Raw Materials Cookbook 2007

"No turning back"
-2007 Raw Materials class-
Name: Margaret Angelo  
Type: Underglaze/Overglaze  
Color: Various  
Texture: n/a  
Cone: 6

Recipe:  

(Note: Some recipes are not out of 100%!!!)

<table>
<thead>
<tr>
<th>Mamo</th>
<th>MLA</th>
<th>Dragon White</th>
<th>R-1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neph Sy</td>
<td>Custer</td>
<td>Kona F-4</td>
<td>Neph Sy</td>
</tr>
<tr>
<td>52.0%</td>
<td>53.9</td>
<td>42</td>
<td>34.65%</td>
</tr>
<tr>
<td>Whiting</td>
<td>Frit 3124</td>
<td>Cornwall Stone</td>
<td>Wollastonite</td>
</tr>
<tr>
<td>3.0%</td>
<td>13.2</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>EPK</td>
<td>Whiting</td>
<td>Whiting</td>
<td>Strontium Carb.</td>
</tr>
<tr>
<td>22.0%</td>
<td>10.0</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Dolomite</td>
<td>Dolomite</td>
<td>EPK</td>
<td>EPK</td>
</tr>
<tr>
<td>18.0%</td>
<td>18.0</td>
<td>5</td>
<td>9.13%</td>
</tr>
<tr>
<td>Flint</td>
<td>EPK</td>
<td>Zinc</td>
<td>Laguna Borate</td>
</tr>
<tr>
<td>5.0%</td>
<td>.8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Add Tin Ox.</td>
<td>Veegum</td>
<td>Titanium Dioxide</td>
<td>Flint</td>
</tr>
<tr>
<td>8.0</td>
<td>.5</td>
<td>4</td>
<td>9.13%</td>
</tr>
</tbody>
</table>

Development Process: The purpose of this research was to develop an overglaze for cone 6 firings.

I started my research by doing a line blend to figure out the percentage of colorant needed to produce the qualities I was after.

All points had 20% ball clay and 1% CMC. At the first point (1.1), I started with 70% colorant and 10% Neph Syenite. The last point on this line blend (1.7) reversed the colorant and Neph Syenite quantities.

I painted stripes using each of these points on bare clay, overttop of a glaze and under a glaze.

This line blend set was applied over top of the MAMO glaze.
1.1 1.2 1.3 1.4

Glazed

Unglazed

Overglaze over glaze
Overglaze over clay
Overglaze under glaze

1.5 1.6 1.7

Raw Mats - Spring 2007 - Carlo Sammarco - NYSCC @ Alfred University
I chose 1.4 as the ratio of flux to stain that worked best (the number after the decimal refers to the percentage of stain)

**Overglaze 1.4**
- Colorant 40%
- Neph Sy 40%
- Ball Clay 20%
- CMC 1%

(20 gram dry batches with 30 grams water)

I then tested this with 3 different stains and over 4 different glazes. Each glaze was applied in thin, medium and thick coats. The underglaze was applied over top of this up to three coats thick.

The colorants used were Pemco blue, Cerdec yellow and Mason Deep Crimson
MAMO base glaze
1.4 overglaze

Deep Crimson

Pemco Blue

Cerdec Yellow
MLA base glaze
1.4 overglaze

Deep Crimson

Pemco Blue

Cerdec Yellow
Dragon White base glaze
1.4 overglaze

Deep Crimson

Pemco Blue

Cerdec Yellow
R-1000 glaze
1.4 overglaze

Deep Crimson

Pemco Blue

Cerdec Yellow
For my final test, I chose one glaze (MLA) and retested some of the earlier colors, while also trying out new colors...

MLA with Mason Tangerine overglaze

MLA with Cerdec Yellow overglaze

MLA with Mason Dark Red overglaze

MLA with Mason Evergreen overglaze

MLA with Pemco Blue overglaze

MLA with Mason Deep Crimson overglaze
Development Process:

In kiln casting, a technique often used in the glass studio, a mold is filled with glass or other materials that will melt and fill the mold during the firing. My goal was to emulate this technique using materials common to the ceramics lab. These included various raw materials, mixtures, and glazes. My hope, with further research, is to be able to find a few good materials that I can use to cast sculpture with.

The difficulty lay in finding a material that would be fluid enough to fill the mold and take its shape yet remain inert enough to not eat through the mold during firing. I began by making small one piece plaster silica moulds. The moulds were 1 part plaster to 2 parts silica (flint) by volume. I made them by taking plastic drinking cups and filling the bottom half with oil clay. I then glued individual medicine cups, bought from the drugstore, to a thin strip of wood. The plaster mix was mixed and poured into the drinking cup and I quickly stuck the medicine cup into the plaster. They were glued to the stick so the stick would rest on top of the drinking cups and I could set something heavy on top of them to prevent the medicine cup from sliding around. Once set, the cups were cut in half and the mould was released. I reused the drinking cups by simply duct taping them back together. The moulds were further dried out inside the chimney of an unfinished kiln. They were dried with air currents and not heat (so as to not break down the plaster). They were packed in sand and surrounded by bricks while being fired.

I filled a few of these moulds with dry materials and packed them as tight as possible. The first tests were with frits and fluxes at cone 6. These just ate right through the molds. I then tried materials that didn’t melt so much and these proved to be better, but they started to seep into a thin layer of the mold. The next step was trying mixtures of fluxes and clay and other fillers at different temperatures. Along with this next series of tests, I started adding fiberglass cloth dipped in plaster around the molds. This was to prevent the hairline fractures in the moulds. It seemed to work a little bit, but cracks should be expected when firing any plaster based material in a kiln. Although these moulds went through a regular ceramic firing, they really did not need to be exposed to this much heat for that long. They really only needed to be brought up to the melting temperature of the material, held for a short while, and then cooled. A raku kiln would be ideal for this purpose. After finding some promising materials, I switched to a two part mould. This mould had a funnel on the top to act as a self feeding hopper to provide extra material to the lower portion of the mold as the materials melted, condensed, and shrank. With these moulds, the funnel worked and the mould filled, but after filling, the material then shrank. This may be due to the nature of the material itself and not the design of the mould.
In the end, I found a few good materials that casted well, Frit 3124 fired at cone 04 having the best results and the next to best being a mix of 85% Kona F-4 and 15% Barnard at cone 10. Although the frit did seem a little stiff and could be mixed with another more fluid flux, it filled the mould perfectly and popped right out of the mould with no color change what so ever. The main problem was that while many of the materials showed acceptable fluidity and casting abilities, they began to eat through a thin layer of the mould. This could be remedied by using a face coat of a harder, less porous material and using the plaster mix as a back up. Much research is left to do.

