

## Arbuckle

## Slips and Engobes

### SLIPS AND ENGOBES

An engobe or slip is a more-or-less liquid mix of clay and water used to change the surface texture or color of a clay piece. Often “engobe” is used to refer to a mixture that is more fluxed and between a slip and a glaze, sometimes referred to as a “vitreous engobe”, or may refer to a slip coating that is an entire layer on the object. After formulating for the maturing temperature and to match the shrinkage state of the body during application (e.g. leather-hard, bone-dry, or bisque application), the artist has the option of considering color. Colorants are an addition to the 100% base slip recipe.

Colors in slips may be influenced by kiln atmosphere (oxidation or reduction) and/or the fluxes added to the slip or fluxes in the glaze applied over the slip. Please keep this in mind when reading colorant charts for slips. In addition to using coloring oxides (e.g. copper, cobalt, iron, manganese, chrome, nickel) and minerals (rutile, ochre, ilmenite, crocus martis, et al.), commercially made ceramic stains may be used to color slips. Some stains are fugitive and will pale or disappear at high temperatures or be affected by reduction. Check the manufacturer’s specifications. Some colors listed as body stains (like Mason 6020 pink, 6485 titanium yellow, or 6319 lavender stains) are refractory and will fire to cone 10, as will inclusion stains, most cobalt blues and chrome greens . See Mason chart online: [http://www.masoncolor.com/ceramic\\_RefGuide.asp](http://www.masoncolor.com/ceramic_RefGuide.asp) Because the clay in the slip is opaque and refractory, the colorants are contained in the clay rather than dissolved in a glass, as they are in glazes, and it usually takes a higher percentage of colorant to achieve saturated color in slips. Inclusion stains encapsulate cadmium and selenium colorants in zirconium, stabilizing them and reducing toxicity. These have been successfully used to make high-fire oranges and reds, but are expensive for slip use.



China, Song dynasty 12th c, stoneware

Colorant percentages are ball-park amounts, and you should test above and below as well. Oxide forms of colorants are stronger than carbonate forms and take a smaller % for the same result, but carbonates disperse more easily. An overload of coloring oxide, especially the ones that also flux (like copper, cobalt, and iron), may cause a refractory, metallic grey surface in the covering glaze at high-fire temperatures.

<b>SLIP RECIPE suggestions</b> adapted from Daniel Rhodes	<b>C 04</b> <b>WET</b>	<b>C 04</b> <b>BISQ</b>	<b>C 4-6</b> <b>WET</b>	<b>C 4-6</b> <b>BISQ</b>	<b>C 10</b> <b>WET</b>	<b>C 10</b> <b>BISQ</b>
kaolin	35	8	28	10	35	11
calcined kaolin		20		20		17
ball clay	30	15	28	10	25	15
neph sy – will deflocculate			15	20		
spar (Custer)					15	18
whiting					5	6
frit	15	15		5		5
talc	5	15				
soda ash		5		9		6
flint	15	22	15	20	15	22
Optional for white: 5-10% opacifier (Zircopax, superpax, Opax, Ultrox)						

Using the soda ash in the above recipes, or .25% (¼%) deflocculant (sodium silicate, Darvan, or soda ash) will make the slip deflocculate (reduce the amount of water needed to make a slip liquid and make the particles orient parallel and slightly repel each other.) This helps the slip brush more easily and reduces drying cracks from shrinkage in thick slip applications This is useful in slips for bone dry and bisque applications.

## Arbuckle

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A slip that is too thin may be thickened some by adding a flocculant like Epsom salts. It mixes best if added as a saturated solution. To make this, add Epsom salts to warm water until crystals remain on the bottom (i.e. no more can be stirred into solution).

Color	Colorant	Percent	Notes
white	Superpax	5%	Most base slips are white as-is. Option to add any zirconium opacifier for added white color. Tin oxide could also be used, but is very expensive.
cream-brown	iron oxide	3-15%	At high fire, high percentages of iron may cause additional fluxing action.
browns to plum	manganese	5-15%	Generally brown, but plummy under alkaline or lead glazes.
grey-brown	nickel oxide	2-5%	May be used to make cobalt slips more of an inky blue.
yellow	rutile	4-7%	Butter yellow in lowfire. Pearly in salt-firing.
pale yellow	titanium	4-7%	Pearly in salt-firing
blue	cobalt	1-4%	Very pale color raw, so it may be hard to remember that it will be very blue. Food coloring in the slip is an option for easier visualization while working.
green	chrome	1-4%	
blue green/teal	chrome cobalt carb	0.5% 0.3%	
tizzy (copper red)	copper carb	8%	In oxidation, a pale greenish color. In reduction, copper red slip under clear glaze
pink	Mason 6020 Pink	12-15 %	Will go to cone 10
stains	Mason or other	12-15%	Some colors will burn out at highfire. Yellows may grey in reduction unless encapsulated stains.

## Slip Tips

- If a glaze crazes over a slip, try adding more flux and/or silica to the slip.
- If slip cracks as it dries, add more non-plastic ingredients (e.g. flint) or reduce ball clay, try thinner application, or deflocculate.

