Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

Content:

1. Sabbatical Goals
2. Summary
3. Guideline On Converting Cone 9 glazes to Cone 6
4. Original Sabbatical Proposal

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

1. Sabbatical Goal

In recent years I have begun preliminary research that indicates our program will benefit greatly from lowering our glaze fire temperature from cone 9 (2336 °F) to Cone 6 (2269 °F) or Cone 5 (2205 °F). Lowering the firing temperature will have many benefits and some possible drawbacks. If we lower the temperature of our glaze fires we will be able to achieve many more bright colors, pottery and sculptures will warp and crack less, we will save money by using less energy, we will create less pollution and the kilns will last longer. However, the lower we go with the temperature the less vitrified (in essence less hard) the pieces will become. Copper red glazes will be more difficult to achieve and the lower silica content in the glazes will make the ceramics less durable. Further research will enable me to find the happy medium.

My theory is that Cone 6 or Cone 5 will yield a good compromise. Research and analysis will be required to select the best glaze fire temperature for the program at Moorpark College. Once the new firing temperature is selected, we need to learn how to effectively fire to that temperature. Firing a kiln is a combination of art and science. Many tests will have to be made before we find the best firing process with just the right amount of reduction.

Our 32 glaze recipes will need to be reformulated to fire to the new temperature. New example test tiles will need to be created. This part of the project will be done by the students in my Glaze Design course. Once all this work is completed, the ceramics studio could switch to the lower temperature, at the start of the following semester. We hope to achieve all the good effects of Cone 9 glaze firing with additional benefits of lower temperature firing.

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

Initial test done at the beginning of sabbatical investigation, Spring 2011

Cone 6 glaze test tiles used by students, Spring 2012

2. Summary

All the goals of the sabbatical were met:

1. Cone 6 firing was selected as the new stoneware firing temperature.
2. Initial tests showed some difficulties converting cone 9 glazes to cone 6 temperatures. After much more testing, some effective methods of converting cone 9 glazes to cone 6 glazes were proven successful.
3. Hundreds of test glazes were mixed and fired to test theoretical strategies.
4. Guidelines for cone 9 to cone 6 glaze conversions were developed.
5. I learned how to successfully fire to cone 6, achieving difficult colors: reduction red and shino glazes.
6. The guideline report was presented to the advanced glaze students so that they could apply my findings, Fall 2011 semester.
7. Together, the students and I developed a new palette of cone 6 glazes in the Fall 2011. Substitute cone 6 glazes were developed for almost all the cone 9 glazes that the ceramics studio used.
8. Several new color and effects were also created.
9. Spring 2012, the entire ceramics studio was converted to cone 6 firing.
10. The guidelines that were developed during the sabbatical continue to be used to develop new glazes.

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

Cone 6 glazes on my “facet” series

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

3. Guideline Report to Glaze Students

How to Convert a Cone 9 Glaze to Cone 6

Three Methods

1. Find a Cone 6 recipe (books and internet and other) that looks like the Cone 9 glaze.
   Make sure that both color and finish (glossy, satin, matt, opaque, translucent) are the same.

2. Use a Cone 6 base glaze with similar flux combination, then add Cone 9 colorants from original recipe.
   The unity formula is needed to do this analysis.
   The new base glaze formula should have a similar finish (glossy, satin, matt) a similar ratio of fluxes. Glaze formulation software must be used to do this step. At Moorpark we have ***glazemaster*** software to do this, but any software that converts recipes to the unity formula will work.

3. Alter Cone 9 glaze to melt at Cone 6.
   The unity formula of the original Cone 9 recipe is needed to do this analysis.
   Lower the amount of Silica (Si) and Alumina (Al) in the recipe.
   Keep the fluxes in the formula at about the same levels.
   Keep the Silica / Alumina ratio the same.

Introduction

The information in this report was accumulated over the 2011 Spring and Summer semesters. Using the glaze software to alter glazes then mixing and firing some theories were discarded and new theories were developed. A total of six firing were completed. The last three were using the Giel programmable kiln. We were able to successfully develop Shino and red glazes and a total of twenty other Cone 6 glazes.

