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POTCLAYS LIMITED

INFORMATION SHEET

HEATWORK AND PYROMETRIC CONES

The effect of temperature and time together is called *heatwork*. Pure temperature only tells half of the story, to understand the ceramic firing process it is essential to grasp that the time taken to carry out a firing has nearly as much bearing on the end result, as has the temperature. For example, if two identical pieces are fired, one taking eight hours to reach temperature, the other only six hours to reach the same temperature the results will be very different. Even though the same temperature has been achieved the shorter firing has not "cooked" the piece for long enough, i.e. it has not had enough *heatwork*.

Heatwork can be measured with Pyrometric cones. These are small pieces of clay resembling tall pyramids that are made from precisely formulated materials. The cones illustrated are self-supporting, the Standard cones do not have a wide base and are supported by clay or a cone holder. Cones soften and bend when the exact amount of heatwork has been achieved; there are many different values covering a large temperature range. A cone has been fired correctly when the tip just touches the ground. Cones have temperature values that assume a constant heating ramp, e.g. 150°C per hour. For example, the cone 06 has a value of 1011°C if fired at 150°C per hour; however, if it is fired at a ramp of only 60°C per hour the top temperature needs only to be 995°C to achieve the same results. The slower rate of heating has "cooked" the work more.

Only the temperatures during the last hundred degrees affect the cone; during this period the rate of heating will be slowing down whatever the ramp rate set on the controller. Kilns cannot maintain high rates of temperature increase because heat loss from the kin increases as the temperature rises; a heating ramp of 200°C per hour from 600°C will for example soon begin to slow down and at 1200°C may be in the region 100°C per hour and at 1280°C it will be more likely to be something like 10 to 15°C per hour. To correlate controller to cone accurately you must monitor the actual speed achieved for the last 100 degrees.

It is useful, if not essential, to use cones when first establishing new programs in your controller, as a cone will give you a measure of the heatwork actually achieved in the kiln. Once you have established a program that puts the appropriate cone down then the controller will replicate it for each firing.

Cones are also used to diagnose problems in the kiln, particularly they will identify unevenness of temperature throughout the kiln. It is easier to interpret cones if you use three different values, one at the desired temperature/heatwork, (the Target cone), the next one lower value (the Guide cone) and the next higher value (the Guard cone).

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The above illustration shows the three cone system, the cone on the left is the guard cone, one cone above the target cone which is the centre cone, on the right is the guide cone. The target cone is perfectly fired, the guide cone is over-fired and the guard cone is underfired.

For more information, please contact our technical staff or go to www.ortonceramic.com click their resources section.

Disclaimer: Technical advice
Technical information/guidance is given in good faith by representatives of Potclays Limited. Trial and error is a fundamental part of ceramic practice and there are an infinite number of variables from application to application. Any suggestions must be user-tested for suitability before full production is undertaken and we cannot accept any liability whatsoever for unsatisfactory results arising from advice given.

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