Mixing a glaze

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Step 1: Calculating

- Find the glaze recipe. Copy it down in on a sheet of paper that has plenty of room on it.

- What's the total quantity of ingredients in the glaze as written? If it adds up to something like 8,649, you will just mix it as written – this will make a bucket of glaze without multiplying anything. Most glazes add up to 100, or close thereabouts. This is good because you can easily gauge the proportions of ingredients. But you will need to multiply this kind of glaze recipe, or you will only end up with about half a cup's worth (that's the space that 100 grams takes up, usually).

- For highfire glazes, we generally make 6000 g at one time.   (Multiply a 100 g recipe by 60).
- For lowfire glazes, we generally make 5000 g at one time. (Multiply a 100 g recipe by 50).
- For raku glazes, we generally make 3000 g at one time. (Multiply a 100 g recipe by 30).

- Multiply every ingredient in the glaze recipe by the same amount. Following is an example. Suppose you want to mix Jackie's Base Black, Cone 04. Find the Jackie's Base glaze in the Lowfire Glaze List and copy it out:

38 gerstley borate
10 lithium carbonate
5 nepheline syenite
5 EPK
42 silica

100
Add 5% zircopax.

- The above is just the base glaze. If you mix it up as is, it will be milky white in color, not black (base glazes are generally clear or white in color). You need to read further down in the glaze recipe list to find the ingredients that will make this base glaze black. Here they are:

2.2% cobalt oxide
.6% chrome oxide
2.6% iron oxide
.8% manganese dioxide

- So, multiplying everything in the recipe by 50, we get:

38 gerstley borate = 1900 g
10 lithium carbonate = 500 g
5 nepheline syenite = 250 g
5 EPK = 250 g
42 silica = 2100 g
5 zircopax = 250 g
2.2 cobalt oxide = 110g
.6 chrome oxide = 30 g
2.6 iron oxide = 130 g
.8 manganese dioxide = 40 g

- One mistake that people make sometimes is to say "Oh, it's 5 per cent zircopax, so I'll multiply .05 X 50 to get 2.5 g." Notice that this mistake leads to your putting 1/100 of the correct amount of zircopax in the glaze recipe! Instead, 5 X 50 = 250 g of zircopax is correct, because 5 per cent of a 100 g recipe is 5 g. Multiply that by 50, and you get the correct answer, 250 g of zircopax for this mixture. When in doubt, ask Priscilla for help in checking over your figures.

- We keep 2 small calculators in the glaze room. There is also a calculator on any working computer.

- *Calculate carefully. This is important for getting the glaze that you set out to mix.*

Step 2: Weighing out ingredients

- Move to the glaze mixing room. Find the scale. Find a glaze weighing container, and make sure it is clean and dry. Put the container on the scale, and zero out the weight of the container.

- Find the old glaze bucket. Don't skip this step! Otherwise, we'll have two or more buckets of the same thing, and this is obviously not a large room to store all of that.

- Find a clean bucket. You will weigh the glaze ingredients into this bucket.
- Put a mask on. Make sure the glaze room exhaust fan is on.
- Turn to your glaze recipe. Mark the first ingredient. After you weigh it out and put it in the bucket, mark that item off your recipe. This really helps when you get a phone call in the midst of mixing a glaze – you'll know just what you've done.
- If we are out of an ingredient or are really low, tell Priscilla so that she can get more. Often you will find additional amounts of an ingredient on top of the shelves in the glaze room.

- *Weigh really carefully. This is your only hope of getting the glaze you set out to mix. If you weigh it wrong, we may hate how it fires on our work. (But if we like it, we'll have no idea how to get that effect again!)*

Step 3: Mixing and adding water.

- When all the ingredients are weighed out and have been put in your clean bucket, take it to the sink.
- Dry mix the ingredients with your hand.
- Notice the level of dry ingredients in the bucket. Add about half that amount of water. Warm water mixes more easily with the dry ingredients than cold water does. Mix again – a whisk is handy for this. You will have a thick, lumpy glaze at this point. You can add more water, but when you have added too much water, it is very hard to take it away – that's why we were so conservative with the water amount a minute ago.

