ART 187 - CERAMICS 2

GLAZE BASICS

GLAZE CHEMICALS: BRIEF DESCRIPTIONS/FUNCTIONS:

SILICAS

SILICA (also known as silicon dioxide, quartz, and flint) is the basic foundation of all glazes. It is present in all glazes in some form. It is highly refractory, melting only at temperatures above 3100° F. Silica is added to glazes from a variety of sources, most commonly:

SILICA - Silicon dioxide is usually added to glazes at 200 Mesh, although you may occasionally see glaze formulas that call for even smaller mesh sizes, such as 400M. Silica at this mesh aize is very dangerous in that it will pass through many respirator masks. When usuing any glaze ingredient of extremely small mesh size, make sure you use a respirator mask appropriate for very fine powders.

FELDSPARS - All feldspars contain silica (see table below).

CLAYS - All clays contain silica (see below).

FELDSPARS

(* indicates feldspars we have in stock)

POTASH FELDSPARS	SODA FELDSPARS
Kingman (not available)	*Nepheline syenite
Buckingham	Kona C-6
Clinchfield	Lu Spar #4
*Custer feldspar	Min-Pro #4
Keystone	Eureka
Yankee	Bainbridge
Maine	#56 Glaze Spar
	Clinchfield

***Plastic vitrox**

Kona A-3

Oxford

Godfrey

Elbrook

Mocoo "h"

POTASH FELDSPARS are important sources of silica and alumina in glazes. Feldspars also contain some fluxes. In potash feldspars, the potassium fluxes predominate.

#303

***Kona F-4**

Del Monte

***Cornwall stone**

***NC-4**

***G200**

SODA FELDSPARS are also important sources of silica and alumina in glazes, and contain a predominance of sodium fluxes. These feldspars have lower melting temperatures than the potash feldspars.

CLAYS

Most glazes contain clay compounds. Clays are inexpensive, non-toxic sources of both silica and alumina in glazes. Most clays have relatively high melting points and are thus called REFRACTORIES. A refractory is a chemical with a high melting point. Of course, clays vary tremendously in composition, often containing significant impurities of coloring oxides. The whiter the clay, the fewer impurities, and thus the higher the melting point. Thus. those clays that are darker in color, due to the presence of high percentages of iron, manganese, and other pigments, have much lower melting points. Following is a list of the most commonly used clays in glaze composition:

ALBANY SLIP CLAY - A naturally occurring clay containing silica, alumina, and flux in the proper proportions to make a glaze at stoneware/porcelain temperatures. Fires glossy brown-black at D8-10. No longer available.

BALL CLAYS - Fine grained, plastic clays, which fire near white. Added to porcelain clays to increase working plasticity. Contains trace impurities of iron oxide which limit it's addition to porcelain bodies because the color of the clay body will darken. Added to glazes to adjust the 'shrinkage' of the glaze so that the glaze will 'fit' the body during the shrinkage of the pot during firing.

FIRE CLAYS - Coarse grained, non-plastic clays that have high proportions of refractory materials. Used primarily in bricks for kiln construction, they are sometimes added to stoneware bodies for texture. Rarely used in glaze preparation due to their coarseness.

KAOLIN - (also known as China Clay or EPK) - Fine grained, relatively non-plastic clays which fire nearly pure white. Contain very little impurities of iron oxide and are extremely refractory. Added to a glaze when clay is desired, but color is not (i.e. clear glazes at D10).

RED STRIPE OR RED HORSE CLAYS - Low temperature smooth grained clays that contain significant amounts of iron oxide. They are brick red in color, plastic, and are used in low temperature terra cotta clay bodies. Because of their high iron content, their use in glazes is limited to glazes that are dark in color.

FLUXES

The fluxes comprise the largest group of glaze chemicals. Their common function is to lower the melting point of the refractory materials, such as silica, clay, and feldspar described above, to the desired firing temperature. Thus a flux is considered to be any compound with a lower melting point. There are thousands, and they vary by the 'side effects' they produce in a glaze. Thus there are fluxes that while lowering the melting point of the glaze, also increase opacity, texture, or influence color development. Some of the more commonly used are:

BARIUM CARBONATE - (BaC03) - Strong high temperature flux. Causes copper to yield blue even in a reduction firing.