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

The success of these experiment is greatly due to the help of a very dedicated group of ceramics students that helped me to mix and assess the hundreds of glaze test that were completed. The students that helped me are (in alphabetical order):

Christine Barkan
Jill Hartman
BettyJo Jones
Karle Koerbling
Steve Martin
Idit Roth
Alex Shahoumian
Marion Wood
Marie Wright

Method 1

Find a Cone 6 recipe (books and internet and other) that looks like the Cone 9 glaze. This may seem like the easy way, but until the recipe is tested in our kiln with a Cone 6 reduction firing it is not known if the new recipe is really similar in color and finish. Often it is best to find a few recipes and test them all out in the same firing.

When looking at other recipes it is hard to get an accurate idea of the color and finish of the glaze. Images in books and on the internet will distort or alter the color.   Look for a description of the glaze that indicates if it is glossy, satin, semi matt or satin. Also look for any information that indicates the translucence or opacity of the glaze.

Method 2

Use a Cone 6 base glaze with similar flux combination, then add Cone 9 colorants from original recipe.
Fluxes in a glaze are the materials that cause the glassy elements (Silica and Boron) in the glaze to melt at a lower temperature. The flux materials are:

Lithium Oxide	Li_2O
Sodium Oxide	Na_2O
Potassium Oxide	K_2O
Magnesium Oxide	MgO

Calcium Oxide	CaO
Strontium Oxide	SrO
Barium Oxide	BaO
Zinc Oxide	ZnO
Lead Oxide	PbO

The Unity formula, which most glaze formulation programs will use, will have all the flux materials add up to a one. This is why it is called the unity formula. Most glazes do not utilize all the fluxes.

An example of a Unity formula: The three fluxes in the Flux column add up to 1.0

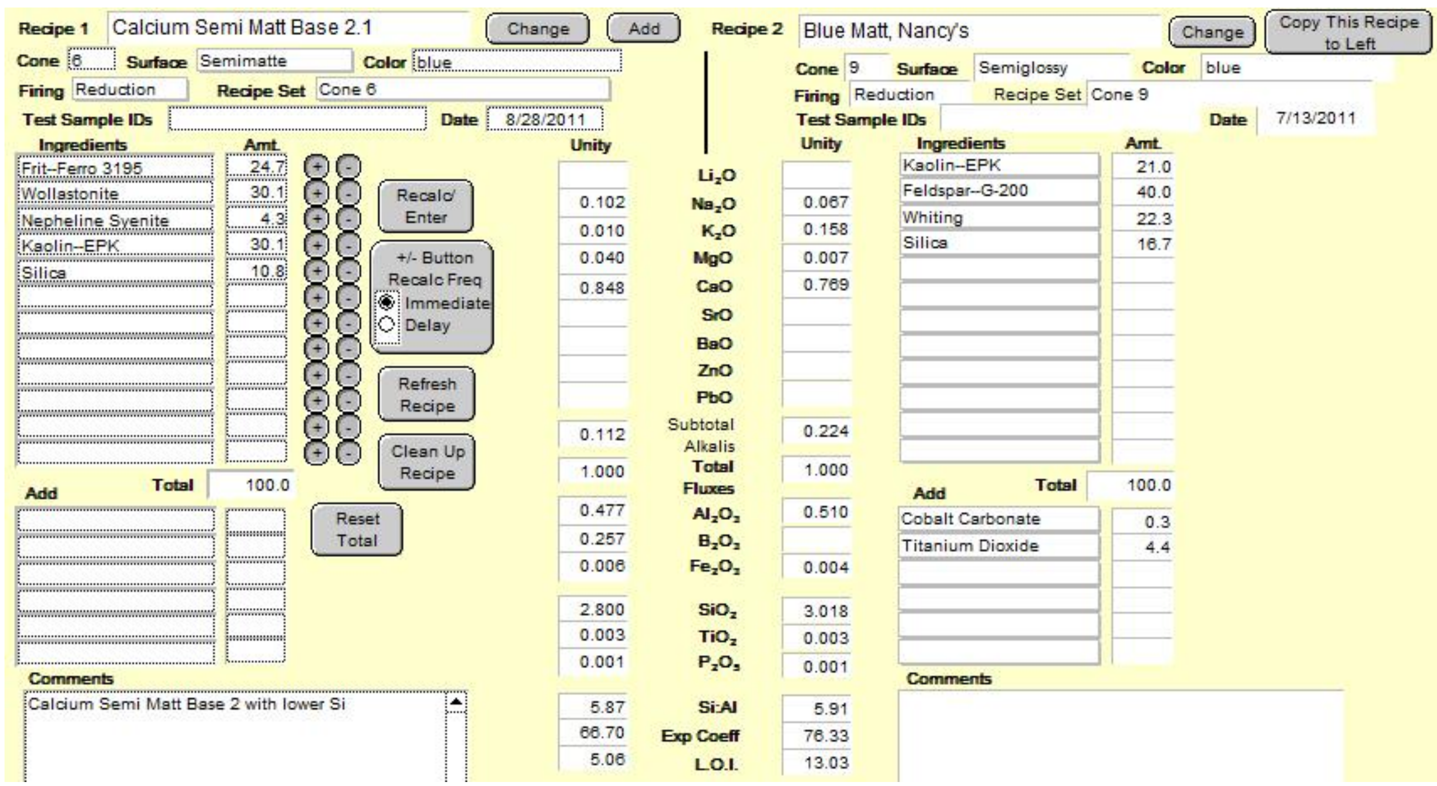
Flux		**Amphoteric**		**Glass former**	
Na_2O	0.5	Al_2O_3	0.3	SiO_2	2.5
K_2O	0.25				
CaO	0.25				

