Gerry Zucca – Cone 6 Crystalline Glaze Research

Proposal For One Semester Sabbatical, FALL 2018

All images are of cone 10 crystalline

Intention:

Research and develop Cone 6 Crystalline base glazes and firing processes. Formulated glazes and processes are intended to be used by Moorpark College ceramics students, glaze design students, sculpture students, 3D design students, similar courses at the other district colleges, me.

Goal:

1. Formulate three cone 6 crystalline base glazes
2. Formulate five different colorant combinations that work well with each base glaze.

Introduction:

I propose a one semester project researching, testing and developing Cone 6 (2269ºF) crystalline glazes. I have completed some preliminary testing and verified that it is possible to grow crystals in a Cone 6 glazes.

The crystalline process is difficult to master. It involves the use of glazes that allow crystals to grow during the firing process. With the right mix of materials, the glaze will melt at a specific temperature. As the glaze cools the kiln will be held at the crystal growing temperature so the zinc and silica in the glaze crystallize. Varying patterns and colors can be manipulated by modifying materials and temperature. First the crystalline glaze must be formulated. Then it must be fired in an oxidation environment (oxidation – ample amount of oxygen in the kiln during the firing). After the glaze is melted the kiln temperature is lowered and held within the crystal growth temperature for that glaze.

Typically crystalline glazes are formulated to fire at Cone 10, in programmable electric kilns. One of the big draw back of this is that firing to Cone 10 uses a lot of energy and it burns up the kiln elements really quickly. This makes the crystalline process very expensive. For these reasons it is rare that community college students have access to this process.

My theory is that Cone 6 crystalline a good compromise. The crystals may be a bit different from the standard Cone 10 crystals; however my preliminary research has shown that they are also beautiful and unique. Research and analysis will be required to formulate the new crystalline base glazes. Once they are formulated they will need to be tested at various temperatures to discover the crystal growth range. Firing a kiln is a combination of art and science. Many tests will have to be made before discovering the right glaze formulation and firing process. Once viable base glazes are found to be successful, colorant tests will be used to produce variations in color.

The idea of developing Cone 6 crystalline is relatively new. There is little information on this process. If we develop a lower temperature, Cone 6, crystalline process, Moorpark College would be leading the way in a new exciting area of ceramics. This lower temperature process will make crystalline affordable and accessible to our students and the community.

Image of cone 10 crystals

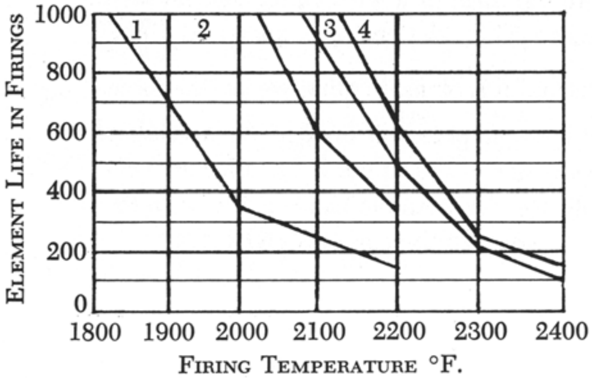
Results/Benefits:

Developing lower temperature crystalline (Cone 6) glazes will make the crystalline process accessible and affordable to our students. This will primarily benefit Moorpark College students (ART M71, M72, M73, M74, M75, M77, M78, M23) and interested students in similar courses at the other district locations. Our students will be able to produce impressive portfolio pieces that will help them to get into the top art colleges in the nation. Some of our students start their own ceramics production businesses. They will have knowledge, practice and experience in making highly marketable pieces. Knowledge from this research helps to fulfill the district and college goals of supporting student learning and student success.

The creation of Cone 6 crystalline glazes is a new idea that will save money on energy and equipment. I have discussed this idea with other ceramics faculty, art faculty and the dean. All agreed that with would be beneficial to the students, art program, district and community.

Cone 10 crystalline is the standard and is very costly. The experts on crystalline all talk about and share information on cone 10 crystalline glazes, John Britt, Ceramics Monthly magazine, Jon and Lori Price, Diane Creber, Marie Wright. Some of these experts mention that lower temperature crystalline can be done, however none do it or have formulas to recommend. Searching on the web for cone 10 crystalline will yield hundreds of sights with information on glaze formulation and firing. Searching on the web for cone 6 crystalline yields no real sights that have adopted or researched this process (don’t be confused by “slow cool cone 6 crystalline” which is something completely different).

Firing cone 10 crystalline uses a lot of electricity and the kiln elements burn out quickly. The chart below shows how the number of firings (life) elements can withstand Vs. the firing temperature.



The graph at left shows the comparative number of firings that may be expected from each of four different alloys under identical conditions. Curve 1 represents a Nickel-Chromium alloy; Curve 2 represents Kanthal D; Curve 3 represents Kanthal A; and Curve 4 represents Kanthal A-1. Read vertically to compare alloys: for example, if every firing is to 2100°, A-1 will last over 1000 firings, A will last 950, D will last 600 and Nickel-Chromium only 150. Maximum temperature for equal life from each alloy may be read horizontally. Larger wire will give longer life than shown.

