



GLAZE TALK

By Karen Latorre

This is the sixth in a series of columns focused on glazes.

The last two columns focussed on the effect of the various oxides in a glaze. This column will look at the raw materials and define what oxides each material.

In most cases we do not purchase these oxides in their raw form. They come in combination with other oxides in a variety of raw materials that are available for mixing our glazes. This column will provide a view of the relative quantity of each oxide molecule provided by each material. The numbers beside each oxide provides a simple way to do comparisons and should give hints to indicate what kinds of changes you can expect when making changes to your glaze.

For instance, if you wanted to change the feldspar you were using from G-200 to Kona F4, you would look on this table and notice that the stiffener and glassformer amounts provided by both are the same, therefore no expected changes in those aspects, but you'll note that where G-200 provides twice as much K₂O as Na₂O, Kona F4 gives the opposite, so you can expect a shift toward the effects of Sodium oxide from Potassium oxide (i.e. you may see a shift away from blue towards purple if you're colouring with Cobalt). You'll also note that Kona F4 provides much less Calcium oxide (one fifth that of G-200), so you might see a glossier surface, but end up with a less durable and hard glaze. Everything is dependent on the total glaze mix, and since we seldom make a glaze with only one or two ingredients, there are no hard and fast rules we can follow. By making educated guesses based on the information provided in this column, and some experimentation, you can start to alter your glaze pallet.

MATERIAL	FLUX (R20/R0)	STIFFENER (R2O3)	GLASSFORMER (R02)	MISC
#6 Tile Clay		1 Al ₂ O ₃	2 SiO ₂	
Alberta Slip	0.8 CaO, 0.6 MgO, 0.3 K ₂ O, 0.2 Na ₂ O	1 Al ₂ O ₃ , 0.2 Fe ₂ O ₃	8 SiO ₂	
Alumina Hydrate		1 Al ₂ O ₃		
Barium Carbonate	1 BaO			
Barnard Clay	0.1 CaO, 0.2 MgO, 0.2 K ₂ O, 0.1 Na ₂ O	1 Al ₂ O ₃	11 SiO ₂	3 Fe ₂ O ₃
Bell Dark		1 Al ₂ O ₃	4 SiO ₂	
Bentonite	0.3 MgO, 0.2 K ₂ O	1 Al ₂ O ₃	5 SiO ₂	0.1 Fe ₂ O ₃
Bone Ash	3 CaO		1 P ₂ O ₅ (secondary)	
Borax	1 Na ₂ O	2 B ₂ O ₃		
Boric Acid		1 B ₂ O ₃		
Cadycal	1 CaO	1.5 B ₂ O ₃		
Chrome Oxide				1 Cr ₂ O ₃
Cobalt Carbonate/Oxide				1 CoO
Copper Carbonate/Oxide				1 CuO
Cornwall Stone	0.2 CaO, 0.3 K ₂ O, 0.4 Na ₂ O	1 Al ₂ O ₃	9 SiO ₂	