An example of how to implement Method 2 is shown below:

Converting Cone 9 Nancy's Blue Matt to Cone 6

The first step is to look at the Unity formula for Nancy's Blue Matt. The fluxes for this glaze indicate that it uses mostly calcium oxide as a flux (CaO = 0.769). Then a cone 6 base glaze that is satin in finish and calcium rich needs to be found. Calcium Semi Matt Base 2.1 (from Mastering Cone 6 glazes) has high calcium flux (CaO = 0.848 and is satin in finish. If this base glaze is used with the colorants that are used in Nancy's blue matt, it is likely that the glaze will look a lot like the Cone 9 Nancy Blue Matt.

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical



Recipe 1: Calcium Semi Matt Base 2.1 — Change — Add

Cone: 6 — Surface: Semimatte — Color: blue

Firing: Reduction — Recipe Set: Cone 6

Test Sample IDs: — Date: 8/28/2011

Ingredients	Amt.
Frit--Ferro 3195	24.7
Wollastonite	30.1
Nepheline Syenite	4.3
Kaolin--EPK	30.1
Silica	10.8
Total	100.0

Add

Recalc/ Enter — +/- Button Recalc Freq: Immediate / Delay — Refresh Recipe — Clean Up Recipe — Reset Total

Comments: Calcium Semi Matt Base 2 with lower Si

Recipe 2: Blue Matt, Nancy's — Change — Copy This Recipe to Left

Cone: 9 — Surface: Semiglossy — Color: blue

Firing: Reduction — Recipe Set: Cone 9

Test Sample IDs: — Date: 7/13/2011

Ingredients	Amt.
Kaolin--EPK	21.0
Feldspar--G-200	40.0
Whiting	22.3
Silica	16.7
Total	100.0
Add	
Cobalt Carbonate	0.3
Titanium Dioxide	4.4

Comments

Unity (Recipe 1)		Unity (Recipe 2)
	Li_2O	
0.102	Na_2O	0.067
0.010	K_2O	0.158
0.040	MgO	0.007
0.848	CaO	0.769
	SrO	
	BaO	
	ZnO	
	PbO	
0.112	Subtotal Alkalis	0.224
1.000	Total Fluxes	1.000
0.477	Al_2O_3	0.510
0.257	B_2O_3	
0.006	Fe_2O_3	0.004
2.800	SiO_2	3.018
0.003	TiO_2	0.003
0.001	P_2O_5	0.001
5.87	Si:Al	5.91
66.70	Exp Coeff	76.33
5.06	L.O.I.	13.03

As can be seen by the screen capture above, when comparing the Cone 6 Calcium Semi Matt Base 2.1 with the Cone 9 Nancy's Blue Matt the flux proportions are similar (not equivalent). But the Silica and Alumina are both lower and the Silica/Alumina ratio is almost the same (5.87 vs 5.91).

Method 3

Alter Cone 9 glaze to melt at Cone 6. The description below will give guidelines on how to do this. But in no way can these guidelines be considered rules or laws.

First, what not to do. Do **not** add more flux to the recipe so that it will melt at a lower temperature. It is correct that this will change the proportions of fluxes in the Unity formula and result in a glaze that will melt at a lower temperature, however it will also, most likely, look very different in color and finish from the original glaze.

