Slip Casting Basics

Slip Casting is experiencing a renewed exuberance with a new generation of makers learning to build and mold their vision into a unique business to manufacture with quality and control. From forming and sculpting their own design, creating a mold (or multiples) that can be cast into their design, slip casting is a simple and reliable method of manufacturing multiples. The basics are simple, but the practice is exacting.

A casting slip may take the form of any clay body where some will be more challenging than others. Casting slip will fall into the same firing ranges as the moist pugged clays; Low-Fire, Mid-Range, and High-Fire. The majority of slip casting falls into the Low-Fire category. Commercially you will find both Low-Fire and Mid-Range slips available. Low-Fire slips are earthenware based talc bodies which offer a bright, white surface that will serve as a great surface for your bright and colorful Low-Fire glaze palette. Red Terra Cotta bodies are available, but your Terra Cotta bodies are a much trickier body to control and cast. Mid-Range bodies will fall into two categories: Stoneware and Porcelain. Stoneware slip, like its moist counterpart, is very plastic and in a casting body can pose a few challenges, but it brings a more durable product. Porcelain bodies are leess plastic, easier to cast, but can pose more challenges in firing. You will have to assess your needs for your body and acquire the skills required to control, cast, and fire the slip body you choose.

The basic slip mixing instructions for all slips are the same. Formulas and deflocculants may differ slightly, but the “how-to” remains the same. We will address individual differences, but proceed with the classic Low-Fire body.

Equipment and Chemicals needed for Slip Making -

- Slip Mixer- depending on the volume of slip you are mixing (50 lb/5 gallons is the smallest unit advisable). You need a container large enough to hold your volume, a motor and blades capable of mixing your batch.
- Gram Scale - you need to accurately weigh the slip to find specific gravity.
- Viscometer - a tool to measure the flow of your slip. A viscometer tube can be created with a PVC pipe: 2” OD, 18” long with a cap on the end which you drill a ¼” hole.
- Liquid Measuring cup
- Respirator - Niosh approved for silica
- Clock or stop watch
- Sodium Silicate (N Brand) - This is the major deflocculant used in both Low-Fire and Porcelain casting bodies. Sodium Silicate is powerful and inexpensive.

Deflocculants - are electolytes that cause the ball clay (plastic) particles to become electrically charged and to repel each other.

- Soda Ash - aids the sodium silicate by dissolving any lignites in the clay.
- Barium Carbonate (Toxic in raw form) - neutralizes the sulfates present in the clay (magnesium, potassium, and sodium sulfates) and water. This allows your deflocculants to do their job properly. The carbonate from the Barium will react with the soluble salts (sulfates) resulting in insoluble chlorides of sodium, potassium, magnesium and will not migrate to the surface of the clay wall to effloresce. Efflorescence is a scumming that will cause a barrier

between the clay and underglaze/glaze which can result in shivering. In red bodies it will appear as a white or dark area on edges and high places of the surface.

- Dipersal (DARVAN 7 or DARVAN 811) - Darvan formulas are poly-acrylates. They are much more forgiving than sodium silcate. Darvan 7 is most commonly used asa n adjuster for sodium silicate based bodies without fear of over-deflocculation. Darvan 811 is used as a deflocculant for Red and highly plastic bodies such as Terra Cotta and stoneware. When Darvan is used as the major deflocculatant, neither soda ash or sodium silicate are used.

Mixing Instructions for Low-Fire Talc body Slip -

Georgies Low-Fire talc body is available two ways; in a 6-Bag Batch or in 50lb bags that have been pre-blended. **ONLY** the dry clay and mineral components can be pre-blended. This means that the defloccualtion checicals and water need to be added and adjusted according to needs. The samller the batch size, the more difficult itis is to accurately measure the ingredients.

The 6-Bag Blend consists of:

- 3 bags (150 lbs) **Texas Talc C-92** - Talc is a hydrophobic, non-plastic filler that fires white and controls thermal expansion which results in the proper glaze fit.
- 2 bags (100 lbs) **Ball Clay** - We use one bag (50 lbs) each of **OM4** and **SPG1** ball clay. These are both Kentucky-Tennessee ball clays and are very reliable and form the plastic (elastic) component that allows the deflocculation to work, allows the clay to form and take the desired shape, and gives the cast piece green strength.
- 1 bag (50 lbs) **Minspar 200** (Soda Feldspar) - Feldspar is a non-plastic and a 'melter'. It is the flux in the body that binds and strengthens the body when fired.