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Casting Materials</th>
<th>Cone #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>n/a</td>
<td>10 ox</td>
<td>shrank horribly and didn’t take shape too well</td>
</tr>
<tr>
<td>2</td>
<td>n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Kona F-4 + RIO</td>
<td>10 ox</td>
<td>filled mould but still shrank even with funnel</td>
</tr>
<tr>
<td>4</td>
<td>neph sy + RIO + yellow ochre</td>
<td>10 ox</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Borax</td>
<td>6 ox</td>
<td>cracked and ate through mould</td>
</tr>
<tr>
<td>6</td>
<td>Gerstley Borate</td>
<td>6 ox</td>
<td>cracked and ate through mould</td>
</tr>
<tr>
<td>7</td>
<td>80--frit 3403</td>
<td>6 ox</td>
<td>cracked and ate through mould</td>
</tr>
<tr>
<td></td>
<td>20--albany slip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>barnard substitute</td>
<td>10 red</td>
<td>shrank slightly, ate into thin layer of mold</td>
</tr>
<tr>
<td>9</td>
<td>nc-4</td>
<td>10 ox</td>
<td>filled mould great, some parts stuck to the mould</td>
</tr>
<tr>
<td>10</td>
<td>frit 3124</td>
<td>04 ox</td>
<td>filled perfectly, didn’t eat mould. PERFECT</td>
</tr>
<tr>
<td>11</td>
<td>60--frit 3110</td>
<td>6 ox</td>
<td>filled well, but showed some color change where it touched the mould</td>
</tr>
<tr>
<td></td>
<td>40--grolleg</td>
<td>40--grolleg</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>85--kona F-4</td>
<td>10 ox</td>
<td>filled great but had color change</td>
</tr>
<tr>
<td>13</td>
<td>15--barnard</td>
<td>10 ox</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>temmoku</td>
<td>10 ox</td>
<td>overflowed, shrank, and had a hard shell</td>
</tr>
<tr>
<td>15</td>
<td>R-1000 *</td>
<td>6 ox</td>
<td>filled well but has a slight texture to it</td>
</tr>
<tr>
<td>16</td>
<td>75--alberta</td>
<td>6 ox</td>
<td>filled well with a color change</td>
</tr>
<tr>
<td></td>
<td>25--frit 3124</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>50--alberta</td>
<td>10 ox</td>
<td>shrank and penetrated the mould</td>
</tr>
<tr>
<td>18</td>
<td>60--neph sy</td>
<td>10 ox</td>
<td>shrank and penetrated the mould</td>
</tr>
<tr>
<td></td>
<td>20--sheffield slip</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20--albany</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Moulds 1-8 were the two part moulds with a funnel
Moulds 9-18 were the small cup moulds

* R-1000 (Temmoku formula from Val Cushing's handbook)

Neph Sy    38.7
Wollastonite 15.2
Strontium   15.2
EPK        10.2
Laguna Borate 10.2
Flint      10.2
Whiting    12
Two-Part mold results

Sample #3

Sample #5

Underside view
Sample #3 shrunk considerably more than sample #5

The master model from which molds were made. The top section of the model was made from a plaster cylinder. The bottom was made from laminated sheets of corian (courtesy of the RePo). The two were then screwed together...

Dimensions of the model
Cup-mold results
Sample #14 sprayed with WD-40 on the left and without on the right
Making a cup mold

Clay was packed at the bottom of the cup to take up some space (the mold doesn't have to be the full height of the cup). Note The cup is cut along the side to allow for easy release. This can be taped with duct tape and re-used.

Casting in progress...

After the plaster/silica has set, the top part is removed. This top part consists of a small 2 ounce cup glued to a piece of wood.

The mold and its product after firing
I found that often the molds would crack apart during firing. I was able to minimize this by reinforcing the outside of the mold using fiberglass cloth dipped in plaster...

After removing from cup

After bandaging

After the mold has been packed with the ceramic material, it is isolated in sand. The sand ensures that even if the mold cracks during firing, it will hold its shape. It also protects the kiln from blowouts during the firing.
Name: Mark Cousino
Type: Glaze Buttons for sprig application
Color: Various
Texture: Smooth
Cone: 6 Ox. and Red.

Recipe: See below…

Development Process:

For my final project I decided to create buttons by dry-pressing ceramic powder in the arbor press. These pre-fired buttons could then be placed on the sides of vessels, allowing them to fuse and accentuate the volume of the form during firing.

I began by doing three separate line blends in order to get an idea for the ratio of clay to frit necessary for the desired melt. The line blends were as follows:

<table>
<thead>
<tr>
<th></th>
<th>Point 1</th>
<th>Point 2</th>
<th>Point 3</th>
<th>Point 4</th>
<th>Point 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redart</td>
<td>50%</td>
<td>45%</td>
<td>40%</td>
<td>35%</td>
<td>30%</td>
</tr>
<tr>
<td>Frit 3110</td>
<td>50%</td>
<td>55%</td>
<td>60%</td>
<td>65%</td>
<td>70%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Point 1</th>
<th>Point 2</th>
<th>Point 3</th>
<th>Point 4</th>
<th>Point 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tile 6</td>
<td>50%</td>
<td>45%</td>
<td>40%</td>
<td>35%</td>
<td>30%</td>
</tr>
<tr>
<td>Frit 3124</td>
<td>50%</td>
<td>55%</td>
<td>60%</td>
<td>65%</td>
<td>70%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Point 1</th>
<th>Point 2</th>
<th>Point 3</th>
<th>Point 4</th>
<th>Point 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grolleg</td>
<td>50%</td>
<td>45%</td>
<td>40%</td>
<td>35%</td>
<td>30%</td>
</tr>
<tr>
<td>Frit 3134</td>
<td>50%</td>
<td>55%</td>
<td>60%</td>
<td>65%</td>
<td>70%</td>
</tr>
</tbody>
</table>

I suggest placing all tests on some surface that will provide information as to the viscosity of the melt.

These tests, although they did not melt in cone 6 oxidation, provided valuable information. From there I knew I needed a third ingredient to get the needed eutectic. So for my next test I added percentages (12% increments from 24-60% and an 85% addition) of fluxes at cone 6 (talc, gerstley borate and whiting). If one were to pursue this method of working, I suggest doing more comprehensive testing of different materials.

I found that the best mixture that has a complete melt yet still remains slightly viscous is as follows

Grolleg 14.71%
Frit 3134 58.82%
Whiting 26.47%

From here I tested various oxides to achieve different desired colors.

Using the next step is where we could use multiple buttons impressed in the surface. These buttons would be to create a plaster mold with multiple buttons impressed in the surface. Then make your desired mixture into a slip and pour it into the mold. Take a squeegee and wipe of the excess slip leaving the buttons full of slip. Once the slip has dried, you will easily obtain many buttons with little effort.

In the following line-blends, a ratio of 20 grolleg to 80 Frit 3134 was blended with individual materials (Talc, Gerstley Borate or Whiting). Exact amounts of these individual materials is a mystery, although they most likely ranged between 24 and 85%.
Grolleg/Frit base blended with Talc

Grolleg/Frit base blended with Gerstley Borate

Grolleg/Frit base blended with Whiting
The samples below were fired in reduction and used various different colorants in the following base:

- Grolleg 14.71%
- Frit 3134 58.82%
- Whiting 26.47%
- .5% Red Iron Oxide
- 2% Red Iron Oxide
- 1% Nickel Carbonate
- 1% Illmenite
- 2% Crocus Martis
- 2% Yellow Iron Oxide
- 2% Light Rutile
- .5% Copper Carbonate
- 2% Yellow Ochre
- .5% Chrome Oxide
- .5% Cobalt Oxide
- 2% Manganese Carbonate
Closeups

2% Light Rutile

2% Red Iron Oxide

From Talc series (note crystallization)
From Whiting series

(Note the odd dimpled surface)
Name: Ross Edwards  
Type: Throwing/casting body  
Color: White  
Texture: Smooth  
Cone: 10  

Recipe: #747 boxed porcelain  

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Grolleg</td>
<td>55.56</td>
</tr>
<tr>
<td>Custer</td>
<td>18.18</td>
</tr>
<tr>
<td>Flint</td>
<td>15.15</td>
</tr>
<tr>
<td>Pyrax</td>
<td>5.05</td>
</tr>
<tr>
<td>Molochite (200 mesh)</td>
<td>3.03</td>
</tr>
<tr>
<td>Bentonite</td>
<td>3.03</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

For casting add:  
Darvan #7 .1812%  
Water 60% (see below!)

Development Process: I have been working on integrating different methods of attaching handles and spouts to my wheel thrown work. I use Linda Sikora’s porcelain body when I throw so I decided that it would be beneficial to deflocculate the body in order to cast with it. Before I did this, I was actually using another body to cast with and it would usually crack or shrink too fast. Being able to cast the same body I am throwing with will enable me to have cleaner attachments. The drying rate along with the body’s color will be equal after bisque.

I went about this test by creating a 2000 gram batch of the clay body. Once I dry mixed the material I then distributed 75 grams (37.5%) of water throughout ten quart containers. Next, I distributed 200 grams of the clay body into each container and mixed with the drill. I then added drops of darvan #7 in incremental amounts to each container until I found the most fluid point. I started at the first container and added 2 drops, then 4, then 6, and so on until I reached the 10th container. I found that containers 6-10 were the best for casting (they seemed fully deflocculated). In the next step I casted several handles to see how the shrinkage would effect the piece. Every piece went through the bisque well so I decided glaze several and fire them to cone 10.