BONE ASH - (Calcium phosphate) - High temperature flux. Also used in bone china to increase translucency.

BORAX - Next to lead, the most common low temperature flux, also used infrequently in high temperature glazes.

COLEMANITE - see Gerstley borate.

DOLOMITE - (Calcium-magnesium compound) - Very common high temperature flux.

GERSTLEY BORATE - (Calcium compound) - Used both as a high and low temperature flux. Tends to develop a milky blue opalescent color in glazes.

MAGNESIUM CARBONATE - (MgC03) - High temperature flux.

TALC - High temperature flux.

WHITING - (also known as CaC03, Calcium carbonate, limestone) Most common high temperature flux.

ZINC OXIDE - (ZnO) - High temperature flux, used often in crystalline glazes. Can also function as an opacifier.

COLORANTS

CHROME OXIDE - Usually added to glazes to produce greens in reduction firings. However, combined with tin, pinks can be produced. If zinc is present in the glaze, a brown will result. Browns are also produced in oxidation firings. Use in 2-3% amounts.

COBALT OXIDE or CARBONATE - Both are common cobalt sources and invariably yield blues in glazes, both reduction and oxidation. If magnesium is present in the base glaze, blue violet colors will result. Use in 1/2% to 2% amounts.

COPPER OXIDE or CARBONATE - Copper yields blue and green colors in oxidation glazes, and red to purple colors in reduction glazes. However, any barium present in the base glaze will cause copper to yield blues even in a reduction glaze. Use in 2-5% amounts.

IRON OXIDE - The most common glaze colorant, used to color clays, slips, washes and glazes. In high temperature, reduction glazes, it tends to develop into celadon colors in concentrations below 2%. In higher amounts, yellows, oranges, golds, brick, brown and black colors can result in reduction firings. Iron is a powerful flux also, so beware glazes running if you increase the iron concentration towards 8%.

MANGANESE DIOXIDE or CARBONATE - A relatively weak colorant which produces browns in reduction firing, and purples in oxidation firings.

NICKEL OXIDE or CARBONATE - A versatile colorant, producing many colors from blue to tan to gray to green depending on base glaze composition. Most often used to soften the effect of another colorant. Used frequently in crystalline glazes. Use in 1-3% amounts.

RUTILE - An impure oxide of titanium which contains iron oxide as well. Used alone, it produces tans and tends to make a glaze more opaque (see below). Most often used in combination with iron oxide and other oxides as a texturizer. Use in 3-5% amounts.

VANADIUM PENTOXIDE - A weak yellow colorant, often combined with tin oxide for stronger yellow. Used in oxidation only, as it produces dull grays in reduction firing. Use in 5-10% amounts.

OPACIFIERS

Opacifiers are added to base glazes to make them opaque. Eliminating them from a glaze will cause the glaze to become transparent. Some of the most commonly used are:

TIN OXIDE - Most effective opacifier, but quite expensive. An addition of 5-7% will produce a completely opaque white glaze. Has a considerable effect on color qualities of most colorants. Is commonly used along with copper to produce better reds in a reduction firing.

TITANIUM DIOXIDE - An opacifier, like its impure form, rutile, it encourages a semi-matte surface.

ZINC OXIDE - May be used as an opacifier in some glazes.

ZIRCOPAX - A relatively inexpensive substitute for tin oxide as an opacifier, often used in combination with tin oxide. Use in 5-10% amounts.

DEFLOCCULANTS

A deflocculant is a compound added to a glaze to decrease its tendency to settle out in the glaze bucket. Some glazes tend to settle out quite rapidly and quite severely making it difficult to restir them and make them reusable. Should you encounter a glaze that exhibits this quality it can be inconvenient. Small additions of the following chemicals may improve the ability of the problem glaze to be brought back into suspension. In general, if the glaze does not exhibit this tendency, you do not need an

added deflocculant. Most common offenders are low temperature glazes that are very low in clay content, such as glazes based primarily on a frit.

BENTONITE - A clay used in 3-5% amounts to get better glaze adherence and to reduce glaze settling. Has no appreciable effect on fired glaze color.

EPSOM SALTS - Use 3-5% to reduce glaze settling.