Basics of Slip Casting-06 Talc Bodies

INTRODUCTION

In theory, slip casting is a simple procedure, but in practice contains some complex variables. These include the base materials, water, the shape to be cast, mold design, and type & amount of deflocculant used. Following a few rules and employing accurate testing procedures will go a long way in helping you achieve good slip casting results.

MATERIALS & CHEMICALS USED IN CASTING SLIP

Talc is a non-plastic material that is used as a filler and body flux. It controls thermal expansion in the fired bisque, which results in a proper glaze fit. Clay is a plastic or elastic material that comes in a variety of grades. Ball clays are most commonly used because of their plasticity and added green strength to the piece. The fluidity of a slip is related to the amount of organics & the variety of particle sizes it contains. Clays higher in organics tend to require a higher percentage of deflocculant to make the slip fluid. Particle size is also critical in that a greater variety of particle sizes will produce a more fluid slip. Less water is also used due to a denser packing of particles.

Deflocculants are electrolytes that cause clay particles to become electrically charged and thus repel each other. The degree to which this occurs it the most important factor in creating a good casting slip. A good casting slip should contain no more than 50% water by weight and this can only be achieved through the use of deflocculants. Sodium Silicate (N grade) is a powerful liquid deflocculant that should be diluted 50/50 with water before use. It is always used in combination with Soda Ash. Soda Ash dissolves lignite in the clay and aids the Sodium Silicate in its ability to deflocculate. Darvan #7 is dispersing agent that may be used as a substitute for Sodium Silicate & Soda Ash or can be used in addition to the Sodium Silicate to fine tune your slip with less fear of over deflocculation. Barium Carbonate should always be used as it neutralizes soluble salts that cause efflorescence (scumming). The carbonate from the barium will react with the soluble salts resulting in barium sulfate. The soluable salts captured by the barium are rendered insoluble and will not migrate to the surface of the clay wall to effloresce (scum). Efflorescence can cause a barrier between the clay and underglaze or glaze, which can result in shivering and hard areas. Use caution when handling as ***Barium Carbonate is toxic in raw form*****.** Ingestion of as little as 40 grams can cause death.

Water is often overlooked when mixing slip. Chemicals such as chlorine are added to the water supplies by municipal water companies. These chemicals may make it necessary to use slightly more or less deflocculant. Changes in the water can occur whenever the water companies make adjustments to their supply. It is important to carefully measure the water each time you mix. Making a mark on the side of the mixing tank is not an accurate way to measure water.

MIXING YOUR OWN SLIP

Start off by reviewing mixing instructions and be sure to have all equipment and pre-measured materials ready to go before you start. The following formula shows the typical amounts of various materials for a 100 lb. (10 gallon) mix.

Dry Casting Slip	100 lbs.
Barium Carbonate	(60 grams - 2 oz.) dry weight
Soda Ash	(30 grams – 1oz.) dry weight
Sodium Silicate	3½ - 4 liquid oz. (diluted 50/50 with water)
Water	5.1-5.4 gallons

Mixing Instructions

1) Wear a NIOSH/MSHA approved respirator (3M #8710/Gerson #1730).
2) Pour 5.1-5.4 gallons of water into the slip mixer.
3) Add up to 1 oz. each of Barium Carbonate & Soda Ash. Mix for a minimum of 5 minutes.
4) Add 90% of your 50/50 Sodium Silicate and water solution. Mix for additional 5 minutes.
5) Slowly add dry clay to mixer. Dumping the clay in too quickly will cause it to "ball up" & take much longer to mix.
6) Work any dry, unmixed clay into the mixer's vortex, avoiding contact with the propeller.
7) After approximately 15 minutes of mixing, observe the mixing action of the slip. Additional sodium silicate/water solution can be added to bring the slip close to it's proper viscosity. This is a critical stage since adding too much sodium silicate will over deflocculate the slip and cause a number of casting problems. The slip should appear a little thick at this stage.
8) Mix for a minimum of 2 hours & shut down.
9) After 24 hours of aging, the slip particles will have fully wetted. It's now time to fine tune the slip with the Sodium Silicate / Water solution or Darvan #7. Before doing this, perform the first 2 of 3 tests to be discussed later. "Eye balling" the slip is not adequate. It must be tested properly.
10) Add additional Sodium Silicate solution or Darvan #7 until your tests show the slip is ready. Add these additions very incrementally using a 5 ml. baby syringe. If you reach a point where even 6.9 oz of Sodium Silicate (13.8 oz solution) does not make the slip suitably thin, then is the only time to consider adding more water (up to ½ gallon, in small increments). Normally, the use of excessive sodium silicate may indicate a high level of sulfates in the slip. The sulfate count should be 125 ppm or lower. If above this number, additional barium carbonate can be added to lower the sulfate count, and thus the amount of sodium silicate to properly deflocculate the slip. A soluble sulfate count can only be known by sending a liquid sample of slip to a lab for testing.