I eventually settled on the fifth container (10 drops of Darvan for 200 gram dry batch or .1812%) because it used the least amount of darvan while giving me the desired viscosity for casting. I ended up bringing the water up to 60% (editors note: This is WAY too much. Should not require more than 40%. Redo the test and add more darvan!)
Bisqued test

After glaze firing
Recipe:

For all variations...

Ceramic recipe 34.04%
Glue mix 62.96% (Elmer's Glue to Glycerin ratio: 80/20)

Recipe #1: (Porcelain #3)
- Tile 6 30%
- EPK 20%
- C&C 5%
- KonaF-4 20%
- Flint 10%
- Pyrax 10%

Recipe #2: (Reeves Porcelain)
- Grolleg 40%
- Custer 34%
- Flint 26%

Recipe #3: (Variation on Silverman's 503R matte glaze cone 6)
- G-200 51%
- Whiting 7%
- Flint 7%
- Barium Carb 35%

Development Process:

I began by testing three different recipes with the same ratio of glue mix to ceramic material at cone 04. I ended with choosing one recipe and firing to cone 6.

The first test that I tried involved all three recipes and was fired to cone 04. I dry mixed the ceramic and then separately mixed the glue and glycerin; I then combined the two by slowly mixing the dry into the Elmer’s and glycerin. I kept the rpm’s low, in an effort to limit the amount of bubbles created. Immediately following the mixing I poured the mixture onto Mylar. The Mylar had previously been mounted to a flat surface with spray glue and had been lightly sprayed with silicon to help loosen the tape after it dried. I cast the tape to a little over 1mm in thickness and let it dry over night. All three recipes were cut into shapes and fired. Cone 04 did not work however: all the pieces were incredibly fragile, and almost impossible to handle without breaking.

The next test continued with all three recipes but fired to cone 6. The first and second recipes hardened and worked great, but the third recipe melted away due to it being a glaze I suppose (surface tension?). Also during this test I tried embedding various materials into the tape while it was wet in order to try to create a fold. None of these turned out, most likely due to shrinkage issues with firing. Some of the tested materials were hardware cloth, fiberglass mesh, and window screen.
The third test only involved the first and second recipes and was fired to cone 6. For this test I cast various thicknesses of the mixtures. I tried one layer (approx. 1.25mm), a double layer (approx. 2.5mm), and a single layer cast and dried and then a second layer cast on top of that. After drying I cut them into strips and looped them to create short cylinders. I made a cylinder for each thickness and also double and triple layered the tape to see which thickness would resist slumping the best. I could test this by setting the cylinders on their sides. I found that recipe one worked best and had the least amount of slumping was the version that was cast to a single thickness, dried, then cast again the next day (i.e. double thickness).

My final firing was to cone 6 and I simply cast a double thick tape of recipes one and two. After drying I made two large cylinders from recipe one, and used recipe two for added decoration. The tape connects to itself and other tape with just water. These cylinders turned out fine, but honestly I did not find the results I had originally desired. I wanted to develop a recipe that could be folded without breaking and hold the edge during the firing. I did find that you can connect strips of recipe one to other strips perpendicular and it will hold. This may be the next starting point for research to continue.

Fired examples of hardware cloth imbedded into tape during casting
Fired example of window screen imbedded into tape during casting
Note: A single layer of tape at the time of casting is the thickness of galvanized sheet metal (approximately 1.5 mm)

Recipe #2 (Reeves Porcelain)

Comparisson of single-thick (left) and double-thick (right) tapes. The extra material in the double-thick version gives it much better support during firing.

Single-thick tape (left) is approximately half the thickness of double-thick tape (right).
Recipe #1

Close-up of single-thick tape laminated four layers thick
Form made by attaching strips with water (Recipe #1)
Recipe #3. Object is made by laminating many different layers.

Backside of above
The following were made using Recipe #1 for the body and Recipe #2 for the straps (approximately 6 inches tall)
Various tapes before firing
Name: Amy LeFever  
Type: Slumping bodies  
Color: Red and white  
Texture: Very glassy and smooth  
Cone: 6  

Recipe: Various/See below  

Development Process: The goal for this research was to develop both light and dark colored bodies with a high degree of flux. The flux would be strong enough so that objects placed on top of each other would stick to each other during firing. This would allow me to compose clusters of objects without having to attach them when wet. The fluxing should be enough to soften the edges of a cut slab without completely losing its structure.

**Test 1 (Red variation)**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Art</td>
<td>85</td>
<td>75</td>
<td>65</td>
<td>55</td>
<td>45</td>
<td>35</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>Neph Sy</td>
<td>15</td>
<td>25</td>
<td>35</td>
<td>45</td>
<td>55</td>
<td>65</td>
<td>75</td>
<td>85</td>
</tr>
</tbody>
</table>

Procedure:

Mixed water with ingredients until a plastic state was reached. Test tiles were then made and placed on a tile setter covered with ¼ inch of alumina hydrate. The tiles were positioned with approximately 40% of the tile cantilevered. Another section of tile, created from the same body, was placed over the back portion of the first tile in order to see how well the body would adhere to itself. The tiles were then fired to cone 6 oxidation.

Results:

Bodies 7 and 8 were impossible to work with as a clay body; they were very thixotropic. The tiles had to be poured, not cut from a slab. All eight tests slumped (90 degree angles except for body 1) and fused, although the edges of the tiles did not even seem to be very soft. The surface of each was very rich and glossy.
**Test 1 (White variation)**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grolleg</td>
<td>85</td>
<td>75</td>
<td>65</td>
<td>55</td>
<td>45</td>
<td>35</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>Neph Sy</td>
<td>15</td>
<td>25</td>
<td>35</td>
<td>45</td>
<td>55</td>
<td>65</td>
<td>75</td>
<td>85</td>
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</tbody>
</table>

Procedure:

Mixed water with ingredients until a plastic state was reached. Test tiles were then made and placed on a tile setter covered with ¼ inch of alumina hydrate. The tiles were positioned with approximately 40% of the tile cantilevered. Another section of tile, created from the same body, was placed over the back portion of the first tile in order to see how well the body would adhere to itself. The tiles were then fired to cone 6 oxidation.

Results:

Only body 8 slumped a little. Bodies 7 and 8 both looked glassy on the surface. None of the bodies really fused, though the higher numbers (6-8) seemed to have gotten tacky. They joined slightly, but could be tapped apart pretty easily.
Procedure:
Mixed water with ingredients until a plastic state was reached. Test tiles were then made and placed on a tile setter covered with ¼ inch of alumina hydrate. The tiles were positioned with approximately 40% of the tile cantilevered. Another section of tile, created from the same body, was placed over the back portion of the first tile in order to see how well the body would adhere to itself. The tiles were then fired to cone 6 oxidation.

Results:
Bodies 1-3, no slumping. Bodies 2 and 3 tacky, could tap layers apart easily. Body 4 slumped slightly and fused. Body 5 slumped to a 45 degree angle, fused very well (with edges softened as well), had the appearance of a crystal matte surface. Body 6 (not in the picture) melted completely, forming a puddle of glaze on the tile setter as well as on the kiln shelf.

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### Test 2

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<td>60</td>
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</tbody>
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Grolleg and frit 3110 blend (Test 2)
Test 3

Procedure:
Coated bowls that had been fired to cone 10 with two or three layers of kiln wash. Mixed body 6 of Red Art test (35 Red Art, 65 Neph Sy) with approximately 22.4% water. This mixture was then squeezed out of a plastic condiment bottle into the bowl forms, to create a somewhat lacy pattern.

Results:
Bowl 1 having the steepest sides and bowl 3 being the shallowest.

