CEMENT KILN APPLICATIONS

Overview
Rotary kilns are cylindrical furnaces that rotate on their long axis. They are constructed with a steel shell and a refractory lining. The axis of rotation is tilted so the limestone and other chemicals that are continuously fed into the high-end, travel down the furnace toward a burner at the low end, and discharge onto a conveyor. The conveyor transports the material to a cooler before grinding in ball mills.

Rotary kilns are used in a variety of processes, though primarily in cement manufacture, but also in the production of high temperature refractory materials such as Dolomite. Kilns operating at lower temperatures are used to calcine lime.

Temperature monitoring at a number of locations is essential to ensure product quality and throughput, to minimize emissions, and to prevent damage to the kiln shell and material handling conveyors. Critical applications are the Burning Zone, Process Material Pre-Heat, Exit Temperature, Kiln Shell, and Clinker Conveyor.

Process Material Preheat
Exhaust gases from the kiln are used to preheat the cold raw material before the gases pass to the scrubbers and the stack. This improves the efficiency of the process and reduces emissions. Inadequate preheating can signal problems in the heat exchanger that will reduce efficiency.

Models PSC-CS-laser-2MH, DG-40N, or Sirius SI16 can be sighted on the preheated material to provide an alarm if the temperature falls below a pre-set level.

Burning Zone
The burning zone is the last stage before the material exits the kiln. A single burner fires towards the approaching material. A 2-color Model MQ11 is extremely effective as it compensates/ignores the effects of dust obscuration in the sight path. Non-contact infrared thermometers should not be sighted through the flame, but sighted along the axis or below the flame. Model MQ11 has, in addition, an integral video chip that provides a video of the burning zone on a video monitor or P.C. PSC’s single color models MY39 or DT-40F have a spectral response of 3.9µ to exclude radiation from the flame but can be affected by dense dust or particulates in the sight path. The Metis MV09 Thermal imaging Camera has also been applied. Cooling and purging accessories are essential for all models.

Kiln Skin Temperature
Hot or cooler areas on the kiln outer surface are caused by a ring-dam formed by a build-up of process material in the kiln. This reduces the flow of material, resulting in a hotter area downstream of the ring, and a cooler area where the ring has formed. Collapse of the refractory lining will also result in a hotter area.

Unevenly heating the kiln shell distorts the metal skin and the cylinder becomes banana shaped, damaging the kiln bearings, causing a process shutdown.

Rapid detection of uneven heating allows the plant operators to break down the dam with a canon shell, or to "steer" hot process material into any gaps in the refractory lining as a temporary solution until a routine maintenance comes due.

Early detection of hot or cooler areas can be achieved with a thermal imaging camera "instant thermal picture" or a line scanning camera. Both provide a thermal picture of the skin temperature in related colors. Single point IRT’s mounted on a mechanical rotary scanner or in a number of fixed locations can be used.
This graphic representation of a typical cement plant illustrates all measurements possible using today’s technology, but not all are routinely applied.

Clinker Conveyor

Hot process material leaving the kiln is conveyed under cooling water sprays before travelling to ball mills to be ground into powder. Failure to cool the material thoroughly can result in fires along the conveyor in inaccessible locations, or in the ball mills.

Detection of inadequately cooled clinker is therefore critical. An IRT with a wide angle field of view, PSC-CS5-laser-2M, DG40-N, & Sirius SI16, or a thermal imager such as the PSC-PI Camera can be applied to this application.

Mid-Kiln Measurements

IRT’s have been applied in cement plants for over 40 years. Prior to that, thermocouples were the only technology available and required frequent replacement due to mechanical damage and wear, or corrosion from process gases. This is particularly true of mid-kiln measurements.

As a practical compromise, Inconel tubes or studs are inserted into the kiln, and IRT’s are sighted at the tip of the tube or the head of the stud.

The tubes and studs are still vulnerable to damage, but if they break off, a reading can still be obtained. Scanning the mid-kiln section with IRT’s eliminates the loss from damage, but provides only an inferential measurement of the kiln burden, and is more useful as a monitor of kiln skin.

Plant Operating Environments

Cement plants are not usually under cover, and, with the exception of the burner hood, IRT’s and imaging cameras will be exposed to the elements. In some geographical locations, weather extremes are severe, calling for some form of protection for the instruments and the support services such as cooling water and compressed air for purges.

This may be as simple as a mechanical shield and careful routing of the services. Though it represents an added expense, the using nitrogen for purging can eliminate such problems as frozen condensate in the lines.

Turnkey System Engineering

Process Sensors’ products are enhanced by the Company’s capability to offer a fully engineered, turnkey system, whether it is a single loop or several. System engineering includes data acquisition and processing, alarms and controls utilizing Windows compatible computer software.

Cement Kiln Sensors

Burning Zone and Product Discharge

Metis MQ11, PSC-DT-40F, MV09 Thermal Imaging

Mid-Kiln

Sirius SI16, Metis MI16, DG-40, PSC-CS-Laser-2M

Clinker Cooler / Conveyor Belt Area

PCS-CS-Laser-LT, PSC-SSS-LASER, DT-42N, PSC-400 IMAGER