What has worked best is lowering the Silica and Alumina levels while holding the Silica/Alumina ratio and the fluxes constant (or close to the same). If the Silica and Alumina levels are lowered to levels that are appropriate for cone 6 glazes, then the glaze will melt at a lower temperature (most likely at cone 6). If the Silica/Alumina ratio stays constant, then the finish qualities of the glaze should stay the same (glossy, satin, matt). If the fluxes and their ratio stay constant, then the colorants in the glaze should yield a similar color.

Most recipes have clay and Silica in them. By lowering the clay content (Kaolin or Ball Clay), both Si and Al will be decrease. Do not completely eliminate clay from the recipe. At least 5% is needed to keep the mixed glaze floating in water. Often the amount of Silica also needs to be altered to retain keep the Silica/Alumina ratio the same. The Unity formula number value for Silica and Alumina needs to be 1.0 to 0.5 less than the initial values.

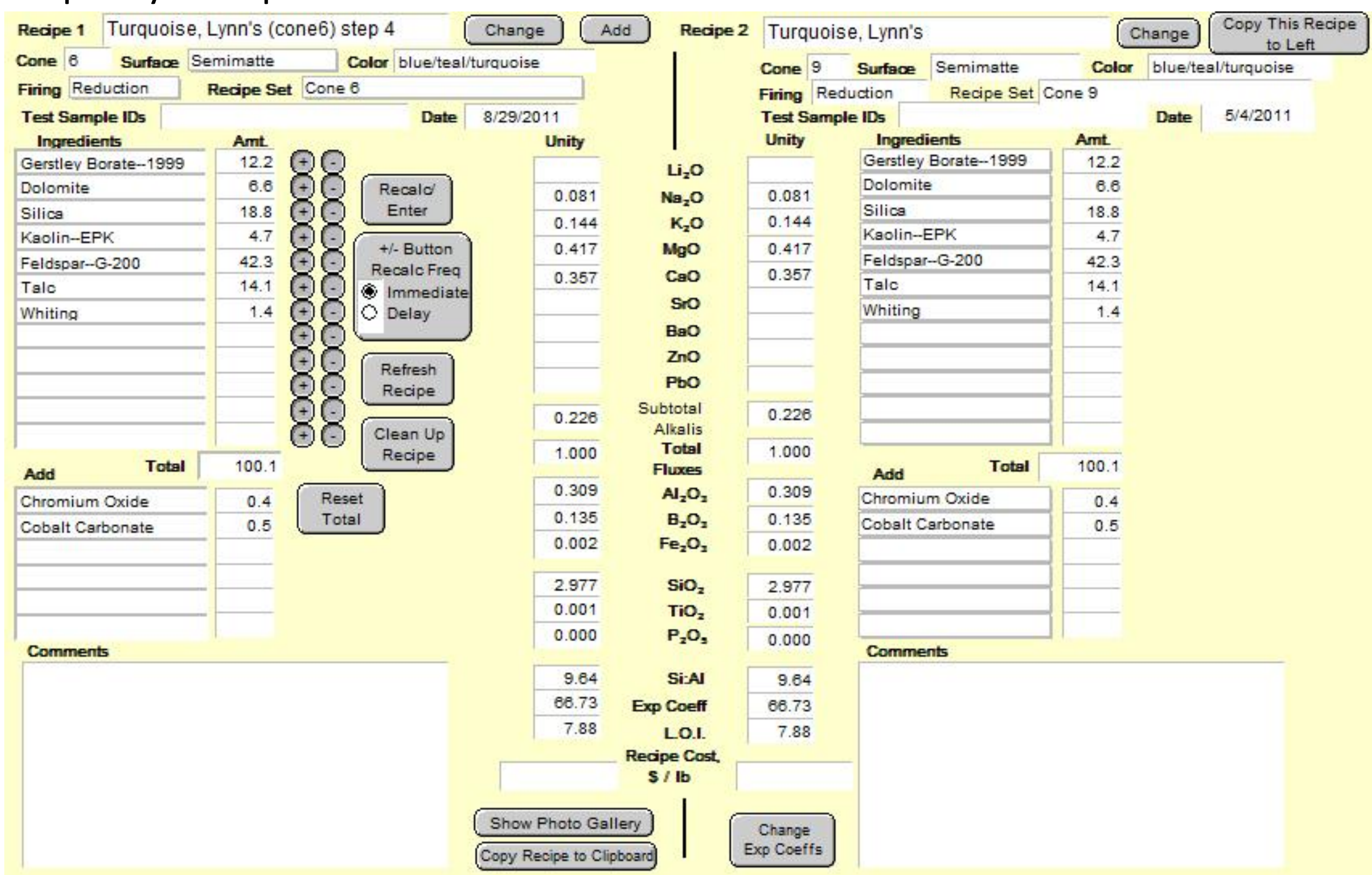
Step by step process:

1. Enter the known Cone 9 glaze into the glaze formulation software
2. Analyze the Unity formula to develop a strategy for lowering Si and Al.
3. Copy over the Cone 9 recipe with a new name. Ex. Nancy Blue (cone6)
4. View both recipes at the same time. Both should be the same at this point.
5. Start lowering Si and Al values by lowering the amount of clay
6. Once the Si and Al are 1..0 to 0.5 lower then adjust the Silica content to match the Si/Al ratio

7. Mix and test fire this recipe. In the test, vary one material (such as Si)

8. If the test results are desirable, then recalculate the batch mix so that is adds up to 100

Example of Lynn's Turquoise



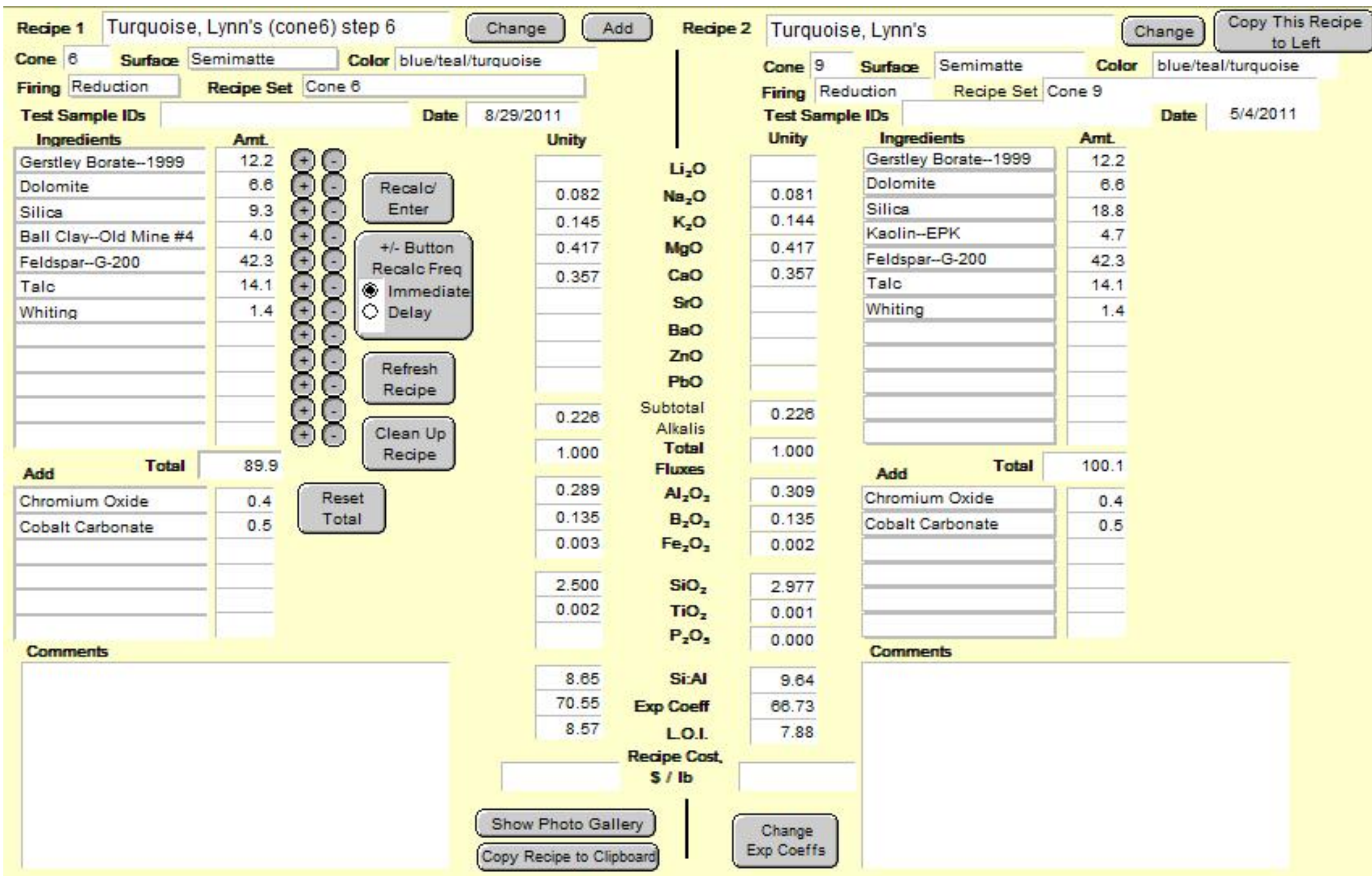
	Recipe 1	Recipe 2
Recipe	Turquoise, Lynn's (cone6) step 4	Turquoise, Lynn's
Cone	6	9
Surface	Semimatte	Semimatte
Color	blue/teal/turquoise	blue/teal/turquoise
Firing	Reduction	Reduction
Recipe Set	Cone 6	Cone 9
Test Sample IDs		
Date	8/29/2011	5/4/2011