- How much water is right? Glazes for dipping (usually highfire) should be thin. Glazes for brushing (lowfire, raku) should be thicker. Try to mix the right thickness of glaze, then have Priscilla check the water balance later (highfire glazes that are too thick will go on the pots too thick, leading to a high chance of crawling and running in the kiln).

Step 4: Glaze suspension

- Some glazes suspend themselves nicely. Glazes with a lot of gerstley borate are a good example (such as Jackie's Base). Glazes with a lot of gerstley borate tend to have a consistency somewhat like pudding – these glazes don't need any extra help with suspension.
- Glazes with poor suspension sink to the bottom like a rock. When you try to use a glaze with this problem, you will often see a clear layer of water on top. When you try to stir the glaze off the bottom, your stirring stick won't even sink in. *Avoid this problem by adding a glaze suspender.* Bentonite often appears at the bottom of glaze recipes – this is a kind of clay that soaks up lots of water and becomes jellylike – it helps suspend the glaze. A newer material that is very easy to add to a glaze is Flocs. Add a tablespoon or two to a bucket of glaze that needs suspension help (almost every highfire glaze needs extra suspension. Any lowfire glaze with a lot of frit needs help with suspension). If you come across a glaze in the lab that is already mixed up that needs more suspension, it's a good idea to add a tablespoon of Flocs and then stir.

- *So – don't forget to add 1 to 2 tablespoons of Flocs to the glaze that you mix if it needs help with suspension.*

Step 5: Sieving

- Your glaze is lumpy. It needs sieving. If you don't sieve, there's a high likelihood that your fired glaze will have odd, nasty little grits in it.
- A 60-mesh sieve is the best all-purpose choice. The lower the mesh number, the coarser the screen. Coarser screens are faster to push the glaze through (but if the

screen is too coarse, it may not take the nasty little grits out). An 80-mesh sieve works well for most purposes, too.

- If the old glaze is still in decent shape (that is, it's still liquid), pull it out of the bucket and put it on top of the newly mixed glaze you've already mixed in the other bucket.
- Wash out the old glaze bucket. Use warm water (it's faster) and a sponge. Scrape out dried glaze on the sides of the bucket and any crusty stuff.
- Put the sieve on top of the original bucket (it should now be nice and clean).
- Push the mixture of old and new glaze through the sieve. This is fastest if you use your hand partly as a scrape and partly like a plunger, squishing it up and down over the screen area in the sieve.
- When you've sieved everything through the screen (except for a little bit of gritty stuff remaining on top of the screen), tap the screen against the side of the bucket. This is to dislodge good glaze ingredients sticking to the underside of the screen.
- Check the glaze. Is it nice and smooth? Fairly often, the glaze is still a bit lumpy, so you'll need to sieve it again.
- To sieve again, rinse the empty bucket and the sieve in warm water. Sieve everything into the other bucket.
- You will need to end up with the glaze in the bucket with the label on it. Make sure the label is very legible – it should say the name of the glaze and the temperature it's fired to. Make sure the lid has the same information.
- Clean your empty bucket and the sieve. Put the sieve back in the top of the gray cabinet, on the left hand side.

- The whole process up to this point should not take more than 20 minutes.

Step 6: Checking and testing

- Show your completed glaze to Priscilla. Have her check the water balance.
- Test your glaze:
- For a lowfire glaze, paint some glaze on a test tile and get it fired. Does the glaze look like it ought to? Show it to Priscilla.
- Follow the same procedure for raku.
- For highfire, assuming it's a dipping glaze, the test will work best if you also dip the test piece. The best test for most highfire glazes is on a little pot – something that stands vertically in the kiln, and that has an inner bowl area as well as an outside surface. You can easily make a quick, small pinch pot out of highfire clay (something 2 inches high works well), get it bisque fired, then dip it in your glaze. When the test comes out of the highfire kiln, be sure to show Priscilla.

Odd but useful glaze facts:

"RIO" stands for red iron oxide.
"GB" stands for gerstley borate.
If a glaze calls for "iron oxide", use red iron oxide.

"Oxide" is not the same as "carbonate". Therefore, cobalt oxide is not a direct substitute for cobalt carbonate.

Chrome oxide = chromium oxide = green chrome oxide.

Magnesium is not the same thing as manganese.

