

ART 186 - INTRO TO CERAMICS

INTRODUCTORY GLAZE COMPOSITION

A **GLAZE** is a glass that has been modified to melt onto a clay. The chemical name for glass is **SILICON DIOXIDE**. Common names for glass are sand, quartz and flint. Silicon dioxide is one of the most common minerals composing the earth and can be easily found in most parts of the world. Glass cannot be used alone to make glazes however, because its melting point is 3100° Fahrenheit, making it unusable as a pure component. This is simply because the melting point of our clays, even our highest firing clays such as stoneware and porcelain, is much below this. Thus the clay would melt in the kiln long before the glaze itself would.

Therefore, modifications need to be made to the **SILICA** to lower its melting temperature. **FLUXES** are chemicals added to the **SILICA** to lower its melting point. The **FLUXES** comprise a large group of minerals, and one of the few things they have in common is their lower melting points, relative to **SILICA**. Since low fire glazes require more melting, they generally contain a higher percentage of **FLUXES** relative to **SILICA** than do the high fire glazes used on stoneware and porcelain. Simply stated, the more **FLUX** added to a glaze, the lower the melting point will be.

Additionally, there is a third class of ingredient that must be added to a glaze to produce an acceptable result. Since glaze is to be applied to bisque ware that will undergo additional shrinkage during the glaze firing, the glaze itself must 'shrink-to-fit' the bisque to which it is applied. The ceramic material we already know that will shrink is **CLAY** itself. So, an amount of **CLAY**, called the **ALUMINA** portion is added to the glaze to achieve this essential shrinkage. Remember, a generalized formula for clay is **SILICA**, **ALUMINA**, water and various impurities. Thus, the addition of **ALUMINA** to a glaze in the form of a clay actually introduces two of the three essential parts of a functional glaze: **SILICA AND ALUMINA**.

All **GLAZES** are composed of three components:

SILICA	ALUMINA	FLUX
the glass former	the portion that 'shrinks-to-fit' the clay	to lower the melting point of the higher temperature ingredients

REFRACTORY INGREDIENTS are those with high melting points, such as the **SILICAS** and **ALUMINAS**.

SILICA SOURCES IN GLAZE FORMULATION

SILICA is added to glazes by the addition of compounds such as: **SILICA, BALL CLAY, KAOLIN, and FELDSPAR.**

SILICA is a commonly used name for Silicon dioxide. Other names for this compound are glass, quartz, and flint.

BALL CLAY is a commonly used clay in glazes and in clay bodies, and is a source of **SILICA** and **ALUMINA.**

KAOLIN is another commonly used clay, very white in color, used in glazes and in the formulation of Porcelain clays in particular.

FELDSPAR is probably the single most commonly used glaze ingredient. It is a natural mineral, derived from granite. It is a source of **SILICA, ALUMINA,** and a relatively smaller amount of **FLUX.**

ALUMINA SOURCES IN GLAZE FORMULATION

ALUMINA is added to glazes by the addition of **BALL CLAY, KAOLIN, and FELDSPAR** (discussed above).

FLUX SOURCES IN GLAZE FORMULATION

FLUX is added to glaze by a wide variety of compounds, a few of which are listed here:

LOW FIRE GLAZE FLUXES

lead oxide or carbonate
borax
gerstley borate
commercially prepared frits
and many others

HIGH FIRE GLAZE FLUXES

whiting (calcium carbonate)
dolomite (calcium/magnesium carbonate)
bone ash (calcium oxide)
organic ashes
barium carbonate
most coloring oxides
feldspar (contains some flux)
and many, many more

A BASE GLAZE is a mixture of these three basic groups: **SILICA, FLUX AND ALUMINA.** A base glaze is clear or white in color. All colored glazes derive from additions of colorants to a base glaze.

Here is a typical base glaze formula:

HIGH ALUMINA MAT Cone 10 (This is a shorthand for 2350° Fahrenheit.)

Feldspar	48.9%	(Source of SILICA, FLUX, AND ALUMINA)
Kaolin	25.1%	(Source of SILICA, ALUMINA)

Dolomite	22.4%	(Source of FLUX)
Whiting	3.6%	(Source of FLUX)
	100.0%	

NOTE: All three categories of essential glaze ingredients are present. We do not know from this analysis whether they are present in the proper proportions or not. This would involve a quantitative analysis that is beyond the scope of this class. If you are interested in further study, read the text, *Ceramics, a Potter's Handbook*, by Glenn C. Nelson. [GLAZE CALCULATION](#) is a course offered here at Glendale College that provides in depth study in this field.

The **BASE GLAZE** will be white or clear unless colorants are added. For a discussion of color in glaze go to [GLAZE COLOR](#).

Ingredients have several characteristics that make them suitable for use in glazes besides whether they are sources of **SILICA, FLUX AND ALUMINA**. Obviously, we need to find sources that are **INEXPENSIVE**. Also, we are looking for the ingredients that are **NON-TOXIC**. Lead, for example, is inexpensive and an excellent flux, but is so toxic that it is not used much anymore. A third requirement is that the potential glaze ingredient must be **INSOLUBLE** in water. This is because glaze is applied to a piece of bisque as a liquid **SUSPENSION** of materials in water. After dipping, the water in the glaze absorbs into the porous bisque, depositing the insoluble glaze materials on the surface of the pot. Thus the water serves only as the **VEHICLE** to get the glaze onto the bisque. Were a glaze ingredient **SOLUBLE** in water, it would travel with the water into the bisque, and not be deposited on the surface. Suppose this soluble ingredient were a **FLUX** -- then the **FLUX** would travel with the water into the bisque, leaving the glaze. Thus the bisque would melt, and the glaze would not. You would have, in a sense, turned the pot inside out. Therefore, all glaze materials must be **INSOLUBLE** in water.

If a chemical is **INEXPENSIVE, NON-TOXIC, INSOLUBLE**, and a source of **SILICA, FLUX OR ALUMINA**, you can bet we use it in glaze composition.

