

## INSPECT pro control 3

### Optimization of Low-rank Fuel Combustion in Rotary Kilns of Cement Industry

Monitoring and control of a rotary kiln in cement industry can be accomplished by means of NIR (near infrared) cameras. Temperature can be measured up to 2500°C. By image filtering, a good view into the furnace is ensured. Characteristics are determined in the burner and flame zones as well as along the brick bed and kiln jacket. On this basis, evaluation, visualization, and automatic control can be performed.

#### Introduction

Economically efficient operation of rotary kilns in cement industry increasingly requires the use of low-rank fuels. Fuel oil, solvents, plastic fractions, or animal meal serve to replace oil or coal dust. So-called multi-X burners feed these fuels into the system using various technologies.

The different calorific values of the individual fractions, selective fluctuations of the calorific value, and variable particle sizes cause an unstationary combustion behavior that influences energy release, energy consumption, and the place of energy consumption as well as product quality. This combustion behavior must be measured online in real time and managed by control technologies.

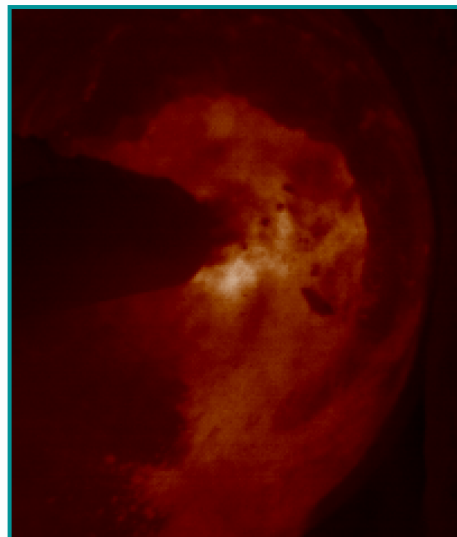


Figure 1: NIR image of the burner and rotary kiln

Innovative camera concepts, such as NIR (near infrared) cameras with absolute temperature measurement, together with a high-performance image processing method, provide new insights into the process and its behavior. By high-performance image processing methods, image interferences due to dust, particles, etc. are removed. Based on interference-free images, advanced methods allow for the calculation of characteristics describing the combustion state, detecting fluctuations, and triggering an online adjustment by means of computers. Interference-induced effects on pyrodetectors can be managed in this way.

For example, absolute temperature distributions in the brick bed can be calculated from the interference-free images of the NIR camera. From them, temperature profiles and variations caused by different calorific values can be identified.

In addition, the burner can be monitored and the shape of the flame and behavior of non-ignited fuels can be determined. To ensure homogeneous energy supply and constant product quality, innovative control methods are applied for the necessary interventions. As an alternative, the characteristics are output to the operations staff for manual optimization of the settings.