Black iron oxide is not the same as red iron oxide or yellow iron oxide. Black nickel oxide is not the same as green nickel oxide. Etc.

Feldspars usually have both potassium and sodium in them, but one will ingredient will predominate in a given feldspar. F-4 feldspar (sometimes called Kona F-4) is a sodium (or soda) spar. Custer feldspar is a potash (or potassium) spar. G-200 is a potassium feldspar. Substituting a soda for a potash spar (or vice versa) may not work. (Then again, it may work – but you would need to test it.)

Flint = silica. Both are a form of ground-up quartz. Silica added to a glaze recipe should be a very fine powder (in other words, don't add "silica sand" to your glaze recipe when silica is called for). Flint is the main glass former in a glaze. However, we can't use flint by itself to make a glaze because it melts only at extremely high temperatures.

Whiting = calcium carbonate

If your recipe calls for a granular form of an ingredient (perhaps granular manganese dioxide), you will need to add this particular ingredient *after* sieving. Otherwise, the sieving process will remove almost all of the granular material! Usually granular manganese dioxide is added to a lowfire glaze recipe for texture and chunkiness (as in Watershed Stone or Chocolate Chip glazes).

Coloring oxides are raw materials (meaning they come out of the ground that way) that are used to color glazes. The common ones are cobalt, chrome, iron, nickel, copper. The coloring oxides are among the more toxic glaze ingredients in the raw form, so handle them carefully. Most coloring oxides are quite expensive.

Glazes may also be colored through the use of ceramic stains. Stains are mixed, prefired, ground up, and tested by a manufacturer. Stains are often identified by a number. Most stains are quite expensive. Traditionally, stains are intended for lowfire use; many burn out in highfire. However, sometimes the colors, even though different, are still interesting in highfire. Reds and oranges are especially delicate in highfire – they burn out easily. The exception is some of the newer highfire red and orange stains that are specially formulated not to burn out at high temperatures (we do have some of those, and they are even more expensive than the regular red and orange stains).

The way we usually change the color of a glaze is to remove the coloring ingredients in the recipe and add different colorants. The amounts will probably need careful adjustment. Experimenting with colorants is a great way to get new and interesting glaze colors. This could be a useful glaze project – see Priscilla if you are interested.

Frits are special materials that are mixed, prefired, ground up, and tested by a manufacturer. Frits are often identified by a number. Unlike stains, frits fired alone come out white or clear. Frits are more expensive than the raw ingredients used to make them because of the extra processing involved. On the bright side, frits are very standardized in terms of their fired appearance and their handling properties in a glaze that you mix. On the other side, frits sink straight to the bottom of the glaze bucket if you don't take steps to suspend the glaze.

Sometimes a recipe will specify an exact kind of clay to use – not just "ball clay" but "OM4" (a particular kind of ball clay). Try to use the specified ingredient if you can (but consult Priscilla if we don't have that ingredient). If the recipe says "EPK", I would use EPK. If it calls for Georgia kaolin or Tile-6, our "kaolin" should work well.

"Calcined" clay is clay that has been fired. This changes the handling properties of the raw glaze (calcining reduces shrinkage, for example). We can calcine dry, powdered clay by putting it in a clay bowl and bisque firing it. Talk to Priscilla if you need this.

Raw glaze materials vary from time to time. Over time, the mine may have come to a slightly different vein of material in the ground, which has slightly different properties in a fired glaze, even though it goes by the old name. Or the mine in one area may have closed, and the material is now coming from a different area. Material from this different area may have somewhat different properties. Over the course of 30 or more years, a material of a given name being mined today may have drastically different firing properties. This is a major reason that you can't necessarily dig a glaze recipe out of an old book in the library and expect to get the result in the picture. Also, sometimes the mine for a given ingredient closes, period – and you can't buy that ingredient anywhere (or maybe it costs 20 times the price to get an old bag of it from someone's hoard). This is the case right now with Albany Slip. Albany Slip was a lowfire clay mined in New York State that was used in glazes. The mine closed. You can go to New York and dig some yourself (some potters do), or you can buy a substitute for Albany Slip that has been mixed from various ingredients in a lab. The substitute Albany Slip has most of the properties of the real thing, but not all of them.