



GLAZE TALK

By Karen Latorre

Welcome to a regular column focusing on glazes. With this first column, I will cover the basics of a glaze, starting with the main ingredients in a glaze.

First of all, what is a glaze? A glaze is a thin coating of glass that covers a ceramic object. The glass can be either transparent, translucent, or opaque, dependent on the interaction of the materials that have gone into making that particular glass.

The main ingredient in glass is Silica, also known as silicon dioxide. Silicon dioxide is a molecule made up of three parts. One atom of silica is joined to two atoms of oxygen. Chemically, this is written as SiO_2 . Si is the chemical symbol for silicon. O is the chemical symbol for Oxygen. The “2” following the O indicates that there are two oxygen atoms in this particular molecule.

Although silica alone can form a glass or glaze, it melts at much too high a temperature (1710 Celsius or more) for it to be feasible to make a glaze with this material alone. In order to make the silica melt at a lower temperature, one must add a melter, or flux to the silica.

Silica and flux are all that’s required when making glass for glass objects such as blown glass vessels. Unfortunately, this is not all that’s required in order to make most pottery glazes. The combination of silica and flux makes for a very liquid, easily flowing glass that would end up predominantly on our kiln shelves rather than on our pots. One more ingredient is required in order to keep the glaze on the ceramic body during the firing cycle.

Alumina, an aluminum oxide molecule (Al_2O_3 – 2 aluminum atoms (symbol Al) combined with 3 oxygen atoms) is the ingredient which is referred to as a stiffener. This makes the molten glaze more viscous, like comparing water (silica and flux mixture) to molasses (silica, flux, and alumina mixture).

So now we have the basic ingredients in a glaze:

Glass Former + Flux + Stabilizer = Glaze

Once again, the glass former forms the glass structure. The flux lowers the temperature at which the glass former melts, and the stabilizer increases the viscosity of the glass so that it doesn’t run off the pot and pool on the kiln shelf.

Each of these three things that make up the fired glaze are in the form of “oxides”. An oxide is a combination of an element with Oxygen.

So, what is an element? Remember the “periodic table” that we were exposed to in Chemistry classes in high school? This table has “elements” like oxygen, hydrogen, gold, and over a hundred others, each with it’s own chemical symbol as I’ve alluded to above with the oxygen (O), silicon (Si) and aluminum (Al). Unfortunately, not all elements have a symbol matching the beginning of their name (such as gold = Au, and lead = Pb).

The glass former oxide has the form of one atom of an element combined with two of oxygen (again, SiO₂).

The flux has either the form of two atoms of an element combined with one atom of oxygen (generally stronger fluxes), OR one atom of an element combined with one atom of oxygen (generally weaker fluxes).

The stabilizer has the form of two atoms of an element combined with 3 atoms of oxygen (again, Al₂O₃).

Following is a table with some of the more common oxides found in a fired glaze:

FLUX	STABILIZER	GLASS FORMER
K ₂ O (“potassium oxide”)	Al ₂ O ₃ (“aluminum oxide”)	SiO ₂ (“silicon oxide”)
Na ₂ O (“sodium oxide”)		
Li ₂ O (“lithium oxide”)		
CaO (calcium oxide)		
MgO (magnesium oxide)		
BaO (barium oxide)		
ZnO (zinc oxide)		
PbO (lead oxide)		
SrO (strontium oxide)		

NOTE: the “ “ marks around some of the names below indicate that they are the commonly used term to refer to this in glaze chemistry. The true chemical names differ slightly and indicate the number of atoms of each element, such as Silicon Dioxide (with the “di” meaning two)

In glaze chemistry, these three types of oxides are commonly referred to as RO or R₂O for the fluxes (with R used as a placeholder replacing the symbol for the element in the table), R₂O₃ for the stabilizer, and RO₂ for the glass former.

For those chemically inclined, the flux is also known as a “base”, the stabilizer as an “amphoteric”, and the glass former as an “acid” due to their chemical composition.

As you’ve probably already deduced, you can’t necessarily purchase many of these oxides on their own. What we buy from the pottery suppliers are feldspars, and things such as talc, wollastonite, and whiting, to name just a few. Each of these materials is

the raw form of the oxide, or a combination of oxides. As an example, Whiting is Calcium Carbonate, or CaCO_3 . When exposed to high temperatures, this molecule breaks down into CaO and CO_2 , or calcium oxide and carbon dioxide gas (count the molecules ... one of Ca (calcium), one of C (carbon), and 3 of O (oxygen) in the original molecule, and the same number after it is broken down by the high temperature!). The CO_2 gas escapes the kiln and the calcium oxide is left in the glaze layer.

Feldspars have all three parts of the glaze (glass former, stabilizer and fluxes)

Clays have glass formers and stabilizers.

Frits have all three parts since they are a premixed glass that has been broken down into a very small particle size.

Other materials are either pure fluxes (i.e. Zinc Oxide), or a combination of two or three of the glaze parts. A later column will look at some of the raw materials and what they provide to the final fired glaze.

Let me close this month's column by providing you with a sample glaze recipe, and indicate what each material provides to the final glaze:

RAW MATERIAL RECIPE			FLUX	STABILIZER GLASS	
Feldspar	40	provides →	K_2O , Na_2O , CaO	Al_2O_3	SiO_2
Whiting	30	provides →	CaO	---	---
Clay	20	provides →	---	Al_2O_3	SiO_2
Silica	10	provides →	---	---	SiO_2

By examining the above information you can see that all three of the components of a glaze are provided by the 4 raw materials in the glaze recipe. In the next column I will talk about the ratio of each of the three parts of a glaze, and a future column will talk about the unity formula which allows the potter to analyze a glaze and make adjustments to arrive at a desired final result in a glaze.