# JM CANTY INC

**Buffalo NY 14094**

## Report: Flame Analysis in Rotary Kiln

Purpose: To assist operations in monitoring flame size and quality with the intent of providing optimum kiln conditions for processing contents.

System:

The Flame analysis system is comprised of a Canty High Temperature Camera unit along with Vector processor for image analysis. Systems can also be provided with Ethernet cameras for connection direct to in place LAN systems. The Canty hardware/software is described in detail at the following locations:

High Temperature Camera: http://www.jmcanty.com/overview/P.Process%20Vision/A7355.PDF
Vector Image Processor: http://www.jmcanty.com/overview/V.Vector/A9562.pdf

The Camera system is designed to withstand the rigors of extreme environments and is used in boiler of all kinds, kilns, annealing ovens and glass furnaces. The software takes the process image and digitizes it so it can be processed. Canty provides many available image filters and outputs to allow the operator to set the system up to extract specific and multiple pieces of information at the same time to allow proper control of the system. For instance, intensity or color detection can be used to monitor flame temperature. Threshold analyses can be used to determine the size of the flame and the size of various temperature zones in a flame if they are visible. In addition it may also be possible to monitor the product in the kiln or furnace at the same time. The software allows many features to be monitored simultaneously and allows the operator to set the feature conditions that will trigger alarm anywhere on the screen or only in specific areas of the screen.

The following images show a view inside a rotary kiln looking down toward the flame. The product is visible as well in the view. The image following the “live” shot show the flame digitized and the output details the flame size in square pixels which in process would be equated to square inches or some other value system that indicates to the operator flame status. The analysis shown here detects the flame as a particle with size and shape characteristics. It can also be detected simply as a count of pixels above the threshold limit. The image is an array of pixels with intensity of 1-255. The software analysis of these images detects pixels in the view that are 246 grey scale values or higher which filters out only the flame from detection as can be seen in the digitized image. The images shown here are black and white, however the same software system will allow analysis of color in RGB and Yuv. Color can sometimes give a more qualitative analysis of the flame temperature.