Ingredients	Amt. (Recipe 1)	Amt. (Recipe 2)
Gerstley Borate--1999	12.2	12.2
Dolomite	6.6	6.6
Silica	18.8	18.8
Kaolin--EPK	4.7	4.7
Feldspar--G-200	42.3	42.3
Talc	14.1	14.1
Whiting	1.4	1.4
Total	100.1	100.1
Add		
Chromium Oxide	0.4	0.4
Cobalt Carbonate	0.5	0.5

Unity (Recipe 1)		Unity (Recipe 2)
	Li_2O	
0.081	Na_2O	0.081
0.144	K_2O	0.144
0.417	MgO	0.417
0.357	CaO	0.357
	SrO	
	BaO	
	ZnO	
	PbO	
0.226	Subtotal Alkalis	0.226
1.000	Total Fluxes	1.000
0.309	Al_2O_3	0.309
0.135	B_2O_3	0.135
0.002	Fe_2O_3	0.002
2.977	SiO_2	2.977
0.001	TiO_2	0.001
0.000	P_2O_5	0.000
9.64	Si:Al	9.64
66.73	Exp Coeff	66.73
7.88	L.O.I.	7.88
	Recipe Cost, $ / lb	

Change | Add | Change | Copy This Recipe to Left
Recalc/ Enter
+/- Button Recalc Freq: Immediate / Delay
Refresh Recipe
Clean Up Recipe
Reset Total
Comments
Comments
Show Photo Gallery
Copy Recipe to Clipboard
Change Exp Coeffs

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical



Recipe 1 Turquoise, Lynn's (cone6) step 6 — Change — Add

Cone 6 **Surface** Semimatte **Color** blue/teal/turquoise

Firing Reduction **Recipe Set** Cone 6

Test Sample IDs **Date** 8/29/2011

Recipe 2 Turquoise, Lynn's — Change — Copy This Recipe to Left

Cone 9 **Surface** Semimatte **Color** blue/teal/turquoise

Firing Reduction **Recipe Set** Cone 9

Test Sample IDs **Date** 5/4/2011

Recipe 1 Ingredients	Amt.	Recipe 2 Ingredients	Amt.
Gerstley Borate--1999	12.2	Gerstley Borate--1999	12.2
Dolomite	6.6	Dolomite	6.6
Silica	9.3	Silica	18.8
Ball Clay--Old Mine #4	4.0	Kaolin--EPK	4.7
Feldspar--G-200	42.3	Feldspar--G-200	42.3
Talc	14.1	Talc	14.1
Whiting	1.4	Whiting	1.4
Total	89.9	**Total**	100.1
Add		**Add**	
Chromium Oxide	0.4	Chromium Oxide	0.4
Cobalt Carbonate	0.5	Cobalt Carbonate	0.5

Recalc/ Enter — +/- Button Recalc Freq: Immediate / Delay — Refresh Recipe — Clean Up Recipe — Reset Total

Recipe 1 Unity		Recipe 2 Unity
	Li_2O	
0.082	Na_2O	0.081
0.145	K_2O	0.144
0.417	MgO	0.417
0.357	CaO	0.357
	SrO	
	BaO	
	ZnO	
	PbO	
0.226	Subtotal Alkalis	0.226
1.000	**Total Fluxes**	1.000
0.289	Al_2O_3	0.309
0.135	B_2O_3	0.135
0.003	Fe_2O_3	0.002
2.500	SiO_2	2.977
0.002	TiO_2	0.001
	P_2O_5	0.000
8.65	Si:Al	9.64
70.55	Exp Coeff	66.73
8.57	L.O.I.	7.88
	Recipe Cost, $ / lb	