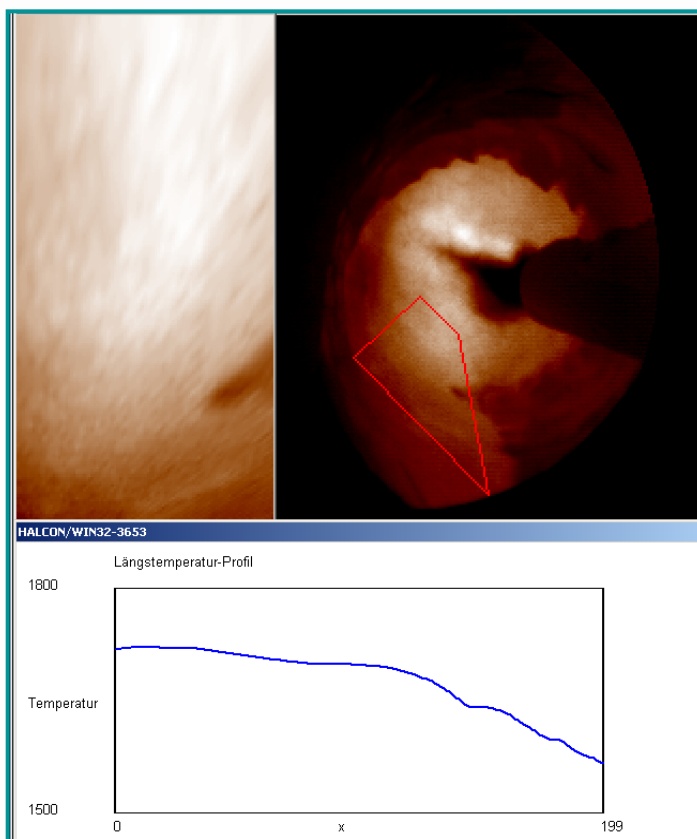


Figure 2: Filtered image (right), equalized image (left), and longitudinal temperature profile of the brick bed (bottom)

### Rotary Kiln Monitoring

The characteristics calculated by the image processing system for the NIR cement application result from calculations made for the burner and flame zones and for the brick bed. Among the parameters determined are

- the temperature and shape of the flame,
  - the non-ignited flame portion,
  - temperatures of the brick bed (total and in 8 regions),
  - charging and filling angles,
  - the rate, angle, and width of discharge,
  - the discharge variance, and
- and other problem-specific parameters, if required.

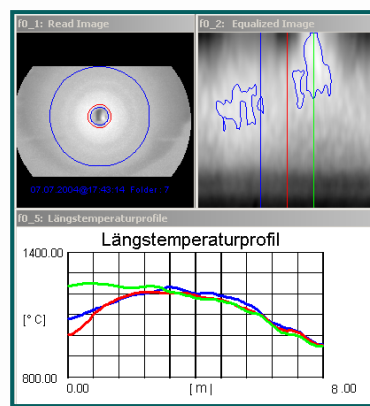


Figure 3: Geometrical model and calculation of characteristics

### NIR Camera

The NIR camera applied allows for the contact-free measurement of two-dimensional temperature distributions with high dynamics and spatial resolution. The instruments are suited in particular for permanent industrial use.

Large temperature measurement range from 600°C to 1500°C, optionally 2500°C, measurement frequency 25 images per second, robust stainless steel housing in combustion chamber probe with probe cooling jacket, objectives with variable apertures, alarm and limit value monitoring. Made in Germany based on technologies of our partners.



Figure 4: NIR camera and combustion chamber probe

### The INSPECT pro control® Software Tool

The methods for optimizing combustion processes in rotary kilns are integrated in the INSPECT pro control® software tool. INSPECT can be connected to any IR-, NIR- and video-camera. The results of the processing steps are transmitted cyclically to the process control system via pre-fabricated interfaces. INSPECT can also archive all process data in a database and visualize them via Ethernet-coupled graphical user interfaces (e.g. in the control room). Since 2000, INSPECT has already been in use at several industrial facilities worldwide.

If you wish to obtain further information or an offer, contact us directly.

### ci-Tec

ci-Tec is an innovative enterprise that specialized in the optimization of thermal combustion processes. With its INSPECT product, the enterprise located in Karlsruhe offers an effective tool to improve highly sensitive process conducts. Close cooperation with the Institute for Applied Computer Science of Karlsruhe Institute of Technology (KIT) results in a rapid transfer of latest scientific research results to practical applications.

The expert team of ci-Tec provides assistance and support in the optimization of these high-tech processes based on its vast know-how and experience. ci-Tec solutions lead to measurable improvements that are of real benefit to your company.

### ci-Tec GmbH

Breite Straße 155

76135 Karlsruhe, Germany

Tel. +49 (0) 721 / 62 69 68 – 60

Fax + 49 (0) 721 / 62 69 68 – 10

E-Mail: [info@ci-tec.de](mailto:info@ci-tec.de)

Internet: [www.ci-tec.de](http://www.ci-tec.de)