Vince Pitelka, 2019 – www.vincepitelka.com
The following is exerted from my book, *Clay, A Studio Handbook.*

All About Plaster

Plaster in Drainpipes - A Plumbing Nightmare - How to Clean Up

Never allow even the smallest amount of plaster residue to go down the drain. Even just small amounts washed off your hands or tools will accumulate in the plumbing traps and cure rock-hard, eventually clogging the pipes. When working plaster, place a trash bag in a five-gallon plastic bucket and fill the bucket with water. After working plaster, rinse your hands and all tools and plaster containers in this bucket. Allow the plaster to settle and cure for 24 hours in the bottom of the bucket, pour the water down the drain, and lift out the plastic bag and deposit it in a trash can. Have a second plastic bucket lined with trash-bag nearby to receive any plaster residue and scraps.

Plaster and Lime Pops – Avoid Contaminating Your Clay

Plaster is made from gypsum heated to drive off the chemically-combined water. In hardening it reforms as gypsum crystals, reincorporating chemical water. As is the case with any form of mineral calcium like limestone, marble, or chalk, if chunks of plaster get into your work, the water will be driven off as the work is fired and these materials turn to calcium oxide. After the firing, calcium oxide is actively *hygroscopic* and absorbs water from the air to become calcium hydroxide, and in doing so it expands. Soon after the firing or later on, any pockets of calcium oxide in your work will expand enough to cause *lime pops* when a small chunk of clay pops out of the surface, usually ruining the work. Take special care to avoid contaminating your work with plaster chips. Clay used for mold purposes should be kept separate and only used for that application.

Measuring, Mixing, and Pouring Plaster

Slip-casting molds often have many parts, and it is essential that each part absorb water at the same rate in order to avoid problems with warping and cracking in drying and firing the clay casting. This requires that all parts be poured from the same plaster mixed to the same consistency. For making molds, always use plaster that has been stored dry and is free of lumps. The plaster-to-water ratio is critical, as excessive water in the initial mix means a more porous but more brittle mold, and insufficient water means a dense, hard, less absorbent mold. The best mold is dense enough to be relatively sturdy and yet porous enough to absorb water adequately. The plaster-to-water ratio is referred to by a number that indicates the parts by weight of water per hundred parts of plaster. A mix with a consistency of 75 would have 75 parts water to 100 parts plaster, no matter how much plaster is being mixed. The lower the number, the less water in the plaster and the denser the mold. Richard Notkin recommends a mixing consistency of 64 to 76 for plaster molds. It is possible to get plaster to set with far less water, but this would make an extremely dense mass without the porosity required for mold-work.

When mixing plaster, use clean tap water approximately 70°F. Warmer water will accelerate curing of the plaster and give less working time. Always mix plaster in a clean container with no residue from previous plaster batches.

It is important to have a fairly accurate idea of how much plaster to mix. Roughly calculate the volume of the mold forms or *cottles* (adjustable mold-boards - see explanation below) minus the approximate displacement of the prototype within the forms or cottles. In more complex molds it may take some guess-work, and in any case it is best to mix up a little extra plaster. Set up appropriate extra forms or cottles on available bench space (sealed down with clay around the edges) into which you can pour extra plaster. The resulting slabs are useful for stiffening soft clay or slurry, or can be hand-carved to create press-molds for texturing slabs or making appliques.

After figuring the displacement of your mold in cubic inches, divide by 231 to give gallons, or by 58 to give quarts. Use the resulting quantity as the amount of water to be used, in which case you will have some extra plaster-mix. Or, you may deduct 20% from the figure to give you a more accurate measure of water to be used. See the U.S. Gypsum water-to-plaster tables below.

When you are ready to mix plaster, consult the table below to figure amounts of water and dry plaster. Weigh out the appropriate amount of plaster in one container, and measure your water and place it in an appropriate clean mixing bowl or bucket. Slowly sift the plaster onto the surface of the water, and get into a rhythm of sifting a handful of plaster onto the surface and allowing it to settle into the water on its own before sifting on more plaster. This allows each particle to be fully coated with water, minimizing or eliminating air bubbles. The size and shape of the mixing container has a lot to do with this process. If you are mixing large amounts of plaster, use a tub or basin with a larger surface area of water. Do not allow more than three to five minutes to elapse while you sift all the plaster into the water.

After the sifting-soaking is complete, use your hand or a wooden stick to thoroughly blend the plaster. For several gallons or more, use a drill-mounted impeller-mixer. Mix the plaster for a minute or two to thoroughly incorporate all dry material, but be gentle so as to avoid introducing additional air bubbles. Excessive mixing will make the plaster set more quickly. There will always be some bubbles from the air in the plaster, and it is important to eliminate them. After you finish mixing, lift the container and bump it firmly against the floor a dozen times. The weight of the plaster pushing down will force the air bubbles up to the surface.

Watch the plaster consistency closely, and do not allow distractions to slow you down. As mentioned above, sifting the plaster should take no more than five minutes, and mixing no more than two minutes. If you are slow, the plaster may begin to thicken as crystals start to form in the mix. If you have stayed within the recommended time for sifting and mixing and have used water of the appropriate temperature, you will have several more minutes before the plaster starts to stiffen.