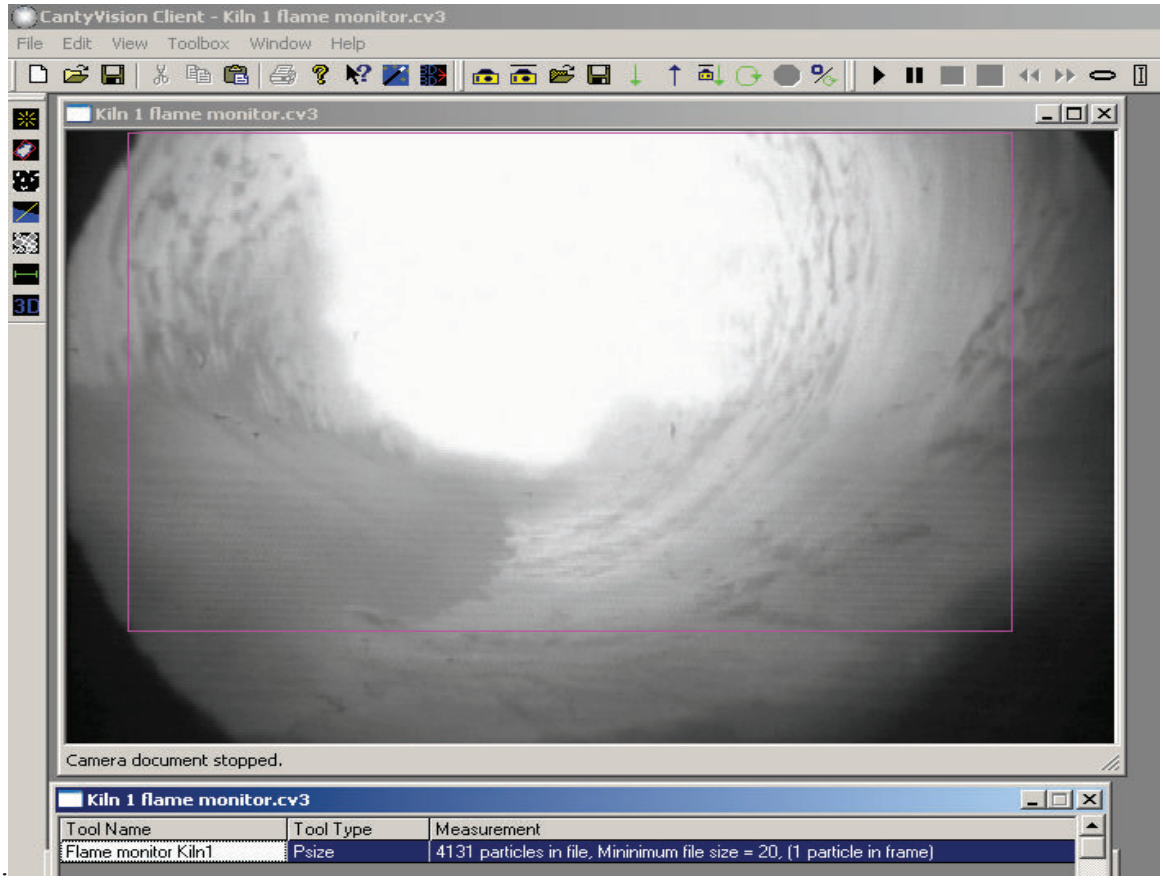


Figure 1, Flame Monitor, Kiln1 pink box shows Particle Size analysis region

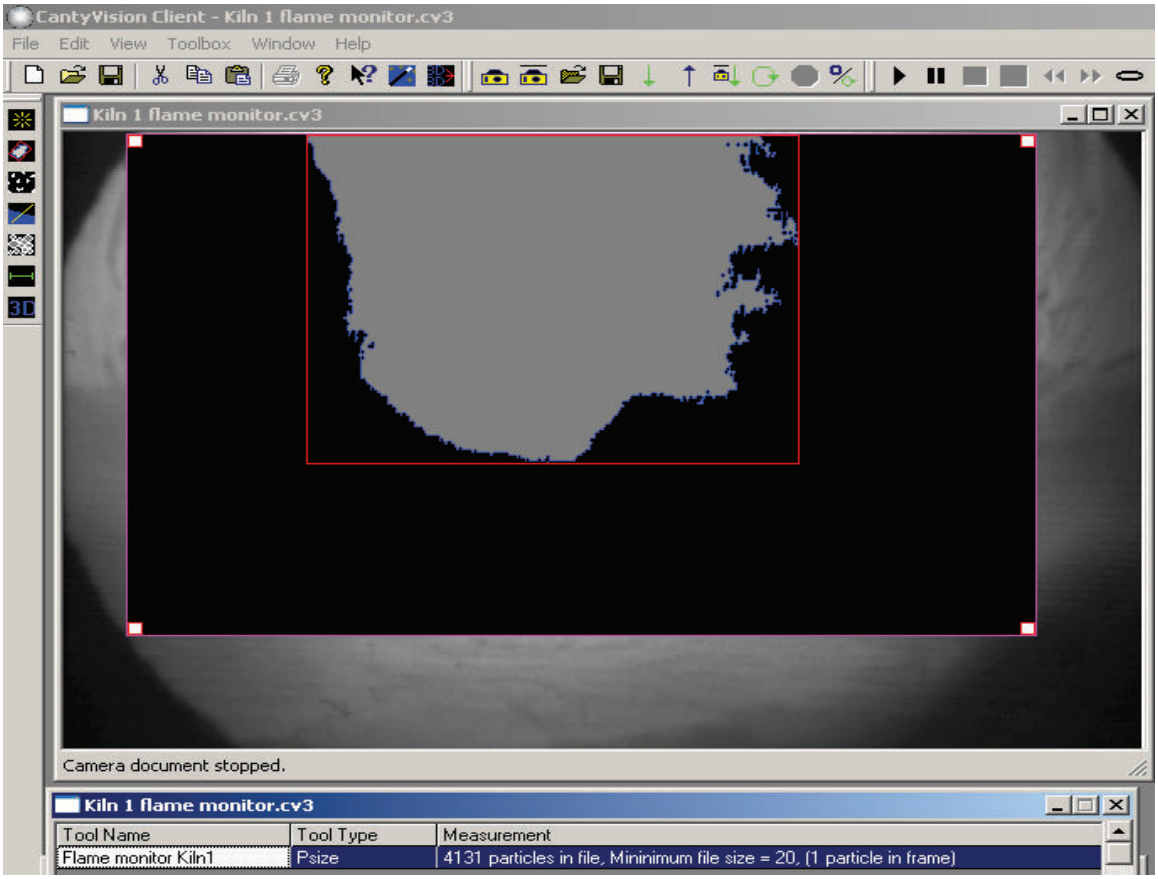


Figure 2, flame detect at threshold of 