Wet:
Bowl 1: difficult to get the clay to stay on the sides, wanted to tear and fall down
Bowl 2: a little difficulty staying in place at rim where steeper
Bowl 3: not much trouble at all

Dry:
Bowl 1: lots of cracking apart of the clay “strings”, especially at joints and steep sides
Bowl 2: not as much cracking as 1, but more than 3
Bowl 3: very minimal cracking

Fired:
Each stuck to the bowl/kiln wash and had to be chipped out of the mold. Cracks occurred in cooling as a result of not being able to shrink as much as it needed. However, the cracks that occurred during drying seemed to have healed and fused back together during the firing.

Problems:
It was difficult to squeeze out of the bottle because of dilatancy: the harder I squeezed, the more the clay “froze” and wouldn’t move at all. Also, the clay stuck to the kiln wash, which did not allow the object to contract stress-free upon cooling. This resulted in cracking. Furthermore, it was difficult to release the object due to cohesion to the kiln wash.
Also in this round of tests, I worked with the Grolleg body again.

This series was done between point 5 and 6 of the last series.

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Procedure:

Mixed water with ingredients until a plastic state was reached. Test tiles were then made and placed on a tile setter covered with ¼ inch of alumina hydrate. The tiles were positioned with approximately 40% of the tile cantilevered. Another section of tile, created from the same body, was placed over the back portion of the first tile in order to see how well the body would adhere to itself. The tiles were then fired to cone 7 oxidation (kiln over-fired).

Results:

Body 2 slumped a lot, at a 90 degree angle and a slight bulge at the bottom where it began to move, but it did not turn into a glaze puddle. The rest of the bodies—3 through 6—were basically very stiff glazes. Bodies 2 and 3 were very translucent even at a thickness of approximately ¼ inch.
Test 4

This series of tests was done with approximately ¼ inch of alumina oxide coating the bowls (which were all shallow this time), instead of kiln wash. The alumina was mixed into a thick slurry with water, and then poured into the inside of each bowl.

Each bowl contains a different clay body, the variables being amount of water, Darvan 811, Epsom salt, and paper. The goal was to find the clay body that had the best workability for this procedure.

1) Red Art 105
   Neph Sy 195
   Water 84 (22% of 100 g batch)
   Darvan 811 8 drops
   Epsom Salt 7 drops

Results: Seemed fairly easy to squeeze out of the bottle, did not have much trouble with getting the “string” of clay/slip to stay on the walls of the bowl. The string retained its shape and did not completely puddle together at joints and where it overlapped. Fired nicely—no cracks (unless in drying and then healed in firing), and came right out of the mold. Beautiful definition of line and nice glossy surface.
2)  Red Art  105
    Neph Sy  195
    Water    96 (24 % of 100g batch)
    Darvan 811 10 drops
    Paper   3 grams (1% of 100 g batch)

Results: Was difficult to squeeze out of the bottle. Also, the surface texture of the string was lumpy—you could see the paper fibers. After being fired, the paper texture still remained. No apparent cracks, unless they healed. Did not stick to mold at all.

3)  Grolleg  144
    Frit 3110  156
    Water    135 (31 % of 100 g batch)

Results: Worked beautifully, held its shape, did not puddle together. Seemed to have cracked during firing and did not heal. The piece still held together as a whole, though. Came out of the mold well.
4) Grolleg 144
Frit 3110 156
Water 96 (24.2% of 100 g batch)
Darvan 8110 8 drops

Results: String did not hold its definition at all, puddled together completely. Did not seem to have cracked in firing. Came out of mold well.

5) Epsom salt added in unknown amount to left over body used in bowl 4

Results: Worked wonderfully, kept definition, etc. Beautiful when fired—held its definition well and did not appear to have cracked. Came out of mold well.
6) Grolleg 144  
Frit 3110 156  
Water 106 (26.1% of 100g batch)  
Darvan 811 8 drops  
Paper 3 grams (1% of 100g batch)  
Results: Worked well, but the paper fiber gave the surface a texture. This texture is not apparent when fired. Did not seem to have cracked and it released from the mold very well.

7 and 8) Body one with body 4 drizzled over top.  
Results: Bodies seem to be compatible. No noticeable cracking resulting from layering the two clays. Released from mold.
Comparison of the bottoms of two separate pieces. Note that it was much easier to remove the Alumina residue than the kiln wash. Also note that where the Alumina contacted the clay, it robbed the clay of its sheen.

Using kilnwash

Using Alumina Oxide

Profile view of sample #6
Point 2 From the Grolleg and frit 3110 blend (Test 3)
Development Process:

Goal: To formulate a slip (white in color) viscous enough to hold onto the texture tulle (a fine mesh synthetic fabric), and strong enough to not break or be brittle once fired.

1. Recipe for slip is adapted from Carlo’s personal recipes; CS#2 at cone 04.
   - Used instructions from Determining the Dispersant-Viscosity Relationship or How to Make the World’s Best Stick-Up Slip.
   - Filled 10 containers with equal amounts of the dry batch; added 37.5% water to each container.
   - Added deflocculant (Darvan #7) to each container, increasing each by 2 drop increments.
   - Test with 30 drops of darvan was most fluid (Dispersant % of Dry Batch = 0.5435%)
   - Tulle was dipped into 10 different points and fired to cone 04 (points before and after the 30 drop point were used).
   - These all proved quite fragile, in part because the clay was too weak, and in part because the clay coating was too thin (i.e. slip sheds off the tulle before it dries because Tulle is non absorbent)

2. Test #5 determined to be most fluid from previous test.
   - Laid out 5 containers with dry batch (500 grams in each)
   - Used the same amount of water and Darvan 7 in each (37.5% water; .5435% Darvan #7).
   - Used the first sample as a control. To the remaining 4 samples I added a saturated solution of Epsom salts in 2-drop increments.
   - Tulle dipped in each sample and fired to cone 04 and cone 6.

Conclusion: Test #5 fired to cone 6 was determined to be the strongest/ least brittle. (Cone 6 samples were stronger overall)
   - Test #5 was 8 drops of Epsom salt saturated solution for 500 grams of dry clay (or .1216% assuming each drop of Epsom salt saturated solution weighs .076 grams)
From the second test: additions of Epsom salt solution to a 500 gram batch of slip

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<th>4 drops of Epsom</th>
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<th>8 drops of Epsom</th>
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<td><img src="image1.png" alt="Image of four drops of Epsom" /></td>
<td><img src="image2.png" alt="Image of six drops of Epsom" /></td>
<td><img src="image3.png" alt="Image of eight drops of Epsom" /></td>
</tr>
</tbody>
</table>

4 drops of Epsom

![Image of four drops of Epsom](image4.png)

8 drops of Epsom

![Image of eight drops of Epsom](image5.png)
Tulle with 8 drops of Epsom was applied to a cylinder thrown using #570 boxed clay. The cylinder was scored prior to application, and the same slip used to dip the tulle was applied to the surface as intermediary glue.
Tulle fabric
Recipe:

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<th>A</th>
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<th>C</th>
<th>D</th>
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<td>C&amp;C 15</td>
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<tr>
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Add:  

**OXIDES**

1. Chrome Oxide 7.5%
2. Chrome Oxide 3.25%
3. Black Iron Oxide 2%
4. Red Iron Oxide 2%
5. Red Iron Oxide 5%
6. Cobalt Oxide 5%
7. Yellow Ochre 4%
8. Copper Oxide 5%
9. Black Nickel Oxide 2.1%

**Commercial Stains**

10. Mason Dark Red #44508 10%
11. Mason Chrome Free Black #44704 10%
12. Mason Delft Blue #44306 10%
13. Mason Peacock Green #44205 10%
14. Ferro Turquoise #44301 10%
15. Mason Praseodymium (Yellow) #44406 10%
16. Mason Pansy Purple #44603 10%

Development Process:  
The purpose of this project was to experiment with colored clay bodies with oxides and commercial stains using clay bodies from previous cookbooks.