Only some elements will go to cone 10 (these are more expensive). Cone 6 is 2269° F and Cone 10 is 2377 °F. This may not seem like a big difference in temperature, but as can be seen by the chart above, at cone 6 the elements would last four to six times longer than if fired to cone 10! With cone 10 crystalline we are forced to replace the elements every two semesters, $400 and 3 hours labor. The higher the temperature and the longer the kiln spends at the high temperatures the more it wears and cracks. Firing to cone 6 Vs. cone 10 saves about two hours of kiln wear and energy use per firing. That is a lot! I don't have an exact calculation for the amount of electricity, but we would use approximately 20% less. This is a substantial savings for the college and the district.

Due to the high cost, we greatly limit the students' ability to experiment with the crystalline process. Firing at Cone 6 will use less resource, preserve our kilns, and allow our students to have more access to the crystalline glaze process.

All pieces are cone 10 crystalline

Action:

Step 1 – Initial research

(August 2019)

A. Research existing literature on crystalline glazes and firing process (see appendices for text list)
B. Consult with experts in the crystalline firing process
    1. Xavier Gonzalez, crystalline ceramics artist.
    2. Visit Marie Wright Crystalline studio (Visit South Carolina)
    3. Crystalline Glaze Workshop with Matt Horne
C. Research possible frits to be used in new glaze formulas (Frits are complex manufactured glaze material combinations)
D. Formulation of five new glazes using existing cone 10 recipes, and new frits with the aid of formulation software (to analyze the recipe unity formula).

Step 2 – Create base glaze formulations, theoretical calculations
(September – October 2019)

A. Make first best guess of six different base glazes ideas
B. Glaze formulation software to adjust first best guesses.

Step 3 – Base Glaze test and crystal growth firing test
(September – October 2019)

A. Melt test on porcelain clays at Cone 6 temperatures to adjust for glaze melt temperature
B. Multiple crystal growth test series to find optimal crystal growth Temperature
C. Test glaze formulations, multiple ideas tested in one firing

Step 4 – Analyze results
(September – October 2019)

A. What's working what's not
B. Theorize on what needs to be done to adjust the promising glazes.

Step 5 – Adjust, mix and re-test (Step 3 and Step 4)
(September – October 2019)

A. Continue to do Steps 3 through Steps 4 until good cone 6 crystal growth is achieved.
B. Retest for reliability and consistancey

Step 6 – Formulate colorant test on viable base glazes

(November 2019)

Step 7 – Test fire colorant test

(November 2019)

A. Multiple ideas tested in each firing
B. Colorant test firings to find effects of oxides on color (cobalt, copper, nickel, iron manganese, stains)

Step 8 – Adjust and re-test (Step 7)

(November 2019)

Step 9 – Write a report

(December 2019)

A. Assess results
B. Document results
C. Write a written report

Step 10 – Post Sabbatical

(Spring 2019)

Disseminate results with students, other instructors othe district location instructors, submit for publication.

I will share the results with students (Spring 2019) by beginning a regular Cone 6 crystalline process for Moorpark College students. Moorpark College students in (ART M71, M72, M73, M74, M75) will be able to formulate and experiment with their own Cone 6 crystalline glazes. As part of an assignment students will produce sets of test glazes. Successful tests will be hung on the classroom glaze tile wall and the students get to name the glazes. Students who discover new glazes and name them often feel a great sense of pride and accomplishment when their glaze formulas are adopted into the studio pallet.

Over the scope of this project I estimate that I will have to fired 80 to 120 tests pieces.

Note: No new equipment or materials are needed.

Summary

In doing this research I will expand my own understanding of glazes and firing. I will integrate this new knowledge into my courses and my own art work.

Moorpark students in the Glaze Design and Ceramics Design class will have direct use of the knowledge learned during the semester sabbatical. The students will use my sabbatical research results to facilitate the development of Cone 6 crystalline glazes.

This knowledge and transformation to lower firing temperature will be an asset to the college. The crystalline process will become accessible to all ceramics students at Moorpark College and to other ceramics programs in the district. It supports the district and college goals of aiding in student learning and student success.

We will fire the kilns for fewer hours at lower temperatures, consume less energy and extend the life of the kiln elements (which are expensive and time consuming to change). Shorter firing times will extend the life of the kilns due to less wear and tear. The improved use and life span of the kilns as well as the cost savings will be of significant financial benefit to Moorpark College and the District.

Our community will benefit from this project by seeing a new exciting variety of ceramics pieces with new colors and new textures in our very popular ceramics sales. And we will lower the overall environmental impact of our program.

During the past five years I have begun some preliminary research on the Cone 6 crystalline firing process, but I haven’t had the time to complete the work while teaching. During the regular semester other responsibilities have taken priority. The research that was outlined above is needed in order for this project to be realized. In the course of a single semester sabbatical I will focus on research and development of Cone 6 Crystalline glazes and firing processes. The students, the college, the district, and the community will benefit from the tangible results of this project.

Appendices: Text List

Diane Creger, Crystalline Glazes / Edition 2, (2005)

Jon Price, The Art of Crystalline Glazing : Basic Techniques, (2004)

Fara Shimbo, Crystalline Glazes: Understanding the Process and Materials, (2013)