Formulating Iron Rich clay Bodies in a Recycled Electric Kiln

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Abstract. Clay bodies can be formulated using commonly available processed clays for a wide variety of specific functions. Some of the functions I am interested in include plasticity for throwing on the wheel, temperature range that a clay can be fired to and color for aesthetic purposes.

Research into this area by ceramic artists is ongoing. Developments in pyrometers; measuring kiln temperatures, and oxygen probes; that measure the relative atmosphere in a kiln, has improved the knowledge and quality of this research. These tools have allowed artists to critically analyze the chemical processes that affect the iron in clay and replicate results achieved when clay is fired and turned into ceramic material.

For consistent results and a fast turn around, I constructed a small gas, 2cu.ft, test kiln out of an old defunct electric kiln. My initial research involved using four different firing methods that cycled between reducing and oxidizing atmospheres on ten formulated high iron clay bodies. I looked for specific color variations in the fired test pieces that resulted from the relationships between the atmosphere and the relative temperature inside the kiln. The clays used in the research undergo vitrification in the firing process and therefore do not need to be glazed to eliminate porosity. This allows the marks made by my hands and tools to be clearly visible in the fired work, which when displayed, or used as a utilitarian object, allows the viewer access into the process of formation and a direct connection back to the maker of the object.

1. Introduction

My interest in utilitarian ceramic work stems from the interaction that is created between the user, the object and the artist. This medium allows my ideas to penetrate the domestic space surrounding an individual, becoming a vehicle through formal beauty and conceptual nourishment. Once in this space my work uses traditional constructs of naturalistic beauty to engage the user in ritualistic acts of nourishment.

In using Table Sets to provide a vehicle that elicits the viewer to become part of an act, I cultivate relationships that reach beyond the informal technologies that inhibit direct human interaction.

My direct interaction with my material and the subsequent remnants that are decipherable by a viewer, are what draws me to investigate unglazed ceramic ware. I am forever looking at ways for my work to procure time with its audience and at first to create an overall visually absorbing object, and then allow users to uncover the details of its conception.

2. Experiment, Results, Discussion, and Significance

The construction of the test kiln used is centered on three main conditions. The first and second conditions being that it needed to be inexpensive to build and constructed in an expedient manner. The third requirement for the test kiln is that it needed to be fired using natural gas as a fuel. All three of these requirements were met with the discovery and conversion of an old electric kiln. The first order of business became pulling out the old elements and removing the control panel. The kiln was then framed together with angle iron, tipped on its side, and elevated 50" off of the ground so it could easily be loaded and unloaded with tests. Two, five inch diameter, holes were drilled at the back of the kiln for the burner ports and a larger six inch diameter hole was drilled out the top of the kiln for a flue. The two burners were then mounted into place and plumbed to the main gas line anolge with two pilot burners that provide security by continuously igniting the gas coming out of the main burners. The kiln was completed by both framing the kiln lid with angle iron and welded vertically on hinges so that the door would be easily actuated and also installing a pyrometer probe into the kiln door.

The clay bodies were formulated to have a variable temperature range so they could be used in both low and high firing methods. They were also engineered to be fine grained and plastic so that they could easily be manipulated without tearing or cracking when thrown on the wheel. The amount of iron in the clay bodies was a result of two available industrially processed clays, Red Art and Laterite. These clays control the color of the finished pieces and of the ten clay bodies tested, five used Laterite and five used Red Art. The atmosphere inside the kiln was measured by the amount of flame exiting the kiln. The manipulation of the damper and the air gas mixture of the burners controlled the kiln atmosphere. When the kiln is placed in a reduction atmosphere there is more fuel than air inside of the kiln and when placed in an oxidizing atmosphere there is more oxygen than fuel inside of the kiln.

When iron inside of clay is reduced it chemically changes from red iron oxide to black iron oxide and when it is re-oxidized it turns back to red iron oxide. When this chemical change occurs relative to certain temperatures inside of the kiln its reaction is recorded by coloration of the clay after the firing. The process high temperature stoneware clay is usually run through in a normal reduction firing is as follows. The kiln is fired up in oxidation to 1600°F-1650°F, at which time it is placed in a reduction atmosphere for thirty minutes to an hour, allowing most of the red iron oxide present in the clays to turn into black iron oxide. The kiln is then placed in a neutral state, meaning neither oxidizing nor reducing, and allowed to climb in temperature until the desired maturation point of the clay is reached, at which time it is shut of and allowed to cool in an oxidizing atmosphere. Research done and published by John Neely[1] states that if the iron present in the clay is allowed to cool in a reduction atmosphere down to a temperature of around 1500°F, the converted black iron oxide cannot re-oxidize and turn to red iron oxide. This fact is due to the clays ability to seal the iron in when converted into ceramic material. The tests done on the two types of iron bearing clay bodies confirm that when a kiln is allowed to cool in a reduction atmosphere, the resulting ceramic tests come out dark grey to black. This clearly demonstrated the reaction and added a larger color range to both sets of test clay bodies.

Along with the reduction cooling method revealed by John Neely, the Laterite test group and the Red Art test group were put through four more types of firing methods. The first being an oxidation firing that was never put into a reduction atmosphere, the results of which become a control group and were on the whole light red to brown. The second Firing was a regular reduction firing in which the clay bodies turn various shades of brown. The third firing involved cooling the kiln in reduction atmosphere, but only down to 1800°F, and the clay bodies ranging in colors from dark red-brown to red-black.

Conclusions

In the final results both sets of tests were successful in that they achieved a wide range of coloration due to the various firing processes. The reduction cooling methods produced a wider variation in colors than I had anticipated and I feel that the application of this research has resulted in my ability to make a more cohesive body of work. The test kiln is also a great addition to the studio, being able to also test glazes; it has a high turn around and can be fired and unloaded in a day.

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1) John Neely, Nice Cooling, Ceramics Monthly, (American Ceramics Society), pp 48-52, 1988.