We started our research by testing 4 different clay bodies that had been developed in previous Raw Mats classes. Absorption tests were done for all four clays. The bodies were similar in color and absorption prior to adding colorants with the exception of the talc clay body, which was denser and less porous.
Absorption rates for uncolored bodies

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<td>.94%</td>
<td>2.06%</td>
<td>3.93%</td>
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For the next step, colorants were added to the base clays. We first tried oxides in various percentages. Most of the oxides and all of the Mason stains were bright in color and had no defects except for those in the talc body, which bleached some of the results.

7.5% Chrome Oxide

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3.25% Chrome Oxide

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2% Black Iron Oxide

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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</table>

2% Red Iron Oxide

| A   | B   | C   | D   |
In a second set of tests, we tried Mason stains at 10%. The results were similar, with the talc body bleaching some of the colors. The black stain also blistered during the firing.
A11 sample cut to reveal the cross section of a bloat. All black bodies bloated with the exception of B11.

From the results, we concluded that Recipe A gives the best result in color, both with oxides and with stains.

With the information from the results, we decided to test handbuilding, using mold and slabs to see how the colored clays would react with each other. For all remaining tests we used Recipe A. The defects in the black stain were especially interesting. We used the black with other stains to see if it would bubble in small amounts. We also sandwiched the black between two other colored clays. We tried carving into these layers and pushing from behind to expose the interior colors. Carving into laminated clays was also tested. In general, all colors seemed to be compatible before and after firing.

Slabs made using black and red colored bodies (10 and 11)
Slab made using black and red colored bodies inset into #444 boxed clay

Colored bodies wedged and thrown. Lighter colored cylinders used #444 boxed clay
Combination of green and yellow bodies wedged and thrown

Cutting the above pot reveals the intricate marbelization that took place during forming
Colored bodies used in press molds

Rear view of pressed heads
Tile made by laminating bodies 12, 11 and 16

Laminated tile. Clear glaze applied in some areas adds "pop" to color...
The goal of this research was to create colored slips that could be applied to both a porcelain and stoneware body for a cone 10 firing.

We started by first choosing four different base slip recipes. Within each of these different base recipes, we tested ten different oxides in both reduction and oxidation firings. From these results, we narrowed down the slip recipes to base 1 (for its whiteness) and base 2 (for its blue hue), and only chose to keep two of the oxides (Chrome Oxide 3.5% and Cobalt Carbonate 5%).

After the results from the oxide tests, we decided to extend our testing to Mason stains to gather desired colors. We were also unsure about which colorants would burn out, so this step would tell us just that. We stayed with two base recipes, two clay bodies (#570 stoneware and #747 porcelain), and with this, we tested eleven colorants, each with three different percentages. We also limited our firings to cone ten reduction.

The next step of our testing was to test the application of slips as well as to test layering. At this point, we were able to choose one base slip recipe (Base 1) to use based on the previous test results. We chose to dip four different layers of slip on stoneware tiles and to brush four different layers on the porcelain tiles.
FIRST COLOR ROUND: OXIDES
A. Chrome Oxide  3.25%
B. Black Iron Oxide  2%
C. Red Iron Oxide  2%
D. Cobalt Carb.  1% and 5%
E. Yellow Ochre  4%
F. Copper Carb.  1% and 5%
G. Manganese Dioxide  3%
H. Manganese Carb.  1%
I. Nickel Carb.  5%
J. Rutile  5%

MASON STAINS USED: ROUND ONE: Varying Percentages
A. Mason Pansy Purple #6385  5%, 7%, 10%
B. GS Orange Brown #600   5%, 7%, 10%
C. Cerdec Yellow #239416   10%, 12%, 14%
D. Mason Deep Crimson #6005  10%, 12%, 14%
E. Mason Dark Red #6021  10%, 12%, 14%
F. Mason Bermuda Green #6242    5%, 7%, 10%
G. Cerglas Lilac #28-161-475  10%, 12%, 14%
H. Mason Tangerine Orange #6027  10%, 12%, 14%
I. Ferro Green   5%, 7%, 10%
J. Mason Alpine Rose #6001  10%, 12%, 14%
K. Ferro Turquoise C636A   5%, 7%, 10%

FINAL COLORANTS/OXIDES USED
A. Pansy Purple   10%
B. Cerdec Yellow   14%
C. Dark Red   14%
D. Bermuda Green   10%
E. Tangerine Orange   14%
F. Ferro Green   10%
G. Ferro Turquoise   10%
H. Chrome Oxide   3.25%
I. Copper Carb   5%

Base slips were made into test bars to give us an idea of colour...
5% Cobalt Carbonate on porcelain in oxidation

Base 1  Base 2  Base 3  Base 4

5% Cobalt Carbonate on stoneware in oxidation

5% Cobalt Carbonate on porcelain in reduction

5% Cobalt Carbonate on stoneware in reduction
7.5% Chrome Oxide on porcelain in oxidation

7.5% Chrome Oxide on stoneware in oxidation

7.5% Chrome Oxide on porcelain in reduction

7.5% Chrome Oxide on stoneware in reduction
Deep Crimson

Base 1 over Stoneware

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Base 1 over Porcelain

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Base 2 over Stoneware

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Base 2 over Porcelain

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Orange Brown

Base 1 over Stoneware

<table>
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Base 1 over Porcelain

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Base 2 over Stoneware

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Base 2 over Porcelain

<table>
<thead>
<tr>
<th>5%</th>
<th>7%</th>
<th>10%</th>
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</table>
Bermuda Green

Base 1 over Stoneware

5% 7% 10%

Base 1 over Porcelain

5% 7% 10%

Base 2 over Stoneware

5% 7% 10%

Base 2 over Porcelain

5% 7% 10%

Turquoise

Base 1 over Stoneware

5% 7% 10%

Base 1 over Porcelain

5% 7% 10%

Base 2 over Stoneware

5% 7% 10%

Base 2 over Porcelain

5% 7% 10%
Final tests

For the final round of tests the stoneware tiles were dipped while porcelain tiles were brushed. Base 1 from previous tests was used throughout for this final series. For color percentages used, refer to index on the first page. The clay state at the time of application ranged from wet through leather hard to bone dry.

For each tile, slip was applied from one to four coats...

In all samples, cracking increased as layer thickness increased. Also note that all the following tests were reduction fired, and that bloating occurred on some of the stoneware samples as a result. This was responsible for some of the cracked surfaces. Also, some of the slips blistered, especially on the stoneware samples. This was probably due to volatile emissions from the body during firing...

Large scale bloating (Chrome Oxide series)  Blistering (Pansy Purple series)
Name: Miki Sato and Ronda Wright
Type: Flameware throwing body
Color: Beige/Light Beige
Texture: Smooth
Cone: 10 reduction

Recipe:

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<th>A-3</th>
<th>B-4</th>
<th>C</th>
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Development Process:

The purpose of doing this research was to develop flameware bodies that could be fired to cone 10 and which could be thrown.

We both started by taking a different recipe and line-blending it with talc. When the line blend came out of the kiln it was apparent that there was a visible eutectic point in "Line Blend A". This is shown in test A8 through A10 where the clay body melted down on the kiln shelf. Selecting the test with no cracks or slumping, we then tested the flame ware properties of each by placing one inch of water in each test and heating it on a gas stove top (we also used a flameware recipe from Susan Peterson’s book “The Craft and Art of Clay” as a reference to which we could compare our results: see recipe “C”). The tests were left on the flame five minutes after the water had evaporated out of the test. At that point we then submerged the tests in cold water.

After looking at the results it was probable that the flame on the gas stove was too even and would not reflect the sample’s true ability to withstand the shock of a random flame such as a flame in a campfire or uneven heating. Therefore, the tests were then taken and heated in a small spot with a hand torch until the clay had turned a glowing red and then submerged into cold water.

