ceramic mold making techniques

tips for making plaster molds and slip casting clay
Ceramic Mold Making Techniques
Tips for Making Plaster Molds and Slip Casting Clay

Plaster molds make it possible for you to repeat complicated patterns and create forms not possible to efficiently construct using any other pottery technique. For thousands of years, potters used bisqued clay for molds but the major drawback was that they could not get a lot of detail. With the discovery of plaster in the 17th century, potters immediately saw the advantages and plaster has been the choice for ceramic molds ever since.

10 Steps to Perfect Plaster
by Bill Jones

Before you can make a ceramic mold you need to know a little about plaster. Plaster can sometimes be a finicky material but if you follow these ten essential guidelines, you’ll be on your way to making successful plaster molds for slip casting.

How to Make a Simple Plaster Press Mold
by Gary Carlos

A press mold is the simplest mold to make and this step-by-step process by master tile maker Gary Carlos is easy to follow. He guides you through making a basic ceramic mold and making a plaster cavity mold.

How to Make Plaster Molds for Double-Walled Vessels
by Hiroe Hanazono

Double-walled vessels are difficult to make – especially when you want the fantastic forms Hiroe Hanazono creates. Hiroe always had a great passion for food and her voluminous serving pieces certainly reflect that. She demonstrates how to make the model and the plaster molds for a delicious ice cream bowl and topping server.

How to Make Casting Slip from Your Clay Body
by Paul Andrew Wandless

You can buy pre-made slip for slip casting in all firing ranges, which is a really practical thing to do in many situations. The disadvantage is that whatever you cast will not match you regular clay body. Paul Wandless shows you how to make casting slip from your regular clay to eliminate this problem.
10 Steps to Perfect Plaster

by Bill Jones

Whether you need a drying bat, a simple hump mold, or you’re making a complex slip mold, you’ll need to mix plaster. Getting the plaster right requires a bit more than just “dumping and mixing.” Here are 10 ways to get the best results for your next plaster project.

1 Prepare your mold. A common mistake potters make is to mix plaster only to realize everything’s not set up for pouring. Before casting, make sure your model is set, the mold boards or cottles are secure, and all the surfaces you’re pouring onto are coated with a parting agent such as mold soap.

2 Prepare your work area. You will need a clean mixing container for the plaster, a scale for weighing the plaster, a measuring cup for the water and a rinse bucket. Note: Plaster cannot be permitted to go down the drain, because it will form a rock-like mass. Even small amounts will accumulate over time. Line a rinse bucket with a plastic garbage bag and fill it with water for rinsing your hands and tools. Allow the plaster to settle for a day, then pour off the water and discard the bag.

3 Use fresh water. The mixing water you use should be at room temperature or 70°F (21°C). If the water is too warm, the plaster will set too fast and vice versa. Use only clean, drinkable tap water or distilled water. Metallic salts, such as aluminum sulfate, can accelerate the setting time, and soluble salts can cause efflorescence on the mold surface.

4 Use fresh plaster. Plaster is calcined, meaning chemically bound water has been driven off through heating. If the plaster has been sitting around in a damp environment, it will have lumps in it, in which case it is no longer usable. Pitch it. Use plaster that has been stored dry and is lump free.

5 Weigh out materials. Do not guess about the amounts of plaster and water you’ll need. Once you start the mixing process, you do not want to go back and adjust quantities. To determine the amount you need, estimate the volume in cubic inches then divide by 2.31 to give gallons or by 58 to give quarts. Deduct 20% to allow for the volume of plaster, then refer to the table.

6 Add plaster to water. Slowly sift the plaster onto the surface of the water. Do not dump the plaster or toss it in by handfuls. Adding the plaster shouldn’t take more than 3 minutes.

7 Soak the plaster. Allow the plaster to soak for 1–2 minutes maximum. The soaking allows each plaster crystal to be completely surrounded by water and it removes air from the mix. Small batches require less soaking than large batches. If the soaking time is too short, it may contribute to pinholes; and if it is too long, it will contribute to fast set times, early stiffening and gritty mold surfaces.

8 Mix the plaster. Small batches of plaster can be mixed by hand. Use a constant motion with your hand and you will notice a change in consistency from watery to a thick cream. Break down lumps with your fingers as you mix. Mix only for a minute or two being very careful not to agitate the mixture so much that air bubbles are incorporated into the mix. Mixing time affects absorption rates—longer mixing times produce tighter and less-absorptive molds.