TESTING PROCEDURES

I) WEIGHING TO FIND SPECIFIC GRAVITY (The density of the slip)

1) Using a gram scale, place a 250 ml graduated cylinder on the platform & "zero out" the scale.
2) Fill the cylinder with slip to the 250 ml mark, weigh it & make a note of the weight.
3) Fill the cylinder with water to the 250 ml mark, weigh it & make a note of the waters weight.
4) Divide the weight of the slip by the weight of the water. This will give you the specific gravity. The proper specific gravity should be between 1.75 - 1.80. If the specific gravity is above 1.80 you should incrementally add more water. If your slip is below 1.75 you will have to do a little math and add more dry slip to bring the specific gravity up to 1.75 or greater.

Specific gravity is also measured with a hydrometer. *Hydrometers should only be used as an indicator. They are not accurate for measuring slip.* A hydrometer is a glass tube with a pre-measured weight and a scale inside. A dry, clean hydrometer is held between the index finger & thumb. Slowly lower the bulb section into the slip & release. Read the indicator chart after it settles to its natural level. This number should validate your numbers achieved by weighing the slip.

II) VISCOSITY OR FLOW TEST

This test simply measures the time it takes for a set volume of slip to flow into a container. A 2" x 10" PVC pipe with a cap attached will work well. Drill a 5/32" hole into the center of the 2" cap & cement this to the pipe. Place your finger over the hole & fill the pipe to the top. While observing the second hand of a clock, release your finger to let the slip flow into a 250 ml. graduated cylinder. At the 250 ml. mark, stop the flow of the slip & simultaneously look at the clock to observe the time it takes to reach the 250 ml. level of the graduated cylinder. The amount of time should be about 25 seconds. If it takes longer, incrementally add the sodium silicate/water solution to the slip and mix for another 15 minutes. Continue to adjust the slip until the proper viscosity(flow) is reached. Make a note of these results for future reference.

III) CASTING TEST

For this test you need to use a 2 piece mold. Use a mold that has some complexity, this will give you a truer test. Use the same mold each time so you have a standard to go by. You will want to time how long it takes to cast, drain, & remove the cast piece. Note the characteristics of the casting such as being soft, brittle, tears from the mold, etc. Over time you will instantly gauge the quality of your slip due to your past observations.

TROUBLE SHOOTING

FAULT	DESCRIPTION	CAUSE	REMEDY
Pinholing	Small holes beneath the surface	Fluidity to low	Increase water addition
		Trapping air when pouring or draining	Tap mold to cause air bubbles rise to top. Allow slip to stand overnight.
Wreathing	Small uneven ridges on mold side of the casting	Uneven pouring or draining of slip	Drain evenly & steadily.
		Due to uneven porosity of the mold	Make sure mixture of plaster is done properly. (If using commercially made mold, try different mold.)
		Specific gravity to high or low	Adjust deflocculant
		Organic ribbons forming between clay particles	Decrease deflocculant
Brittle Casting	Hard, brittle castings difficult to cut or clean	Over deflocculation	Decrease deflocculant
Thixatropic	Slip appears jelly-like and thick	Over contact with air	Keep slip in air tight container
		Improper deflocculation	Adjust deflocculant
		Plaster contamination	Avoid contaminants
Cracking	Small cracks where the handles join the piece	Over deflocculation	Decrease deflocculant
		When an add on is is dryer/wetter than the main piece	Make sure 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 water content
		Specific gravity to high	Adjust deflocculant
Slow Casting	Casting time too long	Fluidity to high	Decrease water amount
		Specific gravity too low	Decrease water amount

*(Keep in mind, these are suggestions. There may be other variables such as weather that may influence your results)