HIGH TEMPERATURE CAMERA

I. Abstract

Monitoring of high temperature processes is a difficult and uncertain exercise. Because of the severity of the atmosphere traditional instruments decay and are not reliable. Canty's technology has revolutionized the way furnaces, boilers incinerators and kilns are monitored and controlled. Inferior camera technology relies on camera extraction when circumstances exist that endanger the integrity of the camera. These systems have a long history of failure. Canty has integrated the design of the camera into the process wall which allows it to survive normal and upset conditions. With a proven solution available, why would you want to extract your camera when the furnace has an upset condition?

II. Requirement

So many industry applications are in dire need of reliable, visual monitoring. Molten glass level, glass web/knurl position, flame detection in heat treat processes and power boilers, belt load and component position in belt furnaces, clinker detection in cement kilns, positive empty detection in shipboard power boilers, melting and pouring operations and numerous others. In all these applications the effectiveness and efficiency of the process is at risk because the operators are essentially running blind or with the assistance of personnel on the plant floor which then creates a safety issue.

It is also the case that many boiler applications require temperature monitoring to detect upset conditions in tubes and also to know the flame temperature in order to maintain proper conditions internally. Rapid detection of flame degradation or extinguishing is critical in maintaining a process within good operating limits.

III. Application

A. Canty meets the need by providing a uniquely designed camera and lens system that performs reliably 24/7 in a wide range of thermal processes. Maintaining a quality image enables the addition of image analysis which provides the added process information to efficiently monitor and control the product and process. Process applications include:

- Flame Detection, Size, Temperature in kilns, annealers, boilers
- Tube Temperature/Position
- Molten Metal Pour – Cast Metals, Plastics
- Product on Belt Inspection – Glass Ribbon
- Enclosed Boiler Inspection
- Ethylene Furnace Flame Detection
- Incinerator Level and Flame
- Coal Bunker Level

B. Typical Images and Results

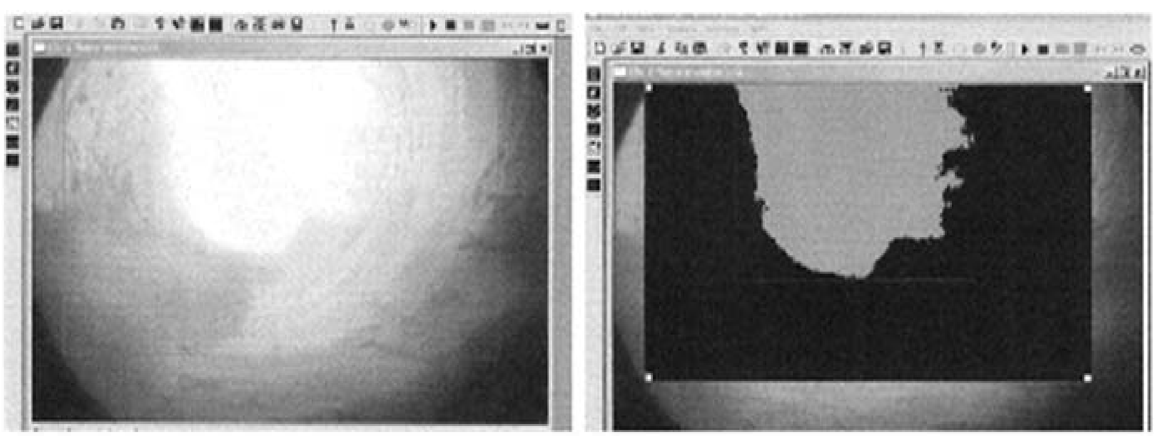

Figure 1. Kiln Flame Size

In this application (Fig. 1) the camera looks up the rotary kiln to detect the flame size. Constant output of the flame area, as determined by the pixel count, indicates state of the flame. Measuring the flame size is done by indicating a low intensity for the flame and then counting the area of higher intensity pixels. Once calibrated a software 4-20 output can be used to provide information elsewhere in the control loop.

