Burning Zone Temperature Measurement
Endurance Series 2 color (ratio) Pyrometer

Abstract
The following article illustrates the importance of burning zone in a cement kiln and the significance of the Endurance Series 2 color (ratio) pyrometer for accurate temperature measurement. It also describes the features of Endurance Series pyrometers, including online temperature and video monitoring, remote sensor configuration, as well as video recording and playback using Endurance software.

Introduction
The burning zone of a rotary lime kiln has the highest process temperature. The formation of the most important cement mineral, C3S (alite) occurs in the burning zone. The temperature at the burning zone is between 1300-1450 °C (2372-2645 °F). The stability of burning zone temperatures directly determines the quality of the clinker. To ensure stability of burning zone temperature and maintain clinker quality, accurate temperature measurement is critical.

Features of Endurance 2 color pyrometer
The Endurance 2 color infrared (IR) pyrometer determines temperature from the ratio of the radiated energies in two separate wavelength bands (colors). 2 color pyrometers measure closer to the highest temperature within the measured spot (spatial peak picking) and their measurement is not affected by dust and fumes in their field-of-view. These features make Endurance 2 color infrared pyrometers ideal for burning zone temperature measurement.

Endurance 2 color infrared pyrometers owe this flexibility to the two different wavelength filters placed one on top of the other. This “sandwiched detector” includes a narrow band detector with spectral range from 0.95 to 1.1 μm and a wide band detector with spectral range from 0.75 to 1.1 μm. The temperature range of Endurance 2 color (ratio) model used for burning zone temperature measurement is from 600-1800 °C (1112-3272 °F).

Installation of Endurance 2 color (ratio) pyrometer
The Endurance IR ratio pyrometer can be installed by mounting the sighting tube on the kiln door/hood, followed by the blast gate and thermojacket assembly. The blast gate is equipped with a quartz window and metal shutter. The window protects the pyrometer from harsh environments, while the metal shutter is useful during maintenance. The blast gate can handle temperatures up to 870 °C (1598 °F). The thermojacket’s rugged cast aluminum housing completely encloses the Endurance pyrometer head and provides water and/or air-cooling, along with air purging in one unit. An endurance pyrometer fitted with a thermojacket can withstand ambient temperatures as high as 315 °C (599 °F).
Endurance 2 color infrared pyrometers can also be installed on a kiln platform looking through the observation window. For this installation, a blast gate and thermojacket are not required. The Endurance pyrometer can be ordered with a factory fitted air purge and integrated water cooled housing. The air/water cooled housing allows the pyrometer to be used in ambient temperatures up to 120 °C (248 °F) with air cooling and 175 °C (347 °F) with water cooling.

Setup and Configuration of Endurance 2 color infrared pyrometer

Sighting and Focus
The Endurance 2 color infrared pyrometer comes with various focus and sighting options. The 600 mm (2 ft.) to infinity focus is ideally suited for burning zone applications. All Endurance 2 color infrared pyrometers are available with through-the-lens sighting. Additional video sighting capability is available as an option to display the focused target area on an external computer monitor via LAN/Ethernet link.

Settings
Setting up an Endurance 2 color infrared pyrometer requires minimum effort. The slope for burning zone temperature measurement is generally set to 1. The slope is the quotient of the emissivity based on the narrow and the wide spectral range (first and second wavelength).

Averaging is used to smooth the output signal. The average time is the amount of time the output signal needs to reach 90% magnitude of an increase in object temperature. The range for the average time can be set from 0.1 to 300.0 seconds, where just 0.1 - 299.9 seconds is the average duration. A relay output is available as an alarm for failsafe conditions or as a setpoint relay. The relay output can be used to indicate an alarm state or to control external actions.

Pyrometer Output
It can be set to 0-20mA or 4-20mA output, which can be directly connected to the plant DCS. The total analog output circuit impedance is limited to 500Ω. A 16-Bit DAC (Digital Analog Converter) guarantees a current loop resolution better than 0.1 per temperature unit (°C / °F) over the total measurement range.
Software Features

Endurance software facilitates real-time burning zone temperature data monitoring with live video feed of the burning zone through the built-in video camera included with the Endurance sensor. This feature is very useful in the event of failure of the HTCCTV camera. The pyrometer communicates with the software over Ethernet. RS485 communication between the sensor and software is also possible for pyrometer configuration and temperature data monitoring. All pyrometer parameters can be configured via the software.

The video feed and temperature data can also be monitored on a web browser via the built-in HTTP server without using the endurance software.