Cryolite	1 Na ₂ O	0.3 Al ₂ O ₃		
Custer Feldspar	0.7 K ₂ O, 0.3 Na ₂ O	1 Al ₂ O ₃	7 SiO ₂	
Dolomite	1 MgO 1 CaO			
Edgar Plastic Kaolin (EPK)		1 Al ₂ O ₃	2 SiO ₂	
Flourspar	1 CaO			F2
Frit 3110	0.3 CaO, 0.6 Na ₂ O	0.1 B ₂ O ₃	3 SiO ₂	
Frit 3124	0.7 CaO, 0.3 Na ₂ O	0.3 Al ₂ O ₃ , 0.6 B ₂ O ₃	2.5 SiO ₂	
Frit 3134	0.7 CaO, 0.3 Na ₂ O	0.6 B ₂ O ₃	1.5 SiO ₂	
Frit 3195	0.7 CaO, 0.3 Na ₂ O	0.4 Al ₂ O ₃ , 1 B ₂ O ₃	3 SiO ₂	
G-200 Feldspar	0.3 Na ₂ O, 0.6 K ₂ O, 1 CaO	1 Al ₂ O ₃	6 SiO ₂	
Gerstley Borate	0.2 MgO, 0.2 Na ₂ O, 0.7 CaO	0.7 B ₂ O ₃	0.3 SiO ₂	
Goldart		1 Al ₂ O ₃	3.5 SiO ₂	
Ilmenite				1 FeO, 1 TiO ₂
Iron Oxide				1 Fe ₂ O ₃ , 1 FeO, or 1 Fe ₃ O ₄
Jackson Ball Clay		1 Al ₂ O ₃	3 SiO ₂	
Kona F4 Feldspar	0.6 Na ₂ O, 0.3 K ₂ O, 0.2 CaO	1 Al ₂ O ₃	6 SiO ₂	
Kyanite		1 Al ₂ O ₃	1 SiO ₂	
Lithium Carbonate	1 Li ₂ O			
Magnesium Carbonate	1 MgO			
Manganese Dioxide				1 MnO ₂
Mullite		1 Al ₂ O ₃	0.7 SiO ₂	
Nepheline Syenite	0.8 Na ₂ O, 0.2 K ₂ O	1 Al ₂ O ₃	4.5 SiO ₂	
Nickel Oxide				1 NiO
Old Mine #4 Ball Clay		1 Al ₂ O ₃	3.4 SiO ₂	
Pearl Ash	1 K ₂ O			
Petalite	1 Li ₂ O	1 Al ₂ O ₃	8.5 SiO ₂	
Redart	0.3 MgO, 0.3 K ₂ O	1 Al ₂ O ₃	7 SiO ₂	0.3 Fe ₂ O ₃
Rutile				1 TiO ₂ , 1 Fe ₂ O ₃
Silica, Flint			1 SiO ₂	
Soda Ash	1 Na ₂ O			
Spodumene	1 Li ₂ O	1 Al ₂ O ₃	4 SiO ₂	
Strontium Carbonate	1 SrO			
Talc	1 MgO		1.3 SiO ₂	
Tin Oxide				1 SnO
Titanium Dioxide				1 TiO ₂
Trisodium Phosphate	3 Na ₂ O		1 P ₂ O ₅ (secondary)	
Whiting	1 CaO			
Wollastonite	1 CaO		1 SiO ₂	
Yellow Ochre		1 Al ₂ O ₃	5 SiO ₂	0.7 Fe ₂ O ₃
Zinc Oxide	1 ZnO			
Zircopax, Superpax, Opax, Ultrox			1 SiO ₂	1 ZrO ₂

The above table shows relative levels of oxides. For accurate calculations, typical chemical analysis information can be obtained from the material supplier. If you are formulating your glazes using either manual calculations, or a software program, and desire accuracy in your calculations, you should request a chemical composition for the materials that you are purchasing from the suppliers. In addition, some materials are variable in composition so it's important to note batch numbers available for the material in question.

Following is the analysis of EPK to allow you to compare the detailed chemical analysis view to the simplified view given above:

Detailed Chemical Analysis of EPK:

SiO ₂	46.08%	- this number represents the percent of Silica that remains after the material is fired.
Al ₂ O ₃	37.46%	
Fe ₂ O ₃	0.69%	
K ₂ O	0.4%	
Na ₂ O	0.04%	
CaO	0.13%	
MgO	0.12%	
TiO ₂	0.03%	
P ₂ O ₅	0.12%	
L.O.I.	14.66%	- this is loss on ignition which means when a material is fired some molecules leave by entering the atmosphere of the kiln and exiting through the exhaust leaving less total weight in the fired material.

Using the simplified view from the table above, EPK (1 Al₂O₃ + 2 SiO₂) would be:

SiO ₂	56.90%
Al ₂ O ₃	28.44%
LOI	14.66%

Some important points to consider when selecting a material for your glaze:

- In general it's good practice to select raw materials that provide more than one oxide into the mix (i.e. choose talc, instead of both Magnesium Carbonate and silica).
- The finer mesh size of the material, the more of the surface is exposed providing a better melt in the firing (250 to 400 mesh is preferable to 100 mesh materials).
- Try to avoid mixing glazes with very few component raw materials since some raw materials have undesirable properties in the glaze bucket (i.e. Nepheline Syenite in large quantities will form a block of glaze at the bottom of your bucket, and Magnesium Carbonate or Gerstley Borate in large quantities tends to absorb the water making the glaze more gel like in consistency, causing difficulty in application of an appropriate thickness of glaze).
- Some materials are soluble in water which means they may alter the composition of your glaze if you remove water from a settled glaze bucket, and in fact may alter the properties of the raw glaze itself and it's state in the bucket. Na₂O, K₂O, and B₂O₃ are common offenders. Look for materials that include these in a mix such as a feldspar or a frit, rather than using the materials in their raw form such as Soda Ash or Borax.