## Arbuckle

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- If the slip cracks during firing, you may need to add flint and/or reduce the flux.
- If a slip pops off the fired piece, increase the shrinkage of the slip by adding more plastic ingredients (ball clay), or reduce the non-plastic ingredients. Slip popping off in the glaze firing may also be a fusion problem w/either too much or not enough flux.
- Less clay, more flux gives earlier vitrification.
- At cone 9, 3-4% whiting = 8-10% feldspar in fluxing power.
- Screen slip through at least a 60 mesh screen to prevent color specking and lumps.
- Color in slips requires a higher percentage of coloring oxide or stain than glazes to make a saturated color. Try 10-15% stains. Oxides vary depending on strength of the material: cobalt may only need ½—2%, while iron and copper may be used around 8%.
- Slips for leather-hard application must shrink w/the body: use more plastic clays for the base.
- Slips for bisque or bone-dry application need low shrinkage to be compatible with the piece: use calcined clay or less plastic clays for the base.
- Grog, sand, wood ash or granular materials may be added to slip (after screening) for textural surfaces.
- Bisque slips should be deflocculated for best results.
- Slips containing soluble ingredients (e.g. borax, soda ash, some frits such as 3110) will form crystals in the slip if stored for a while. These crystals will produce hard, glassy spots in the slip when fired to bisque temperatures, and may accentuate fluxing in a glaze over them.

## Resources:

### Books:

Phillips, Anthony, *The Complete Potter: Slips and Slipware*. B.T. Batsford Ltd, London, 1990

Pollux, John, *Slipware*, Pitman Publishing, London, 1979

Rhodes, Daniel ch. 26, *Engobes, Clay and Glazes for the Potter*, Chilton Book, 1973

### Some historic ceramic countries/cultures known for slip decoration:

China, especially Song dynasty

English slipware, including Thomas Toft's trailed slipware

Japanese Oribe ware

Korea – developed mishima (inlaid slip decoration)


Middle Eastern ceramics (Persia, Iran, Iraq, Turkey, et al.)

Minoan ceramics

USA: Pennsylvania-Dutch slipware, Mimbres ware

Central and South America: Nazca, Maya

**Slip recipes**

<b>03-04 slip for leather-hard clay</b>		<b>Slip color suggestions- oxidation</b>			
ball clay	40	white	5% zircopax		
kaolin	20	deep green	3% chrome + 3% copper carb		
neph sy	15	yellow	10% yellow body stain, e.g. Mason 6485 titanium yellow		
talc	15	blue	1 - 2% cobalt carbonate		
frit 3124	10	pink	12 -15% pink body stain, e.g. Mason 6020 pink. Can be toned w/2% rutile if desired.		
<b>total</b>	<b>100</b>	black	12 -15% black stain or black oxide mix. Better black if the base is made with Redart in place of ball clay and 3124 reduced to 5		
<b>Bisque Slip cone 04</b>		<b>Crackle Slip c 04 - Karon Doherty</b>		<b>Slip Slap-On Slick Thick cone 5-6</b>	
kaolin	18	EPK	20.2	Neph syenite	20
Calcined kaolin	18	Ball clay	16.8	Feldspar	20
Talc	12	Frit 3124	29.4	Silica	20
Frit 3124	28	Gerstley borate	12.6	Ball clay	40
Flint	23	Zinc oxide	4.2	<b>Total</b>	<b>100</b>
Soda ash	0.5	Bentonite	16.8		
<b>Total</b>	<b>99.5</b>	<b>Total</b>	<b>100</b>		
+Zircopax	10	Zircopax	2.5		
+Bentonite	2				
<b>Black Slip cone 10</b>		<b>Slip cone 10</b>		<b>Cone 10 reduction slip colors</b>	
Custer spar	17	Ball clay	25	<b>Green</b> = chrome	4%
Ball clay	34	EPK	30	<b>Blue</b> = cobalt carbonate	3%
Redart	34	flint	25	chrome	½ %
Manganese Diox	9	F-4 Spar	20	<b>Tizzy</b> (red) = copper	8%
Cobalt carbonate	3	Total	100	<b>Pearly slip</b> for vapor-firing = rutile (buff in reduction).	15%
Chrome oxide	2				
<b>Sam Chung Mustard Slip c10</b>		<b>Mills Bisque Slip cone 10</b>		<p>Nancy Barbour. Flip-flop plate.</p> 	
Kentucky OM #4	45	Calcined kaolin	25		
calcined kaolin	45	Ball clay	25		
Nepheline syenite	10	Potash feldspar	45		
<b>Total</b>	<b>100</b>	Ferro frit 3124	5		
+ Titanium dioxide	10	<b>Total</b>	<b>100</b>		
<b>Black Oxide Mix</b>					
iron oxide	20				
cobalt	15				
manganese	10				
chrome	5				
<b>Total</b>	<b>50</b>				
Use like a stain.					