The following image (Fig. 2) shows tube walls being monitored for temperature. Cameras can do temperature measurement over defined spans when calibrated to another device, or be used for relative measurements to detect hot spots over the entire surface of a component and not just in a single discreet point as would be provided by alternate thermal technologies. The measurement zones shown in figure 2 offer different capabilities for tracking temperature. The two large zones on the left measure average tube temperature for comparison to adjacent tubes. IF a tube starts to become less efficient it can be detected in comparison to its neighbors or by its trending average temperature over time. The two small zones on the right allow distinct temperature measurements from different levels of the tube. This type of set up can more quickly detect clogged tubes.

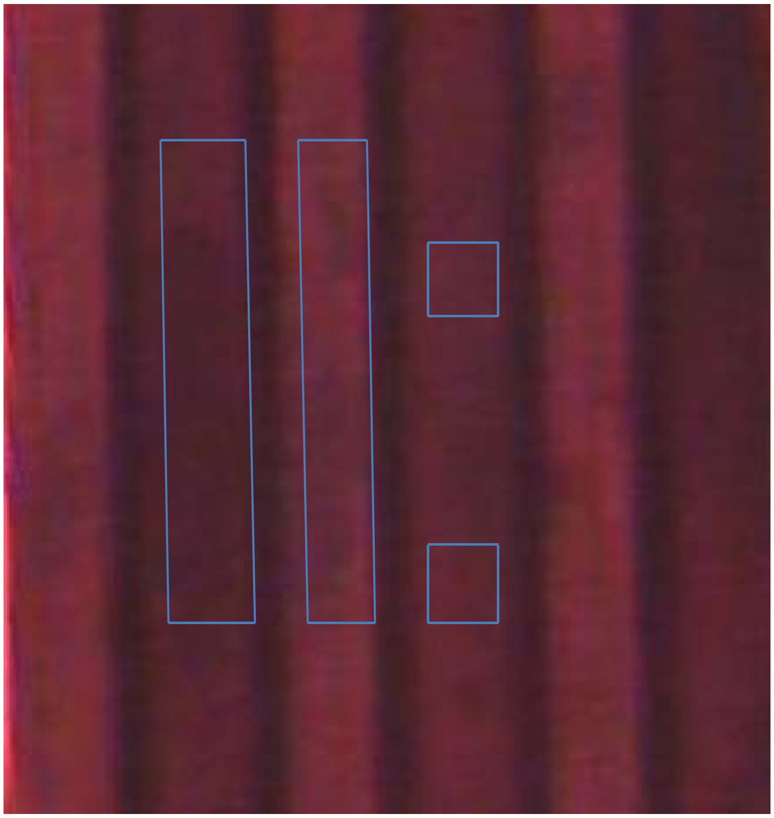

Fig 2. Red Hot Furnace Tubes

In addition to temperature readout, image analysis can provide position monitoring and confirmation for molten extruding, pouring and filling applications. Figure 3 shows a continuous feed operation. When the feed goes out of control it will splash, thereby changing the constant image and allowing the vision system to detect the upset and its location. A mold filling operation would be similar to this. As the mold fills the camera detects the final change in brightness at the top of the cavity and shuts off the ladle feed as the fluid tops off but does not spill.

Figure 3. Continuous Molten Feed.

C. System Design

The patented design is an integration of material selection, thermal component design and installation configuration that work together to create the most versatile and best performing camera available to industry today.