Comments

Comments

Show Photo Gallery — Copy Recipe to Clipboard — Change Exp Coeffs

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

Recipe 1 Turquoise, Lynn's (cone 6) [Change] [Add]

Cone 6 **Surface** Semimatte **Color** blue/teal/turquoise

Firing Reduction **Recipe Set** Cone 6

Test Sample IDs **Date** 5/4/2011

Ingredients	Amt.
Gerstley Borate--1999	13.6
Dolomite	7.3
Silica	10.3
Ball Clay--Old Mine #4	4.4
Feldspar--G-200	47.1
Talc	15.7
Whiting	1.5
Total	99.9

Add	
Chromium Oxide	0.4
Cobalt Carbonate	0.5

Recalc/ Enter

+/- Button Recalc Freq
- ◉ Immediate
- ○ Delay

Refresh Recipe

Clean Up Recipe

Reset Total

Comments

best 10g si

Change silica 10g, 13g 15g, original

Unity (Recipe 1)		Unity (Recipe 2)
	Li_2O	
0.082	Na_2O	0.081
0.145	K_2O	0.144
0.417	MgO	0.417
0.356	CaO	0.357
	SrO	
	BaO	
	ZnO	
	PbO	
0.227	Subtotal Alkalis	0.226
1.000	Total Fluxes	1.000
0.289	Al_2O_3	0.309
0.135	B_2O_3	0.135
0.002	Fe_2O_3	0.002
2.504	SiO_2	2.977
0.002	TiO_2	0.001
	P_2O_5	0.000
8.65	Si:Al	9.64
70.55	Exp Coeff	66.73
8.54	L.O.I.	7.88
	Recipe Cost, $ / lb	

Show Photo Gallery

Copy Recipe to Clipboard

Change Exp Coeffs

Recipe 2 Turquoise, Lynn's [Change] [Copy This Recipe to Left]

Cone 9 **Surface** Semimatte **Color** blue/teal/turquoise

Firing Reduction Recipe Set Cone 9

Test Sample IDs **Date** 5/4/2011

Ingredients	Amt.
Gerstley Borate--1999	12.2
Dolomite	6.6
Silica	18.8
Kaolin--EPK	4.7
Feldspar--G-200	42.3
Talc	14.1
Whiting	1.4
Total	100.1

Add	
Chromium Oxide	0.4
Cobalt Carbonate	0.5

Comments

4. Sabbatical Proposal (Spring 2011)

Intention – research, develop Cone 5 and Cone 6 firing process

Action – research, assess, decide, test

Results/Benefits – transition to lower temperature glaze firing = more color, less environmental impact

Introduction:

I propose a two semester project with the initial research and testing completed over a one semester sabbatical. I teach courses in ceramics, glaze design and sculpture. I organize and facilitate the ceramics lab (this includes equipment needs, materials ordering, and firing of kilns). Currently the ceramics studio glaze and firing process is designed around a specific high fire temperature (Cone 9, 2336 °F). Our glaze formulas, mixed by the students, have been perfected for this specific temperature. We have 30 years of experience with glazes and firing to this temperature. Cone 9 yields durable and beautiful results. It will not be easy to switch to a new temperature, but there could be many benefits to firing at a lower temperature. This is what I intend to research.

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

In recent years I have begun preliminary research that indicates our program will benefit greatly from lowering our glaze fire temperature from cone 9 (2336 °F) to Cone 6 (2269 °F) or Cone 5 (2205 °F). Lowering the firing temperature will have many benefits and some possible drawbacks. If we lower the temperature of our glaze fires we will be able to achieve many more bright colors, pottery and sculptures will warp and crack less, we will save money by using less energy, we will create less pollution and the kilns will last longer. However, the lower we go with the temperature the less vitrified (in essence less hard) the pieces will become. Copper red glazes will be more difficult to achieve and the lower silica content in the glazes will make the ceramics less durable. Further research will enable me to find the happy medium.

My theory is that Cone 6 or Cone 5 will yield a good compromise. Research and analysis will be required to select the best glaze fire temperature for the program at Moorpark College. Once the new firing temperature is selected, we need to learn how to effectively fire to that temperature. Firing a kiln is a combination of art and science. Many tests will have to be made before we find the best firing process with just the right amount of reduction.