246, min particle 400 pixels

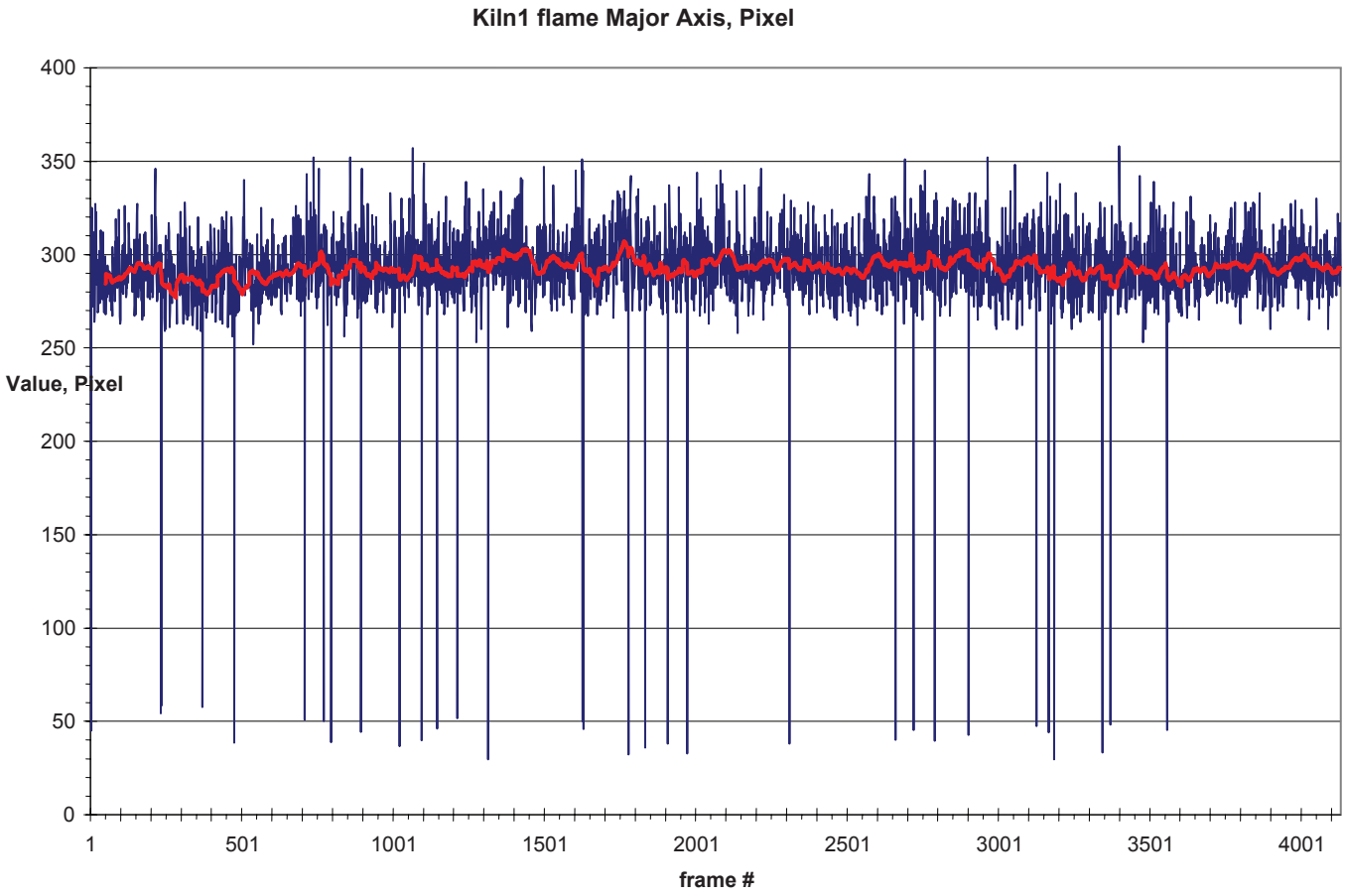


Figure 3, flame detect major axis shows about 1% small flame regions greater than 400 pixel Average Major Axis near 285 pixel