9 Pouring the plaster. After mixing, tap the bucket on a hard surface to release trapped air. Pour the plaster carefully. Wherever possible, pour plaster carefully into the deepest area so the slurry flows evenly across the surface of the mold. Once the mold is poured, tap the table with a rubber mallet to vibrate the mold and release more air bubbles.

10 Drying plaster. When plaster sets, it heats up because of a chemical reaction. When it has cooled, it is safe to remove the cottles or forms—about 45 minutes to an hour after pouring. Molds must be dry before use. Drying molds properly promotes good strength development, uniform absorption and reduced efflorescence. Dry molds evenly. Do not set them near a kiln where one side is exposed to excessive heat or the relative humidity is near zero. Place them on racks in a relatively dry location away from drafts.

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**Water to Plaster Mixing Chart**

<table>
<thead>
<tr>
<th>Volume</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 quart</td>
<td>2 lbs. 14 oz.</td>
</tr>
<tr>
<td>1½ quarts</td>
<td>4 lbs. 4 oz.</td>
</tr>
<tr>
<td>2 quarts</td>
<td>5 lbs. 11 oz.</td>
</tr>
<tr>
<td>2½ quarts</td>
<td>7 lbs. 2 oz.</td>
</tr>
<tr>
<td>3 quarts</td>
<td>8 lbs. 9 oz.</td>
</tr>
<tr>
<td>3½ quarts</td>
<td>10 lbs.</td>
</tr>
<tr>
<td>1 gallon</td>
<td>11 lbs. 6 oz.</td>
</tr>
<tr>
<td>1½ gallons</td>
<td>17 lbs. 2 oz.</td>
</tr>
<tr>
<td>2 gallons</td>
<td>22 lbs. 13 oz.</td>
</tr>
<tr>
<td>2½ gallons</td>
<td>28 lbs. 8 oz.</td>
</tr>
<tr>
<td>3 gallons</td>
<td>34 lbs. 3 oz.</td>
</tr>
</tbody>
</table>

This table is based on USG® No. 1 Pottery Plaster mixed to a consistency of 73 (73 parts plaster to 100 parts water) recommended for most studio applications. Excessive water yields a more porous but more brittle mold, and less water means a very dense, hard mold that will not absorb water.
How to Make a Simple Plaster Press Mold

by Gary Carlos

After college, and while working part-time for a small slip-casting studio, I began to explore a career in art education. This exploration led me to San Francisco’s vibrant mural community. Crafting a work that will hold up in the face of extreme weather conditions and graffiti is of great concern to mural painters. Many muralists have re-discovered that ceramic tile has always been an attractive, alternative medium to paint.

With a background in both painting and ceramics, in addition to my interest in public art, working in tile seemed like a natural progression for me. I find it extremely satisfying to bring work out of the studio and into public spaces, where it can become a living part of the community.

As my interest in tile grew, a colleague told me about the historic Moravian Pottery and Tile Works in Pennsylvania. Within weeks I was on a plane to attend one of their 3-day workshops. In that short time I learned many of the simple techniques tile makers have used for centuries. In the years since, I have

Blue Streets, 2001, 23×23 inches, made from earthenware and using low-fire glazes.

Blue Streets detail. A geometric pattern was first carved into a plaster block. I pressed a tile with this pattern and added the small house-like elements. A cavity mold was then made from the finished tile.

Freeway, 2001, 11×17 inches, made from earthenware and using underglaze, stains, and glaze. For this piece the original tile prototype was made completely out of clay.

Hive, 2000, individual tiles are 4 inches wide, made from earthenware with oxides, glaze, and grout. This hexagon-shaped tile has a shallow Y-shaped groove cut into it for grout, making it appear as three separate shapes, adding another element to the design.
found my own way of using tile to explore a variety of themes in my work. I hope this brief introduction to tile making allows you to discover some new possibilities in your own work as well.

**Making a Basic Mold**

Start by making a good set of adjustable mold boards (figure 1). Cut four laminated boards (¾×5×12 inches is a good size). Attach a 90° framing bracket (available at hardware stores) flush to one edge of each board. Caution: If you are not comfortable using power tools have someone who is do this step for you. Most home centers will cut wood to your specifications.

