optic cables. The processing unit was installed in the electronic component room, adjacent to the control room and connected via Ethernet cable to the PC and displayed where the SIRCIM software was running. The commissioning and training took place in 3 days.

The Kilnscan is a high end system providing single brick resolution, which allows for quick problem detection and proactive actions to re-build coating: the maintenance manager had the necessary information to locally cool down the shell with fans or modify the burner settings if needed. The quality of the Kilnscan's optics guarantee that the beam angle out of the scanner is adequate to provide early warning in case of problems. Average or low quality optics would negatively impact the warning cycle: scanners with low resolution can give a late warning by averaging the temperature peaks on the thermal map. When it comes to hot spot detection, a late warning comes at a high cost.

Additionally to high spatial resolution, the Kilnscan has excellent thermal sensitivity: at less than 1/10 of a degree Celsius, it guarantees sharp and precise display of unwanted change in temperature.

The Kilnscan provides, through a user friendly 3-D shell display, precise alarms on critical parameters such as hot spots detection, tyre slip or coating loss. High accuracy of measurement needs to be consistent over time though: by using a blackbody as an external temperature reference, or a pyrometer in contact with the shell to measure and correct a potential change of atmospheric conditions, the Kilnscan can recalibrate itself, through the external blackbody, when needed, without operator's intervention.

Historical data management of all relevant parameters, such as temperature profile, brick and coating thickness, kiln speed and tyre slip allows the maintenance manager to get a clear overview of the kiln status and trends in a centralized dashboard.

As a result, it is easy to plan for kiln re-alignment or replacement brick purchases. The software communicates with the plant's Distributed Control System through OPC: all critical information such as kiln speed, individual alarm status, reference blackbody or pyrometer status, kiln shell heat loss can be transmitted and displayed in real time on a central console.

Lastly, Kilnscan provides a unique feature. The Thermal Warp Computation allows users to calculate the kiln distortion induced by temperature changes over the shell, letting operators see what's happening within the kiln: evolution of coatings, kiln push of un-burnt material, potential stress on the shell, tyres or roller stations. By collecting and analyzing this data, the plant manager can get indicators on:

- Mechanical and thermal stresses in the shell and tyres
- Hot spots under tyres
- Load fluctuation supported by each pier
- Shell and tyre out-of-round Distortion
- Breakage of tyres according to the fatigue criteria
- Shrinkage stress fluctuations in the rollers
- Bending stresses in the roller shafts
- Specific pressure fluctuation on the roller bearing

With these data in hand, the operator can decrease the shell distortion by adjusting the flame and rotation speed to adapt burning conditions and homogenize the coating. Efficient shell distortion monitoring also results in avoiding hot spots.

RESULTS

The plant has been dependably and efficiently operating since its opening. No breakdown or failure caused any production interruption and the two Kilnscans are functioning smoothly and reliably.

The plant employees and management are delighted with the system, reporting that it is easy to use and that the images are very clear and precise.

CONCLUSION

When choosing a line scanner, the Kilnscan brings the best the line scanner industry has to offer in spatial resolution and thermal sensitivity in the line scanner industry today. Its advanced and unique software features allow for unmatched monitoring. The Kilnscan also offers the largest field of view available on the market (140 degree), which comes very handy when the line scanner has to be placed near the kiln. The Kilnscan will insure that plants get the best return on their investment for years to come. With 1000 units installed all over the world, some of them still consistently operating after 20 years in use, the Kilnscan remains the market leader of high performance line scanners.

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