We selected A3 from Line Blend A and B4 from Line Blend B as our final choices. Each of these clays bodies were used in a throwing process. They throw similarly to non-plastic porcelain. B4 was slight more finicky when larger objects were to be constructed. It is still a throw able clay body. If we had more time to continue testing we would have included cone packs by each test to determine if the firing plays a role in the flame ware quality. After finding a clay recipe that we know would be a high quality flame ware body the next step would be to find a glaze that would fit the body and stand up to the heating and cooling of cooking as well as the clay body itself.
Line blend recipes:

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<td>48.88</td>
<td>52.34</td>
<td>55.80</td>
<td>59.26</td>
<td>62.72</td>
</tr>
<tr>
<td>Tile 6</td>
<td>2.28</td>
<td>2.50</td>
<td>2.72</td>
<td>2.94</td>
<td>3.16</td>
<td>3.38</td>
<td>3.60</td>
<td>3.82</td>
<td>4.04</td>
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<tr>
<td>Talc</td>
<td>48.20</td>
<td>43.20</td>
<td>38.20</td>
<td>33.20</td>
<td>28.20</td>
<td>23.20</td>
<td>18.20</td>
<td>13.20</td>
<td>8.20</td>
</tr>
<tr>
<td>G-200</td>
<td>2.74</td>
<td>3.00</td>
<td>3.27</td>
<td>3.53</td>
<td>3.79</td>
<td>4.05</td>
<td>4.32</td>
<td>4.59</td>
<td>4.85</td>
</tr>
<tr>
<td>Flit</td>
<td>1.82</td>
<td>2.00</td>
<td>2.18</td>
<td>2.36</td>
<td>2.54</td>
<td>2.72</td>
<td>2.90</td>
<td>3.08</td>
<td>3.26</td>
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Absorption Test Results:

<table>
<thead>
<tr>
<th></th>
<th>Dry(g)</th>
<th>After soaking(g)</th>
<th>Porosity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>312.1</td>
<td>316.37</td>
<td>1.35</td>
</tr>
<tr>
<td>A-2</td>
<td>307.44</td>
<td>319.69</td>
<td>3.98</td>
</tr>
<tr>
<td>A-3</td>
<td>222.48</td>
<td>233.75</td>
<td>5.07</td>
</tr>
<tr>
<td>A-4</td>
<td>303.45</td>
<td>316.94</td>
<td>4.45</td>
</tr>
<tr>
<td>A-5</td>
<td>337.48</td>
<td>359.44</td>
<td>6.51</td>
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<tr>
<td>A-6</td>
<td>316.73</td>
<td>331.9</td>
<td>4.79</td>
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<tr>
<td>A-7</td>
<td>314.43</td>
<td>317.81</td>
<td>1.07</td>
</tr>
<tr>
<td>A-8</td>
<td>290.13</td>
<td>292.2</td>
<td>0.71</td>
</tr>
<tr>
<td>A-9</td>
<td>246.71</td>
<td>249.87</td>
<td>1.28</td>
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<tr>
<td>A-10</td>
<td>343.92</td>
<td>350.6</td>
<td>1.94</td>
</tr>
<tr>
<td>A-11</td>
<td>324.05</td>
<td>351.56</td>
<td>8.49</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Dry(g)</th>
<th>After soaking(g)</th>
<th>Porosity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>B-2</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>B-3</td>
<td>346.47</td>
<td>347.55</td>
<td>0.31</td>
</tr>
<tr>
<td>B-4</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>B-5</td>
<td>340.35</td>
<td>341.05</td>
<td>0.21</td>
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<tr>
<td>B-6</td>
<td>325.65</td>
<td>326.45</td>
<td>0.25</td>
</tr>
<tr>
<td>B-7</td>
<td>364.94</td>
<td>366.61</td>
<td>0.46</td>
</tr>
<tr>
<td>B-8</td>
<td>340.25</td>
<td>348.21</td>
<td>2.34</td>
</tr>
<tr>
<td>B-9</td>
<td>319.11</td>
<td>329.54</td>
<td>3.27</td>
</tr>
<tr>
<td>C</td>
<td>297.62</td>
<td>306.08</td>
<td>2.84</td>
</tr>
</tbody>
</table>
Flameware test:

Test 1 - One inch of water heated directly on the gas stove. Left on stove 5 minutes after all water had evaporated, then submerged in cold water.

Test 2 - Heating small area and with torch until glowing red and submerging in water.

<table>
<thead>
<tr>
<th></th>
<th>Test 1 (with a stove)</th>
<th>Test 2 (with a torch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A-2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A-3</td>
<td>no ping, no cracks</td>
<td>no ping, no cracks</td>
</tr>
<tr>
<td>A-4</td>
<td>no ping, no cracks</td>
<td>no ping, no cracks</td>
</tr>
<tr>
<td>A-5</td>
<td>no ping, no cracks</td>
<td>no ping, no cracks</td>
</tr>
<tr>
<td>A-6</td>
<td>no ping, no cracks</td>
<td>one loud ping, no visible cracks</td>
</tr>
<tr>
<td>A-7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A-8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A-9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A-10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A-11</td>
<td>no ping, no cracks</td>
<td>no ping, no cracks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Test 1 (with a stove)</th>
<th>Test 2 (with a torch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>no ping, no cracks</td>
<td>no ping, no cracks</td>
</tr>
<tr>
<td>B-2</td>
<td>sharp ping sound, no cracking visible</td>
<td>no ping, no cracks</td>
</tr>
<tr>
<td>B-3</td>
<td>no ping, no cracks</td>
<td>no ping, no cracks</td>
</tr>
<tr>
<td>B-4</td>
<td>no ping, no cracks</td>
<td>no ping, no cracks</td>
</tr>
<tr>
<td>B-5</td>
<td>heard ping, cracking</td>
<td>ping when in water, a big horizontal crack</td>
</tr>
<tr>
<td>B-6</td>
<td>heard ping, cracking visible</td>
<td>no ping, no cracks</td>
</tr>
<tr>
<td>B-7</td>
<td>no ping, no cracks</td>
<td>pinged and cracked</td>
</tr>
<tr>
<td>B-8</td>
<td>heard pinging, no cracks</td>
<td>pinged, several big cracks when cooling</td>
</tr>
<tr>
<td>B-9</td>
<td>no ping, no cracks, but one loud creak sound</td>
<td>ping, but no cracks</td>
</tr>
<tr>
<td></td>
<td>no ping, no cracks</td>
<td>no ping, no cracks</td>
</tr>
</tbody>
</table>

C no ping, no cracks | no ping, no cracks
"A" series
(Note the Eutectic from A-8 to A10)
B-8
After firing, the cracked section separated from the body with very little force.

Final bodies

"C" body A-3 B-4
"C" body

A-3

B-4
I wanted to be able to dip paper in a casting slip and have it fire without cracking. I knew I would need a casting body with minimal shrinkage. I thought of this idea because a friend of mine from a handbuilding class made origami paper cranes and cast them. However the clay cracked and some of her birds were destroyed. I didn’t want the slip to crack as it dried against the paper structure.

I tried using different shapes, stacking, and number of dips. Before the firing the clay didn’t crack and even after the firing was the same. The paper seemed to have burned out from the inside creating a fragile, lightweight, and hollow piece. Even though some of the pieces I cast thicker with more layers they all seemed to have held their shape. Although the texture was smooth, it resembled wet paper or a cloth-like look to it. In the future, I would like to create from these samples, to create large scale paper cast sculptures. Another way to go about this is to create a collage of cast paper objects and shapes. The dispersant-Viscosity test definitely helped hold their shapes without cracking or pulling away from each other. The paper also seemed to have helped the drying process by dispersing the moisture level on the inside with the wet paper.

Overall I got the information I need and the correct clay body with minimal shrinkage to create cast paper sculptures.
1 dip

2 dips

3 dips

Crumpled/folded before dipping
Crumpled/folded after dipping
Recipe:

1) Frit 280 - 170g  
   Black Nickel Oxide - 20g  
   EPK – 5g

2) Frit 280 - 170g  
   Black Nickel Oxide - 20g  
   EPK – 5g

3) Frit 280 - 170g  
   Black Nickel Oxide - 20g  
   EPK – 10g

4) Frit 280 - 170g  
   Black Nickel Oxide - 20g  
   EPK – 15g

5) Frit 280 - 170g  
   Black Nickel Oxide - 20g  
   EPK – 20g

Development Process: I wanted to use raw materials to create my own glass color to use in the hot shop. I found that the ingredients worked well for that purpose, though they were a little stiff if not covered with another gather.