If you are pouring a mold, do so immediately. Pour the plaster carefully along the outer walls of the mold in order to minimize splashing that might create air bubbles. If you are using the *flick-smear method*, wait until the plaster begins to thicken, and then apply it very quickly.

As soon as the cottles or forms are filled with plaster, gently pound your fist or a rubber mallet a few times on the table or board upon which the mold is sitting in order to dislodge air bubbles and encourage the plaster to flow into details of the mold. Be careful in doing this, because excessive shaking can cause cottles to become unsealed from the base surface, allowing plaster to escape from the mold.

Leave the casting undisturbed as the plaster sets up. If you have used 70-degree water little change will take place for fifteen to thirty minutes, but then the mold will heat up from the reactions taking place and all surface water will disappear. It is important that the plaster has cooled significantly before you try to remove cottles or forms. This will generally take 45 minutes to an hour after pouring. Do not attempt to use the mold right away, because plaster does not develop its maximum strength for several days.

It should be evident from all of this that you must have everything completely ready before you start mixing plaster, have a clock visible during the process, and remain alert throughout the process. It is very satisfying to have everything work properly and end up with a good mold.

Water to Plaster Tables

The following tables are based on ***United States Gypsum #1 Pottery Plaster*** mixed to a consistency of 73. For maximum working time, be sure to use 70 degree water and the recommended soaking and mixing times.

WATER	PLASTER
1 quart	2 lbs. 12 oz. - (1,248 grams)
1 ½ quarts	4 lbs. 2 oz. -- (1,872 grams)
2 quarts	5 lbs. 8 oz. -- (2,497 grams)
2 ½ quarts	6 lbs. 14 oz. - (3,021 grams)
3 quarts	8 lbs. 4 oz. -- (3,744 grams)
3 ½ quarts	9 lbs. 10 oz. - (4,388 grams)
1 gallon	11 lbs. ------- (4,992 grams)
1 ½ gallons	16 lbs. 8 oz. - (7,488 grams)
2 gallons	22 lbs. ------- (9,984 grams)
2 ½ gallons	27 lbs. 8 oz. - (12,480 grams)
3 gallons	33 lbs. ------- (14,976 grams)

The Use of Cottles as Casting Forms

While some plaster molds are made without exterior forms into which you cast the plaster, simple press-molds and slip-casting molds are often easiest made with adjustable wooden casting-forms called *cottles* generally used in sets of four to create a mold-box, as shown in figure ##. The size is determined by the range of casting-forms or mold-boxes needed. For the broadest flexibility, it is advantageous to have a number of sets of cottles in varying sizes. Simple cottles are just lengths of plywood set up in a box-form with the end of each board protruding, so that all boards may be moved in or out to increase or decrease the enclosed space. Hard-bricks and clay are used to anchor the cottles in place while the mold is poured. Superior cottles have a small right-angle strip of wood attached at one end, so that when set up each cottle may be attached to its neighbor with a C-clamp. The width of board used determines the maximum height of the casting-form.

Using Strips of Sheet Metal or Linoleum as Casting Forms

For round objects, a cylindrical mold-form is often an advantage. In this case, a strip of linoleum or aluminum roof flashing works well. Wrap the strip to get the desired internal diameter and fasten with tape or band with rope or a strap clamp, set up the mold-form on a smooth table surface or board, and seal down with plenty of moist clay.

The Concept of Draft

An important concept in all mold-making where a rigid mold is used is that of *draft*. When a mold, or the original prototype from which a mold is lifted, has satisfactory "draft," it means that there are no undercuts or straight vertical edges, where the pressed or cast clay form would catch or drag when pulled from the mold. In press-molded or slip-cast forms you may see what appear to be vertical edges or ridges in the surface, but careful examination will reveal that there is always *draft* - the slightest degree of slope off the vertical, so that the form pulls free from the mold without dragging or scraping. This is critical in all plaster mold-making. If undercuts are required for a particular aesthetic or functional purpose, they are carved into the casting after it is removed from the mold.

Mold-Release Agents (Parting Agents)

Plaster will not stick to damp or leather-hard clay, so no mold-release agent is needed on those surfaces. You must use a mold-release agent on any non-clay surfaces and on the inside of any cottles or other non-clay mold-forms. Some mold-makers prefer commercial release agents like *Partex*, but ordinary liquid hand-soap or dish-soap works well. When applied, the soap should dry without leaving any brush marks. Try it on another surface, and if necessary, thin the soap with a little water. Apply several coats, letting it dry between coats. When making molds for slip-casting or hand-pressing, ***never use oil-base release agents*** like Vaseline, vegetable oil, cooking sprays, WD-40, penetrating oil, etc., as these seal the pores in the plaster and render the mold useless. Brush on the soap with a moderately loaded soft brush, and do not allow it to pool in any recesses. Allow the last coat of soap to dry before mixing your plaster. In humid circumstances, use a blower or hair dryer to accelerate the drying.