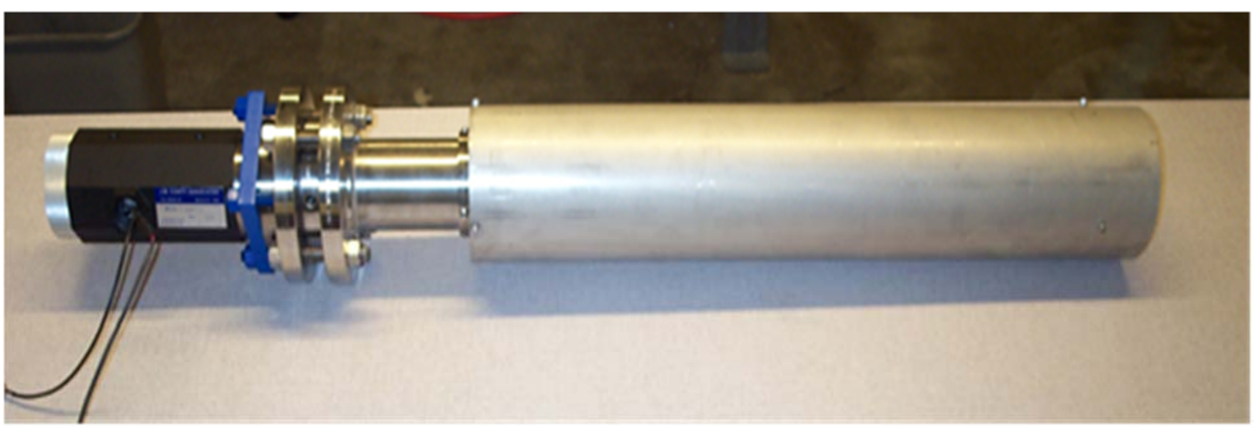

Figure 4. UltraTemp Camera

1. Lens Design – the internal lens is made of high temperature lens materials such as quartz and sapphire. A protective shield sits in front of the lens train for added protection. The internal lens is separated from the camera housing by a fused glass to metal window which protects the internal electronics.

2. Thermal Design – the internal lens, in addition to being made of appropriate materials, is suspended within the insertion tube in a way that transfers as little heat as possible to it. The design limits the frontal exposure of the camera to convective and radiative influences from the process and then created barriers for the heat to overcome.

3. Installation – lastly, the installation of the camera into a tight fitting port through the refractory eliminates any convective or radiative heat sources from contributing to the heat rate into the lens system. A frontal exposure with low convective and radiative coefficients is all that is allowed.

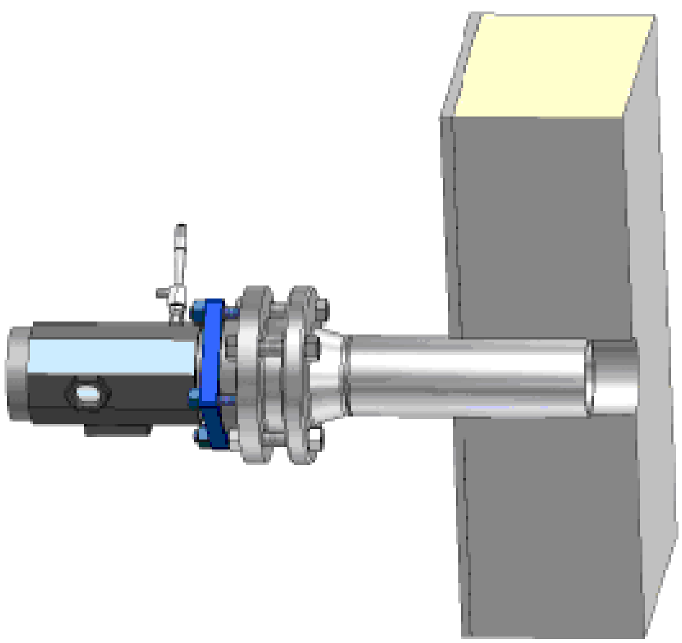

Figure 5. Installation Graphic – Recessed Mounting

Within the internal lens tubes an air purge is provided for applications that require it to maintain a clean lens. The air blows past the protective shield to keep internal debris from contacting the shield. When it does it usual that it stay there and eventually the protective shield will have to be replaced, however it will have served its purpose in protecting the objective lenses behind it.

4. Thermal Design

Canty engineering includes finite element analysis which is used, in conjunction with analog methods and good engineering judgment, to arrive at thermal designs that meet the challenge of high temperature environments.

