Kiln Controllers

Introduction

Like everything in this golden age of technology, the means of controlling the temperature inside a kiln has advanced rapidly. We have moved from an "intuitive sense" developed through years of trial and error, to visual inspection of pyrometric cones, to mechanical shut off devices, and now have electronic devices that can do everything but throw the pots for you.

While electronic controllers have been around for quite a while they have only recently come down in price enough to fit into the average potter's budget. What may have cost thousands of dollars 10 or 15 years ago is now only a few hundred. Because of this drop in price, electronic kiln controllers are no longer reserved for the industrial ceramic engineer. They are used by teachers, home hobbyists, and professional artists all over the world.

What is a Kiln Controller

There are many different types of kiln controllers. Some can control the atmosphere of the kiln as well as the temperature. We are going to look at the more basic units that are sold with most top loading electric kilns and some front loaders.

An easy way to understand how a controller works is to break it down to its core functions: Sense, Decide and Act.

The thermocouple senses the temperature in the kiln chamber and sends that information to the controller. The controller takes the information and compares it to the firing program input by the operator and makes a decision to act or not to act. If the program data indicates a need to act the controller will send a signal for the relays to open or close. The relays are the components that control the power to the heating elements. When they are open the power is off and when they are closed the power is on.

Programming

There are 2 types of programs that can be entered into the controller, custom designed programs and programs which come with the controller that are designed to simulate a firing using cones. These are commonly called Cone Fire programs.

Custom Designed Programs

Custom designed programs are often referred to as "Ramp and Hold" or "Ramp and Soak" programs. They all are comprised of one or more segments. A segment consists of 3 pieces of data, Heating/Cooling Rate, Ending Temperature, and Hold Time. Below is a 5 segment Cone 10 program that was designed for sculptural pieces with thick walls.

Segment	Rate	Ending Temperature	Hold
1	50°/hr	150° F	24:00
2	150°/hr	1000° F	4:00
3	40°/hr	1150° F	0
4	570°/hr	2100° F	0
5	108°/hr	2345° F	0

You will notice the first segment instructs the kiln to heat up at a rate of 50°/hr until it reaches 150° F and then holds for 6 hours. This is an excellent example of how you can customize programs to meet specific needs. Most boards allow 8 segments to use in constructing a program and 6 spots to save favorite programs in permanent memory.

Ramp and Hold programs do not calculate the heatwork for you, therefore it takes a good understanding of heatwork to design your own program. Heat work is a measurement that incorporates time and temperature. If you increase the time of the firing or the final temperature you will increase the heatwork.

If you look at an Orton Cone Chart you will notice that each Cone value has a temperature associated with it. Many people do not realize that this temperature is only valid if the kiln is being fired at a specific rate during the last 150° F of the firing. Most controllers are calibrated using the 108°/hr Large Self-Supporting Cone Chart published by The Edward Orton Jr. Foundation. Therefore if you are firing slower then 108°/hr, you will need to adjust the temperature down. Unfortunately determining how much is still going to take a little trial and error.

Also, it is important to realize that just because you program the kiln to do something it does not mean that the kiln is capable of achieving it. If you program a kiln for a rate faster than it can achieve, it will do only what it can.

Cone Fire Programs

Cone Fire Programs are the most popular because all of the programs are preloaded into the software of the control board and the user only needs to load the right one. As mentioned before Cone Fire programs are designed to simulate the heatwork needed to bend a pyrometric cone. The controller will automatically adjust the final temperature depending on the speed at which the kiln is firing

With the Cone Fire Mode you simply enter the Cone you want to simulate, enter the speed you wish to fire, and how much time you would like to hold the temperature at the end of the firing. It is very common to enter a 5 or 10 minute hold at the end of the firing to allow the kiln time to balance out in temperature and give glazes time to flow.

Prior to controllers it was necessary to regulate the heating rate of the kiln by coming back every so often to advance the switches. With the Cone Fire programs in the new controllers the kiln will automatically slow the rate down through critical temperatures. Below is an example of a Cone 04 , Medium Speed firing.

MedGraph.tif

As you can see in the graph, the kiln begins at a slow rate to allow water vapor to escape, slows again through quartz inversion and then again at the end to insure good cone correlation. This is possible, but difficult and inconvenient to duplicate with a KilnSitter controlled kiln.

For the most part controllers are relatively easy to use and accurate. Most of the problems associated with controllers can be prevented if the following things are kept in mind:

1) Thermocouples are like heating elements, they wear relative to use and must be changed on occasion. There are many different types of thermocouples but the most commonly used is the Type K. When type K thermocouples wear they begin to error towards an overfire. This is a gradual process and should be easy to catch by using shelf cones every so often.

2) Relays will need to be replaced on occasion. When one fails it is often a good time to change all of them.

3) Electronic components are sensitive to excessive heat and moisture. When controllers were first introduced to the hobby market they had a few problems which were mostly associated with heat. Since then, manufacturers have been able to design ways of insulating the circuit board from the heat of the kiln. The problems occur when kilns are placed in tight confines with little circulation. The

heat gets trapped in the room and the temperature rises. If you observe manufacturer's installation recommendations you should not have a problem with heat.

4) Do not try to program the kiln beyond it's capabilities. All kilns are rated to a set temperature. If the elements are in good shape and the power is sufficient, the kiln should achieve the rated temperature in a reasonable amount of time. When elements begin to wear or there is a voltage supply problem the kiln will take longer and longer to fire. The controller will eventually shut off the kiln in order to prevent an overfire caused by too much heatwork. This normally occurs when the kiln is not capable of climbing at a rate of at least 12°/hr.

Automatic kilns have opened up a whole new world of freedom to artists. Freedom to experiment with products that are difficult to fire such as crystal glazes and glass and freedom from having to baby sit each firing. Kiln controllers have come a long way over the last 15 years they are more accurate and dependable then ever before. Every year new features are being developed that can help potters solve firing problems. If you don't own one now, chances are you will in the future.