Good plywood also works for mold boards, but use mold soap on them. Try to get wood covered in Formica. Shelving sold in most home centers is only covered with thin contact paper. This will work, but after continuous use it will begin to deteriorate around the edges. Try a local cabinet shop for scraps or a home center for a damaged countertop. If you can’t get laminated wood for templates or a smooth work surface to pour directly on, try Plexiglas, glass, or fine-grained plywood coated with sealer. Remember to always use a release agent, such as oil soap, on a porous surface before pouring plaster on it.

Cut additional square pieces of laminated board as templates for plaster molds. When determining the size of your template, accommodate for clay shrinkage in the final tile: if you’re using a clay body that shrinks 12% you’ll need a 4½-inch mold for a 4-inch tile and a 6¾-inch mold for a 6-inch tile. Assemble the mold boards snugly around the template (figure 2). The mold should be level so check your work surface with a level and adjust it with shims if necessary.

Fasten the boards together with four spring clamps (figure 3) or C-clamps. If the boards are all cut accurately at right angles, the assembled form will keep plaster from leaking without the need to seal the joints with clay. Since laminated wood is nonporous, it also eliminates the need for a release agent. Put a wad of clay at the base of each wall to keep the form secure (figure 6).

For most studio applications, I use #1 Pottery Plaster. Make sure the plaster is fresh (stored for no more than 6 months) and completely free
of moisture. Measure room-temperature water and plaster by weight (figure 4) in a ratio of 0.7 parts water to 1 part plaster. Use 1 lb water to 1.4 lb plaster for a 4½-inch square mold and 2.1 lb water to 3 lb plaster for a 6¾-inch square mold. Note: I’ve used decimals not ounces.

Slowly sift the plaster into the water (figure 5). Once all the plaster is in, allow it to soak (slake) for one minute without any agitation. Mix the plaster with a clean stick until it becomes a heavy cream consistency (a milkshake consistency is too thick). This should ideally take 2 to 3 minutes, but can happen anywhere from 1 to 5 minutes.

When the plaster has reached a proper consistency, pour it into the form in a slow steady stream (figure 6). Shake the table (but not too much) to bring any air bubbles to the surface, and to settle the plaster out, making the top completely flat. Swirl some water in the dirty mixing container immediately and dump it into a waste bucket.

Caution: Never pour plaster or plaster waste water down a drain.

When plaster sets, it gives off heat. After about 30 minutes it will cool back down and you can then take the form apart (figure 7). If the boards stick give them a quick tap away from the mold and they will pop off. Tip: Pouring a few of these plaster blanks is a good way to get used to plaster before trying something more critical.

Clean up the edges on the top of the mold with a scraper (figure 8).
Leave the other side (facing the template) untouched; it should already be perfectly flat and free of air bubbles. This is the side you will carve.

Create a scale drawing of your image (figure 9). Remember that your final product will be a mirror image of this, so if you use any text it will need to be written backwards. To transfer the design, place your drawing over the block and trace it with a slight amount of pressure (figure 10). This will leave a shallow mark in the plaster.

If you have trouble seeing the design, scribble some graphite or charcoal onto a piece of paper and smear it on the block. Use a hook tool or a V-shaped linoleum block carving tool to deepen the grooves to about \( \frac{1}{16} \)-inch (figure 11). This is most easily done when the plaster is damp. If the plaster block is dry soak it in some water for a few seconds.

You can press some clay onto the mold to check what it will look like, but allow the mold to cure and reach full strength (about two weeks) before using it for production. Cut a slab of clay slightly larger than the mold (figure 12). Roll the slab out so that it is a bit thicker than the desired tile thickness (figure 13). Use a straight edge to smooth the surface of the slab.

Place the mold on top of the clay and place a wooden block on top of the mold. Hit the wooden block a few times with a rubber mallet until the clay squeezes out on all
four sides (figure 14). If your table is not sturdy, you may want to do this on the floor. Caution: It is possible to crack a mold in half (more common with cavity molds). To avoid this, use soft clay and make sure the wooden block and plaster mold are both flat and free of debris.

Trim the excess clay with a knife before removing the mold (figure 15). To keep the corners square, place your thumb at the end of each cut. If the tile does not come off right away, set it aside and allow the plaster to do its work. Before long, the clay will stiffen up and release easily (figure 16). One of the things tile makers struggle with is preventing tiles from warping. Try not to bend a wet tile as plastic clay retains a memory. Place it on an absorbent board and allow the tile to dry evenly.

**Making a Cavity Mold**

If you have a sculptural tile and want to minimize distortion around the edges, or want a consistent tile thickness, you should make a cavity mold. Make an original tile out of clay, avoiding undercuts. Rub some water on the bottom of the tile to create a thin slip and stick it to a board allowing a 1½-inch border around all sides (figure 17).