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

Our 32 glaze recipes will need to be reformulated to fire to the new temperature. New example test tiles will need to be created. This part of the project will be done by the students in my Glaze Design course. Once all this work is completed, the ceramics studio could switch to the lower temperature, at the start of the following semester. We hope to achieve all the good effects of Cone 9 glaze firing with additional benefits of lower temperature firing.

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

The Project Organization:

1. Initial research –
   A. Research existing literature on lower temperature glazes and glaze firing (see appendices for text list)
   B. Tour Colleges during February and March that fire to Cone 6 or Cone 5. I will schedule my visit of the colleges to coincide with the firing and the unloading of the kilns.
   The list of colleges includes:

      CSU Long Beach, Cone 5 and Cone6

      CSU Fullerton, Cone 5

      Humboldt State University, Cone 6

      Santa Barbara Community College, Cone 5

      Oxnard Community College, Cone 5

   C. Attend conferences and workshops by know experts in the field (**conference and workshop exact dates are not yet available for Spring 2011**)

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

1. NCECA conference - National Council on Education for the Ceramic Arts is an annual conference (April, 2011) and will be in the West Coast in 2011.
2. John Britt's Reduction Firing workshop (May, 2011)
3. Paul Giel workshop on Reduction High Fire with a Gas Kiln (May, 2011). Paul Giel is the kiln manufacture of the large car kilns that we use at Moorpark College.

D. Vitrification test on stoneware clays at Cone 5 and Cone 6 temperatures. Using four different stoneware clays and porcelain, I will compare hardness and vitrification differences at Cone 5, Cone 6 and Cone 9.

E. Weigh the pros and cons of each temperature and select one as our new glaze fire temperature.

2. Preliminary glaze test and firing test

   A. Test fire five of the existing cone 9 glaze formulas to the new temperature.

   B. Reformulate five glazes using glaze formulation software and glaze limit formulas.

   C. Test reduction firings to new temperature with small samples in a gas kiln. This test should include copper reds and shino glazes, which will be difficult to reproduce cone 9 results. Successful firing at this new

temperature can only be achieved by trial and error. A detailed log must be kept for each firing. Gas pressure and flue opening are manually adjusted over time to create the appropriate atmosphere for the development of reds. I expect firing time will be shortened by approximately two hours for each firing that currently take 10 hours. Once this is implemented in the studio it should result in a savings of 24 hours of firing time over the course of each semester. These test fires will be done at Moorpark College.

3. Test firing
   A. Test firing of larger works. I will use a series of pieces that I create during the sabbatical to test these new glazes and to determine if we can get reliable results on larger ceramics art work.
   B. Assessment of results will be documented in detail to serve as a guide to the reformulation of the remaining glazes.
4. Reformulation of the remaining glazes from Cone 9 to new firing temperature will be done by the students in my Glaze Design course. Once I return from sabbatical this task will be integrated into the Glaze Design course. On average, reformulation of a glaze takes three to four test firings. As part of the assignment the students will produce the set of example test tiles that will hang on the classroom glaze tile wall. Students

will feel a great sense of pride when their glaze formulas are adopted for the studio.

5. Switch over at the beginning of the next semester (Spring 2012) to the new glaze formulas and the new glaze firing temperature. **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 class have direct use of the knowledge learned during the semester sabbatical. The students will use my sabbatical research results to facilitate the reformulation of the glazes. Students in ceramics, 3-D design and sculpture will benefit by having less warping and cracking in their work as well as having a larger more vibrant color pallet available.

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

This knowledge and transformation to lower firing temperature will be an asset to the school; we will fire the kilns for fewer hours, consume less energy. 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 great financial benefit to Moorpark College.

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 5 and Cone 6 firing process, but I haven't had the time to do this important project while teaching. During the regular semester, other projects and responsibilities have pushed this project back. 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 this important project and the students, the college and the community will benefit from the tangible results.

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

Gerry Zucca Sabbatical Report , Spring 2011 sabbatical

Appendices: Text List

John Hesselberth and Ron Roy, *Mastering Cone 6 Glazes,* (2002)

James Chappell, *The Potter's Complete Book of Clay and Glazes: A Comprehensive Guide to Formulating, Mixing, Applying and Firing Clay Bodies and Glazes*, (1991)

Brian Sutherland, *Glazes from Natural Sources*, (2006)

Michael Baile, *Glazes Cone 6,* (2001)