Ingredient	Pre-Blend	6-Bag Blend
Clay	50 lbs	300 lbs
Sodium Silicate	1¼ oz	8-12 oz
Soda Ash	½ oz	3 oz
Barium Carbonate	¼ oz	1½ oz
Water	2½ gallons	15 gallons

1. Wear a NIOSH approved respirator and protective clothing. Talc, ball clay, and Feldspar all contain respirable silica.
2. Add water - measure carefully!
3. Add Soda Ash, Barium Carbonate, and 50% of the minimum Sodium Silicate required.
4. With the mixer/tank running, begin adding your clay. If you are mixing the 6-Bag mix - it will be easiest to add the ball clays first.
5. When the slip starts to thicken, you can begin adding more material. This can be slow, but you want to include any mix clinging to the sides and get any clumps fully wetted. Small additions of your sodium silicate will open the mix up to allow you to get all the clay mix entered without the fear of over-deflocculation. ***CAUTION** - many times your water provider uses sodium silicate in the water supply to adjust the PH level. Our city water in Portland tends to

be acidic and the city routinely controls this with sodium silicate. This is unknown from day to day, so be warned that we need to be very careful and not make assumptions in regard to the formula. Additional sodium silicate can always be added, but NEVER removed.

6. Once all of your ingredients are in the mixer, allow to run for 30-60 minutes and allow the mix to set overnight to fully hydrate. The ingredients need a minimum of 12-24 hours to hydrate, which will allow you to make accurate adjustments. You never want to pour slip that has just been mixed.

Testing Procedures -

Slip can appear thick or thin. Adjustments cannot be made on its' appearance. Two tests are required to assure that the slip will perform as needed. We need the slip to have an adequate Clay to Water ratio for good, solid particle packing - meaning our cast will be durable plus the glaze fit and shrink will be on target.

Slip must also be fluid to allow the mold to draw water and the slip to drain properly. The specific gravity test will allow you to control the clay to water ratio and keep it consistent. The viscosity test will determine the flow rate of yoru slip and allow you control the necessary deflocculant in your slip.

Step 1: Weighing the Slip to Find the Specific Gravity -

1. Using a gram scale, weigh and zero out the container to measure and weigh the water and slip.
2. Weigh the water
3. Weigh the same volume of slip
4. Divide the weight of the slip by the weight of the water. This is the specific gravity. You want your slip to have a specific gravity of 1.75.
5. If you slip is heavier (i.e. 1.80) add water to bring down the weight.
6. If your slip is lighter, you will need to add more clay to increase the weight

Step 2: Viscosity Test or Flow Test -

- To determine the proper amount of deflocculant, you must determine the viscosity/flow time for the volume of slip in your container. You can make a viscometer/flow tube with PVC pipe from the hardware store (2" OD, 18" long with cap on one end and a ¼" drilled hole).
- Fill the tube with the slip you that have adjusted the specific gravity. Holding your finger over the hole and watching a clock with a second hand, release your finger and begin your count. When the tube is nearly evacuated, the flow will cease being a steady stream - a break. Stop your count.
- Depending on the size and scale of work your are casting, you want a count between 25-40 seconds.
- If your count is longer, you can adjust with Darvan 7 - up to one ounce.
- If your count is faster, you may have over-deflocculated.

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Trouble Shooting

Fault	Description	Cause	Remedy
Pinholing	Small holes beneath the surface.	Fluidity too low.	Increase deflocculant.
		Trapping air when pouring or mixing.	Tap mold to cause air bubbles to rise to top. Allow slip to stand overnight.
Wreathing	Horizontal ridges on the mold side of the casting where the slip “skips” along the surface of a mold.	Organic ribbons forming between slip particles from over deflocculation.	Decrease deflocculant ratio by adding water and dry slip.
Brittle Casting	Hard, brittle castings difficult to cut or clean.	Over deflocculation.	Decrease deflocculant ratio by adding water and dry slip.
Cracking	Small cracks where the handles join the piece.	Over deflocculation.	Decrease deflocculant ratio by adding water and dry slip.
		When an add-on is dryer/wetter than the main piece.	Make aure both pieces are equally moist.
		Specific gravity too low	Reduce water to achieve 1.75 - 1.80
Poor Draining	Slip does not drain from narrow sections.	Fluidity too low.	Increase deflocculant.
		Specific gravity too high. (above 1.80)	Adjust water/dry slip ratio to a specific gravity of 1.75.
Slow Casting	Casting time too long.	Over deflocculation.	Decrease deflocculant ratio by adding water and dry slip.
		Specific gravity too low.	Decrease water amount.
Thixtropic	Slip appears jelly-like.	Over deflocculation or under deflocculation.	Adjust deflocculation.