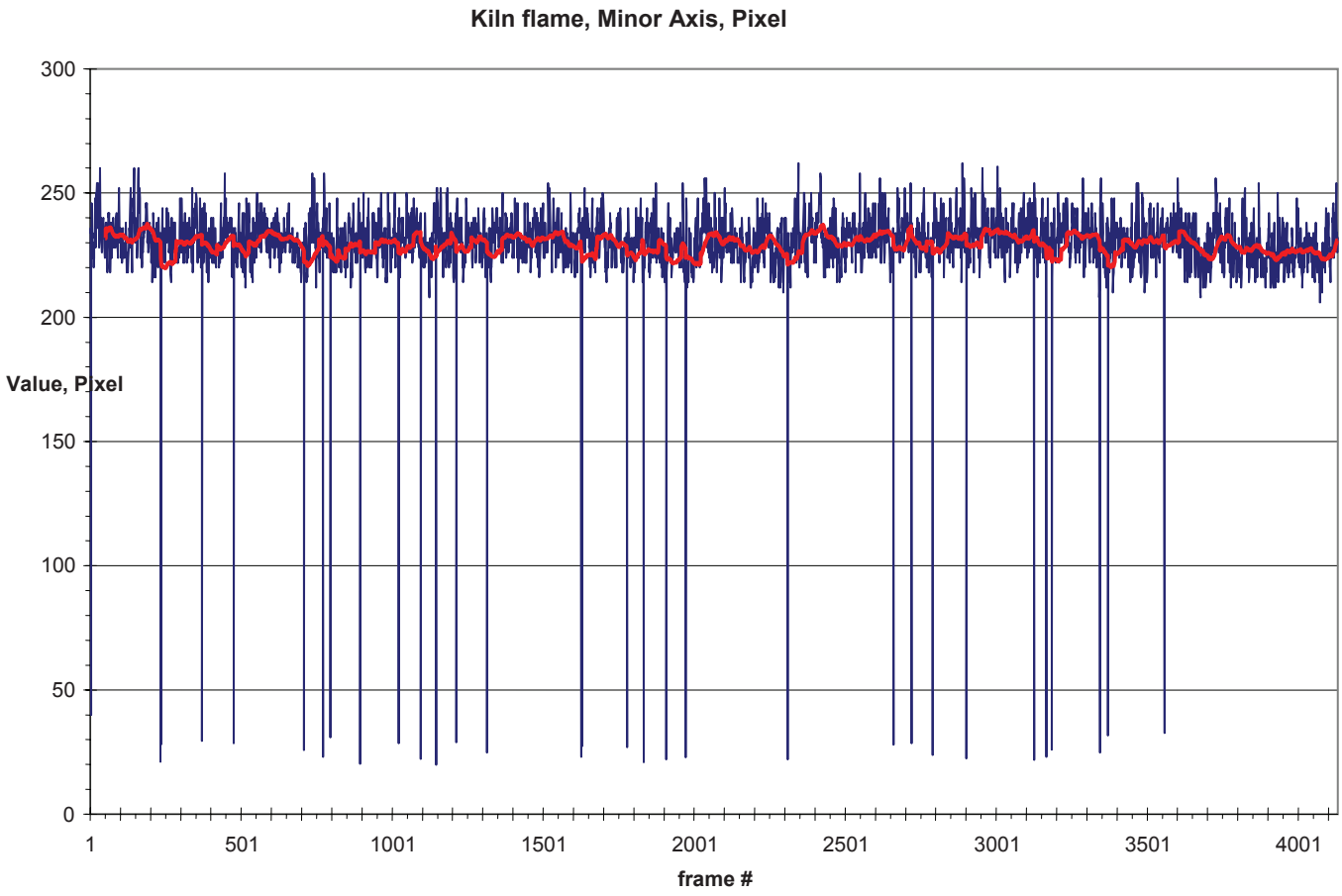


Figure 4, flame detect minor axis shows about 1% small flame regions greater than 400 pixel

Average Minor Axis near 235 pixel