



GLAZE TALK

By Karen Latorre

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

In the last column we walked through the most common oxides found in a glaze. There are other less common oxides that are found in glazes that can produce interesting effects, along with the colouring oxides. This column will complete the coverage of oxides and their properties.

For each colourant, a percentage range is shown which indicates the amounts usually found to produce a good range of colour strength.

OPACIFIERS	
Titanium (TiO ₂)	<p>Similar to silica.</p> <p>Hardens a glaze.</p> <p>5-10% gives a crystalline soft matt surface and provides creamy opacity to a glaze.</p> <p>Has the tendency to pull any colour from the body underneath, incorporating it into the crystals in the glaze.</p> <p>In small amounts can intensify colours. Moderate amounts (2 – 6%) will break up colour by mottling. Large amounts subdue colour and give some sparkling to the glaze.</p> <p>In presence of some rutile can be phototropic (colour changes with light) and thermotropic (colour changes with heat – for instance glazes which are white at room temperatures are yellow at temperatures above 150C/302F).</p>
Tin (SnO)	<p>Strongest opacifier in common use (5% - 8% will opacify the glaze). Opacity can be lost in high fire reduction and can produce an unpleasant grey cloudiness or scumming on the glaze surface.</p> <p>Subject to Chromium flashing*. In combination with Chromium gives crimson colours.</p> <p>Gives softer whites (creamy or bluish milk white).</p> <p>Can act as a flux at high temperatures, and can increase viscosity. If using over 8%, calcine first to avoid crawling.</p> <p>SnO₂ is the white form. SnO is the black form.</p> <p>Important in underglaze colours for yellow, pink, red, and crimsons.</p>
Zirconium (ZrO ₂)	<p>Like tin but requires higher levels in the glaze for similar opacity (approx 10% compared to 5% tin).</p> <p>Gives extreme and possibly harsh whites.</p>

Phosphorus (P ₂ O ₅)	<p>Acts as a secondary glassformer.</p> <p>Creates small bubbles in the glaze scattering light and opacifying and giving a depth to the glaze – shows as a bluish flush in the glaze. Basis of the bluish flush in Jun / Chun glazes.</p> <p>In large amount can cause blistering.</p>
COLOURANTS	
<p>Copper (CuO)</p> <p>Carbonate: 2 – 4 %</p> <p>Oxide: 1 – 2 %</p>	<p>Will produce turquoise blues in a high soda or lithium glaze, yellow-greens in high potassium glaze, and blue-greens or browns in high barium glaze. In high magnesium, a small amount can produce soft mottled pinks.</p> <p>In reduction produces copper reds.</p> <p>Produces lustres in Raku glazes.</p> <p>Tends to increase the amount of leaching (material release in presence of acids) in a glaze.</p> <p>Dissolves readily in a glaze and can spread in the glaze body.</p> <p>The carbonate is a green powder, the oxide is black</p>
<p>Cobalt (CoO)</p> <p>Carbonate: ½ - 1 %</p> <p>Oxide: ¼ - ½ %</p>	<p>Strongest colourant used in pottery. Produces blues, except in presence of high magnesium glaze where it will produce purples. If base glaze is also high soda, the purple will be emphasized. With a certain combination, may produce pink in a high barium glaze.</p> <p>The carbonate is a mauve powder, the oxide is black. The oxide is 1.6 times stronger than the carbonate. The oxide is more likely to cause speckling than the carbonate.</p> <p>In high amounts acts as a flux</p>
<p>Chromium (Cr₂O₃)</p> <p>Oxide: 1 – 2 %</p>	<p>Produces olive or grey greens, unless in presence of zinc, where it will tend to brown.</p> <p>In proper ratio with tin, will produce a range of pinks to crimson.</p> <p>The raw oxide is a dark green in colour.</p>
<p>Iron (Fe₂O₃)</p> <p>Oxide: 2 – 6 %</p>	<p>Red iron oxide or yellow iron oxide. Black iron oxide is Fe₃O₄. Black iron oxide is always a flux.</p> <p>In a reducing atmosphere, Iron performs as a flux.</p> <p>Produces yellows to browns, except in reduction atmosphere where in small amounts produces celadon green.</p>
<p>Manganese (MnO₂)</p> <p>Dioxide: 2 – 6 %</p>	<p>Produces browns, and in alkaline glazes can produce plum purples.</p>
<p>Vanadium (V₂O₅)</p> <p>Stain: 4 – 8 %</p>	<p>Produces weak yellows. In presence of titanium or tin will produce a stronger yellow.</p>

Nickel (NiO) Oxide: 1 – 2 %	Green is Ni ₂ O ₃ . NiO is black nickel oxide. Usually gives a greenish or brownish grey but can provide a range of colours including greys, browns, blues with zinc, tan with calcium, grey-brown with barium. In oxidation, with 20 – 50% Barium Carbonate and 10% Zinc Oxide, 1 – 3 % Nickel oxide can develop pinks, blues and greens.
Cadmium	Low fire colourant (below cone 010) Produces yellows in it's sulphide form, and reds when in combination with selenium, although the colours are fugitive and react quickly to changes in kiln atmosphere.
OTHER ELEMENTS FOUND IN COMMON POTTERY MATERIALS	
Flouride (F)	Gas released in the kiln which can cause bubbling and blistering in a glaze. Used to produce crater glazes. Forms hydrofluoric acid during firing which will damage kiln bricks and etch glass.
Carbon (C)	Released during firing in the form carbon dioxide. Used to produce crater glazes. When incorporated into a glaze in the form Silicon Carbide (SiC) in very fine mesh form, can produce artificial copper reds in an oxidation firing by adding carbon to the glaze structure as would happen in a reduction firing when reducing the amount of oxygen available to form carbon dioxide.

* Flashing: During a glaze firing, some molecules volatilize and move from the glaze they are a part of to another pot, embedding themselves in the glaze layer. This forms a "blush" on the other pot. Chromium is one such material that will enter the atmosphere of a kiln, and will react with glazes that have tin to create a blush on that pot.

There are some other oxides which have either been used in the past and are no longer available, or have only been used experimentally by some potters. These include antimony oxide (opacifier and colourant for yellows, highly poisonous), arsenic oxide (glass former, can absorb unwanted colours in transparent glazes, highly poisonous), beryllium oxide (alkaline earth flux, very expensive, poisonous), bismuth oxide (flux and craze reduction, very expensive, used in lustres), cerium oxide (lanthanide (also known as rare earth) oxide, opacifier, colourant for yellow), erbium oxide (lanthanide, colourant for light pinks), germanium oxide (glassformer), molybdenum oxide (used in yellow stains, poisonous), neodymium oxide (lanthanide, colourant for purple and blues), praseodymium oxide (lanthanide oxide, colourant for yellows and greens), uranium oxide (colourant for yellows and orange reds, very expensive).