I tried the recipes both dry and wet, but the wet mixture didn’t adhere to the glass at all. I just mixed the ingredients with a drill, nothing special. The varying amounts of clay didn’t seem to make a difference in the color. It only added white specks where it hadn’t been completely integrated with everything else. The color deepened with each layer of powder added, as with all glass color, so that was the only thing that altered the color.

I did find that the fumes from melting the powder into the glass were a little nauseating, but blowing with a respirator negated that. A little cumbersome, but it worked. Keep in mind that different colorants can be added to any sort of frit to make different colors.
The white mark circled in red is unmelted kaolin (EPK)

The image below shows the ceramic layer sandwiched between two gathers of glass
Name: Laura Turo
Type: Handbuilding/Casting body
Color: Off-white/Yellowish
Texture: Smooth
Cone: 6 Oxidation

Recipe:

<table>
<thead>
<tr>
<th>Recipe A</th>
<th>Recipe B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundry Hill Crème:</td>
<td>Foundry Hill Crème:</td>
</tr>
<tr>
<td>30.60%</td>
<td>15.6%</td>
</tr>
<tr>
<td>Helmer: 15.50%</td>
<td>Helmer: 30.4%</td>
</tr>
<tr>
<td>OM4: 15.50%</td>
<td>OM4: 15.6%</td>
</tr>
<tr>
<td>Neph Sy: 26.40%</td>
<td>Neph Sy: 26.4%</td>
</tr>
<tr>
<td>Flint: 12%</td>
<td>Flint: 12%</td>
</tr>
<tr>
<td><strong>Total</strong> 100%</td>
<td><strong>Total</strong> 100%</td>
</tr>
</tbody>
</table>

*If casting:* Darvan #7: 1.15%
Water: 40%

Development Process:

My objective was to create a smooth plastic stoneware that would cast well and could also be easily manipulated.

I started by doing a dispersant test on a recipe that was known to be plastic enough for hand building (referred to as Recipe A).

From the dispersant test, I chose 1.15% Darvan #7. I also made a plastic version of this body. I then tried joining parts that were slip cast from this recipe with parts that were handbuilt from the same recipe (without Darvan). The cast time was about 24 minutes and the set up time (in the mold) was also about 24 minutes. Although the casting time is consuming, the cast itself was very plastic and could be easily manipulated. The cast could almost be bent into a right angle from its original position if formed directly after being taken out of the mold. The plastic body held its weight well on a small to medium scale (I have not built with this body on the large scale, but doing so would probably require an addition of grog; 7% fine grog would probably work well). When attaching the cast to the plastic body, I typically would wait until they both felt to be about the same moisture level. I found that if this was not done correctly, the pieces would dry at different rates and crack. I could also reach a similar moisture level by covering the whole piece in cheesecloth or plastic overnight.

The body required further fine tuning because it tended to gel when left in the mold too long. This meant that areas that should be hollow in the cast often sealed up, creating almost solid objects that would crack and behave unpredictably with the hand built elements. To solve this, I brought the water in the casting slip up from 37.5% to 40%. I also drained the mold earlier during the casting cycle.
Though this recipe was now working, I wanted to see if I could speed up the casting by altering the recipe (it was taking 33 minutes to build up ¼” walls). I created another body that was derived from Recipe A called Recipe B. While this new body cast a lot quicker because of the larger particles in the recipe, the clay was very short and felt dead.

So Recipe A is more plastic, while Recipe B casts more quickly.

I now had the option of combining handbuilt parts made using the more plastic recipe A body with parts cast using this new casting body. There was too much cracking in the actual tests. I think a lot of it was due to Recipe B alone, however. Even when I tried joining plastic and cast versions of Recipe B, these shrunk at different rates and cracked. This recipe is quite non-plastic and cannot tolerate much manipulation without cracking.
This test attempted to attach plastic body A and cast body B. It also examined whether merging the two bodies would be better (one cast quicker, the other built better…etc).

<table>
<thead>
<tr>
<th>Casting: 40% water</th>
<th>Recipe A</th>
</tr>
</thead>
<tbody>
<tr>
<td>notes:</td>
<td></td>
</tr>
<tr>
<td>plastic clay:</td>
<td>great to work with, very plastic- holds itself up over its own weight</td>
</tr>
<tr>
<td></td>
<td>when rolled in hand and bent over itself, very minimal cracking, very smooth and wonderful</td>
</tr>
<tr>
<td></td>
<td>when rolled in hand and bent over itself, very minimal cracking, very smooth and wonderful</td>
</tr>
<tr>
<td></td>
<td>when rolled in hand and bent over itself, very minimal cracking, very smooth and wonderful</td>
</tr>
<tr>
<td></td>
<td>when rolled in hand and bent over itself, very minimal cracking, very smooth and wonderful</td>
</tr>
<tr>
<td></td>
<td>when rolled in hand and bent over itself, very minimal cracking, very smooth and wonderful</td>
</tr>
<tr>
<td>casting clay:</td>
<td>entire casting process took about an hour, very plastic however still a little gooey on the inside. Bent easily and did not crack as much as other body. Did not dry out as fast as other body</td>
</tr>
<tr>
<td></td>
<td>The mold needs to be slammed on the side before dumping out (to destroy gelling) can be pinched pretty thin before cracking</td>
</tr>
<tr>
<td></td>
<td>in mold cast time- about 24 minutes, set up in mold time- about another 24 minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Casting: 37.5% water</th>
<th>Recipe B</th>
</tr>
</thead>
<tbody>
<tr>
<td>notes:</td>
<td></td>
</tr>
<tr>
<td>made plastic clay and cast clay</td>
<td>FHC 15.6</td>
</tr>
<tr>
<td></td>
<td>Grolleg 30.4</td>
</tr>
<tr>
<td>plastic clay:</td>
<td>very short/ feels kind of dead… when rolled in hand and bent over itself- cracks dramatically and deforms cannot hold itself up on its own weight, can’t get too thin plastic but very short at the same time</td>
</tr>
<tr>
<td></td>
<td>Neph Sy 26.4</td>
</tr>
<tr>
<td></td>
<td>Flint 12</td>
</tr>
<tr>
<td></td>
<td>Darvan #7 0.88</td>
</tr>
<tr>
<td>cast clay:</td>
<td>great cast, poured out after about 19 minutes, and took out of mold around the half hour mark. Shook the mold prior to draining, no gelling problems. Inside of cast dried quickly. Plastic characteristics- able to bend but dried out quickly, some cracking could pinch lightly, but using lots of force leads to perpendicular cracking about 20 minutes in mold, 10 minutes setting up in the mold</td>
</tr>
</tbody>
</table>

Attachments:
- Plastic A and Cast A
  - no cracking at seams
  - good contact
- Plastic A and Cast B
  - minor cracking at weak connection, strong connections have no cracks
- Plastic B and Cast A
  - minor cracks at weak connections
- Plastic B and Cast B
  - cracked most of all- not catastrophic but unless really strong connectivity will crack

All cracks were in the cast area, not handbuilt

In conclusion, although Recipe A takes a long time to cast and needs to be slammed before draining the mold (to destroy the gelling effects), it is a great casting slip that has very little cracking between plastic and cast parts.
Examples combining plastic body A and cast body A
Class evaluation of group claybodies...
Developed by: Group 1
Type: Throwing
Color: White
Texture: Smooth
Cone: Cone 6 Ox.