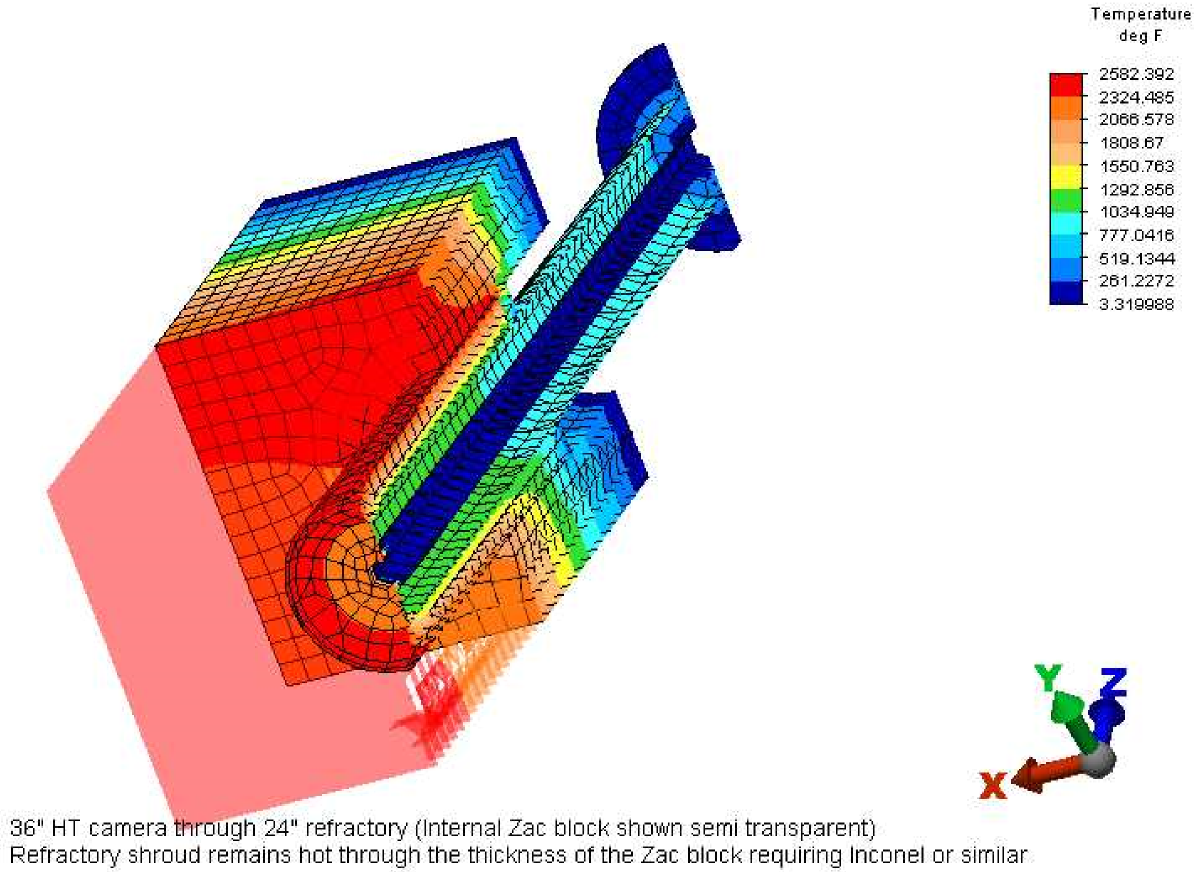

Figure 6. Thermal Analysis of Internal Lens System

D. Flushmount High Temp Camera

In addition to the traditional insertion through the refractory type system we have been discussing, Canty also offers a ‘lower’, high temperature version that mounts flush to a flange connection and does not have an insertion. These are typically used for cooler incineration applications, low temperature (<1000 F) annealing applications and other processes with similar temperature profiles.

III Benefits

A. The internal lens system has been designed to survive the process conditions without reliance on cooling air. If air supply is lost, which it will be eventually, the lens system survives and the protective shield is all that may need to be replaced. A lens system can cost several thousand dollars. Cameras that are designed to retract for their protection often do not function properly and you are left with an expensive and lengthy repair with no visual into the process.

B. System costs are surprisingly low considering the technology and design built into the systems. Site preparation is critical to the effective installation and operation of the camera, however once that is accomplished the system yields enormous payback with its low maintenance and long life

C. The view into the process is invaluable for maintaining the process within good operating limits, identifying the location of upset conditions and trouble shooting to resolve them efficiently and for achieving continuous improvement of the product and process.

D. Canty has placed hundreds of high temperature systems into operation in the various industries mentioned previously herein. Installations include glass furnaces, power boilers, ethylene furnaces, molten metal pouring, glass/plastic extrusion, cement kilns, waste incinerators, ship board boilers and many more. The integration of all the design aspects has yielded a well proven system ready for successful application.