Application Report: Non-contact Temperature Measurement in Tunnel Kilns for Optimal Fuel Efficiency

Intensified competition and the constant downward pressure on prices have had their effect on industrial manufacturing including the heavy clay industry. Manufacturers who don't strive to reduce production costs will eventually fall out of the running.

It only makes sense to influence such cost-intensive operating parameters which have the greatest savings potential: reducing energy consumption and minimizing the reject rate.

The kiln temperature profile has a significant influence on the amount of fuel required and the quality of the yield. In this respect, it is of utmost importance to precisely monitor the temperature of the clay product during the firing cycle using accurate measuring instruments.

Advantages of Non-contact Temperature Measurement

Today we see a trend toward equipping new kilns (and retrofitting older ones) with so-called pyrometers, which—as opposed to thermocouples—measure the temperature directly at the surface of the ceramic product, and thus give the most accurate representation of the real heating process taking place within the kiln to enable optimal process control. Thermocouples merely measure the air temperature within the kiln. Their measurement reading will deviate up to 50° C from the actual temperature of the fired ware, and will furthermore depend on variables such as air flow and kiln setting.

Thermocouples react sluggishly to thermal fluctuations whereas pyrometers instantly indicate temperature changes. A pyrometer immediately detects the lower temperature of a new batch entering the kiln so that the firing process can be adjusted accordingly. Tighter control of the optimal kiln temperature profile will result in a significant reduction of fuel consumption.

Since effective process control depends on reliable temperature measurement, the sensor drift that all thermocouples experience while in service is a major drawback of thermocouple use. Sensor drift will creep up unnoticeably and measurement errors will not be recognised until defects are discovered on the products exiting the kiln. Process intervention is only possible at a very late stage in the firing process.

Pyrometers have the advantage of not being subject to drift. Process control based on reliable pyrometer readings results in a considerably lower reject rate. Furthermore, pyrometer measurement is a nonwearing system meaning that no follow-up costs will be incurred. Today the purchase price of a pyrometer system hardly exceeds the initial cost of a thermocouple. With a view toward operating cost reduction it is wise to switch to pyrometer measurement.

Stationary System

The pyrometers of the PS Series have proven successful for stationary measurements at the kilns of countless ceramic works. The entire optics and electronics are housed in a stainless steel enclosure with a 30 mm diameter and a length of 180 mm. The output signal of the instrument is a 4-20 mA linear current signal, thus the pyrometer can be directly connected to standard, commercially available displays, controllers and PLC's.

A comprehensive range of accessories—designed especially for tunnel kiln applications—round off the system. This set consists of an insulation tube, a quartz window, an air purge, a sighting tube and a mounting flange.

CellaTemp PS Pyrometer installed at the top of a tunnel kiln, including protective accessories

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Portable Instrument

The portable radiation pyrometers of the Optix series have been well established for temperature checks. Optix instruments feature a precision lens system which is focusable and interchangeable. The target marker of the through-the-lens sighting device indicates the exact measurement spot and thereby facilitates precise aiming. In addition to the instrument's integrated LCD screen the measurement value can be read while looking through the viewfinder. A standard feature of Optix is the built-in data memory to log up to 200 temperature readings.

Portable Pyrometer Optix G

The PC connection cable and the data transfer software, which are included in the scope of supply, enable the user to download the readings to a standard PC. Temperatures measured over a period of up to one hour can be recorded and archived. With the help of standard programs such as Excel spreadsheets can generated to view, graph and analyse the data.

Conclusion

Pyrometers can easily replace thermocouples for temperature measurement tasks at tunnel kilns as they offer a number of advantages over thermocouples. Pyrometers are not subject to any follow-up costs and result in lower reject rates and a reduction in fuel consumption. The initial investment costs are only slightly higher than the expense of thermocouples. The use of the PS series as a stationary measurement system as well as the Optix series' portable pyrometers for quick temperature checks represent a significant step forward in process optimisation.

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