Recipe:
Peerless 27.95
Grolleg 27.95
NephSy 23.1
Flint 12
Tenn #10 5
Molochite 3
Veegum 1

100%

Wet to dry shrinkage 6.7%
Absorption .19%
Dry to fired shrinkage 9.5%
Total shrinkage 16.2%

Class Ratings
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Poor</td>
<td>1</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>3</td>
</tr>
<tr>
<td>Good</td>
<td>4</td>
</tr>
<tr>
<td>Very Good</td>
<td>5</td>
</tr>
</tbody>
</table>

Throwing
7 students surveyed
Plasticity 4.4
Building strength/Resistance to slumping 3.3

Hand Building
7 students surveyed
Plasticity 4.6
Building strength/Resistance to slumping 3.3
What the critics are saying...

"Very smooth. Stands nicely. Good color"

"Feels like cream cheese"

"Very nice throwing body. Love it"

"So smooth. Really easy to throw quickly. Harder to handbuild with due to slumping a bit. Dosen't hold shape really well"

"Too plastic for handbuilding. Not enough grog but still workable for a throwing clay body"

"Alright to throw with. Better for plates and cups"

"Great texture, smooth out real well. Some trouble with structural strength and holding shape"

"Really nice while building, plastic, responsive. May be good as a slip?"

"Was a horrible handbuilding body, but everyone seems to love it for"

"It is good for throwing. I like the color, too. But the edge is very easy to be broken when its dry"

Note the cracked surface on handbuilt piece below...
Developed by: Group 2
Type: Throwing
Color: Light beige
Texture: Smooth
Cone: Cone 6 Ox.

Recipe:
- FHC 30.3
- Helmer 15.3
- OM4 15.3
- Neph Sy 26.1
- Flint 6
- Fine Grog 7

100%

Wet to dry shrinkage 7.4%  Absorption .38%
Dry to fired shrinkage 8%
Total shrinkage 15.4%

Class Ratings
<table>
<thead>
<tr>
<th>Class</th>
<th>Rating</th>
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<tbody>
<tr>
<td>Very Poor</td>
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<tr>
<td>Poor</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>3</td>
</tr>
<tr>
<td>Good</td>
<td>4</td>
</tr>
<tr>
<td>Very Good</td>
<td>5</td>
</tr>
</tbody>
</table>

Throwing
7 students surveyed
<table>
<thead>
<tr>
<th>Property</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasticity</td>
<td>3.9</td>
</tr>
<tr>
<td>Building strength/Resistance to slumping</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Hand Building
7 students surveyed
<table>
<thead>
<tr>
<th>Property</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasticity</td>
<td>4.4</td>
</tr>
<tr>
<td>Building strength/Resistance to slumping</td>
<td>3.7</td>
</tr>
</tbody>
</table>
What the critics are saying...

"Very nice claybody. Smooth texture"
"Feels like oil clay"

"Good for throwing"

"Too plastic for handbuilding. Not enough grog but still workable for a throwing clay body"

"Slightly sticky. Maybe more drying is needed. Good Plasticity"

"Really plastic and wonderful! Holds its weight well"
"Throws OK"

"Very nice, decent throwing and handbuilding qualities. Great color, slow to dry"
Developed by: Group 3
Type: Handbuilding
Color: Dark Brown
Texture: Semi-smooth
Cone: 04 Ox.

Recipe: Barnard Substitute 32.5
        Red Art 32.4
        Frit 3110 12.4
        Mullite 35 9.1
        Medium Grog 4.6
        OM4 8
        Bentonite 1
        100%

Add: Barium Carbonate .25%

Wet to dry shrinkage 7%
Dry to fired shrinkage 5%
Total shrinkage 12%

Class Ratings

<table>
<thead>
<tr>
<th></th>
<th>Very Poor</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Throwing
7 students surveyed

<table>
<thead>
<tr>
<th>Plasticity</th>
<th>2.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building strength/Resistance to slumping</td>
<td>3</td>
</tr>
</tbody>
</table>

Hand Building
7 students surveyed

<table>
<thead>
<tr>
<th>Plasticity</th>
<th>3.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building strength/Resistance to slumping</td>
<td>4</td>
</tr>
</tbody>
</table>
What the critics are saying...

"Very pliable as far as bending it"

"Didn't really like this so much. Didn't really connect well with separate parts despite scoring and wet attachment"

"Awful to throw with-boo"

"Works like a crumbly paste if its just a little dry"

"Absorbed water very quickly and left a "slippy" mess with grog. Not nice to work with on the wheel (acted like crappy porcelain with large grog added)"

"Not good for throwing"

Excellent handbuilding clay body. Plastic and has enough grog"

"It was not so comfortable to throw. My hands, tools and water… everything became red/brown when throwing"

When thrown, the grog becomes visible on the surface

When handbuilt, the grog remains below the surface
Developed by: Group 5
Type: Throwing
Color: Off white
Texture: Smooth
Cone: 10 Ox. / Red.

Recipe:
- Tile 6 11.69
- XX Sagger 26.41
- C&C Ball 11.69
- Kona F-4 30.06
- Flint 12.15
- Molochite 200 8

100%

Wet to dry shrinkage 7%
Absorption .25%
Dry to fired shrinkage 7.7%
Total shrinkage 14.7%

Class Ratings

<table>
<thead>
<tr>
<th>Class</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Poor</td>
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Throwing
7 students surveyed

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<th>Property</th>
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What the critics are saying...

"Great for a smooth sculpture body"
"Feels and works like a combination of porcelain and stoneware"

"Throwing was amazing. I recommend wedging the clay and letting it sit for 10 minutes"
"Very good for throwing"

"I like it"
"Really smooth"

"Too plastic for handbuilding. Not enough grog but still workable for a throwing clay body"
"Very nice texture, although slumping happened when handbuilding thicker walls. Nice color though"

"Nice throwing body"
Developed by: Group 4
Type: Throwing/Handbuilding
Color: Grey/Orange
Texture: Rough
Cone: 10 Ox / Red.

Recipe: 
- Hawthorn Bond 35 30.4
- Alfred Shale 15.2
- C&C ball clay 15.2
- Kona-F4 19.2
- Flint 20
- 100%

Wet to dry shrinkage 7.25%  
Absorption 1.68%
Dry to fired shrinkage 7.25%
Total shrinkage 14.5%

Class Ratings
- Very Poor 1
- Poor 2
- Average 3
- Good 4
- Very Good 5

Throwing
7 students surveyed
- Plasticity 3.6
- Building strength/Resistance to slumping 3.7

Hand Building
7 students surveyed
- Plasticity 4.1
- Building strength/Resistance to slumping 4.4
What the critics are saying...

"Loved working with this claybody. Smooth but strong"

"Works like a good stoneware"

"Good for throwing"

"I threw and handbuilt with this body, the tooth helped it retain shape, could handbuild very small and delicate without breaking"

"Excellent handbuilding clay body. Plastic and has enough grog"

"Great body to throw with. Stands up very well, great balance of coarseness and smoothness"

"Good building body"

"Weakened a lot when thinned (pinched)"

Impurities in Hawthorn create localized bubbling on the surface of reduced samples
Developed by: Group 6
Type: Handbuilding / Throwing
Color: Speckled brown
Texture: Semi-rough
Cone: 6

Recipe:
- Barnard Substitute 15.2
- Lizella fireclay 15.2
- EPK 30.4
- OM4 24
- Neph Sy 10.6
- Fine Grog 4.6
100%

Wet to dry shrinkage 6.7%
Dry to fired shrinkage 9.3%
Total shrinkage 16%

Class Ratings

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What the critics are saying...

"Great color! Very pliable as far as bending it"

"Excellent handbuilding clay body. Plastic and has enough grog"

"The body threw really well. Trimming it was like butter"

"Slightly self-glazing when fired. Nice texture and color. Stands well"

"Good for throwing but not the best"

"Hard to make thinly thrown work. Dries out. Had to be very sensitive to touch"

"Body feels slightly thixotropic-is really resistant when molding or modeling. Gummy feeling. Smoothes out well. Color is great"

"Very nice, love the color (prefired). Held shape very well in both throwing and handbuilding"

"It was not so bad for throwing"