Pour the plaster at least 1½ inches over the top of the tile—any less and the mold may crack during pressing. To use the mold, cut a slab of clay the same size as the opening (figure 18). Cover the clay with canvas and use a rubber mallet and a block of wood to press the clay into the mold.
If you get serious about tile, you may want to invest in a tile press (figure 19). There are several types available. I prefer this converted arbor press. It is compact and applies over 2 tons of pressure. Cracking molds is sometimes unavoidable, but, if it is a problem, switch to a plaster mix of 2 parts #1 Pottery Plaster and 1 part Ultracal.

Use a wire cutter to slice off the excess clay (figure 20). This homemade wire tool is based on one used at Moravian Pottery and Tile Works. Use a wooden straight edge to scrape off and level the back of the tile (figure 21). You may want to sign or stamp the back at this point.

Give the clay some time to set. This may vary greatly depending on the weather and dampness of the mold (figure 22).

If you want to make several production molds of the same tile, create a durable master with mold making rubber (figure 23). To do this, seal a cavity mold with oil soap (Murphy’s). When the soap has dried, mix the 2-part mold making rubber and fill the mold to the brim. When the rubber has cured, glue it to a board and use it as you would a clay master. Remember, if you are pouring plaster on plaster, always seal the plaster original with oil soap.

After setting, if the tile still sticks in the mold, gently tap the mold on all four sides and the open-face side with your palm or a rubber mallet. Or try shooting air between the clay and plaster with an air compressor.
How to Make Molds for Double-Walled Vessels

by Hiroe Hanazono

I’ve always had a great passion for food—cooking, eating, setting the table, and sharing in the full dining experience. It’s why I make functional pots. The pots I create consist of simple line forms with muted glaze colors, and the work’s minimal aesthetic doesn’t compete with anyone’s domestic surroundings, nor with the food it eventually holds.

I’m especially fascinated with design that’s clean and almost severe in its simplicity, and attracted to modern interior design and architecture because both practices work to frame and contain the contents of a given space. Architects and interior designers must consider how people and furniture fit into the overall design of a space. They consider purpose, and how the space will be used. Potters must consider these same issues—good pots consider purpose, use and that which they will eventually contain.

The minimal design of my forms create an ideal setting for the display of food. Simple forms allow for beautiful relationships between the forms themselves and the elements contained within them.

My surfaces are also simple foils for the display of food. The repeti-
tion of simple geometric shapes and lines goes beyond the idea of de-coration, becoming an element that blends into the form. The patterns that I create could serve as the de-sign of the forms of my pots. They could also be rendered subtly in low relief on the surface of my pots, without interfering with the simplic-ity of the presentation I desire.

Making the Pattern

I use slip casting in the produc-tion of my forms. It’s the technique that best satisfies my intent to create immaculately executed and unusual forms. Each new piece begins by carving out a pattern, generally made from MDF (medium density fiberboard), from which I then create a plaster mold. Once I have settled upon a design, a meticulous scale drawing is made from which I then begin laying out the MDF pattern. Because there is roughly 20% shrinkage in the casting body, I make the pattern larger than the final piece I’m aiming to produce (see box). Many other artists create their patterns out of plaster or clay, but I’ve found that wood and MDF better suit my needs. I can control these materials better, with the edges of my forms sharper and the
transitions fairer. Also, the durability and longevity of the original pattern is a definite bonus.

The patterns are fabricated using primarily woodworking tools—band saw, table saw, sanders, router, and various hand tools including scrapers, rasps, files, and chisels. A great deal of time is also spent sanding and refining the pattern. The final step in preparing the pattern for mold making is to seal it with at least three layers of polyurethane (figure 1).

Making the Mold

First determine the number of sections the mold will have and identify the location of the plug holes. My molds are typically made in four pieces—the bottom, two sides and the top. Sometimes I embed molduct tubing that’s been attached to a metal frame into one of the plaster sections to facilitate removal of the wet slip cast form from the mold (figure 2). The tubing creates a porous channel so that compressed air can circulate through the mold and help to release the section from the casting with minimal distortion. With double-walled forms, you need to make special considerations when it comes time to make the molds. Simple open molds are not possible.
for I have to enclose the pattern entirely in plaster to achieve a double wall. This also necessitates creating plug holes for pouring the slip into the mold and then for draining it.

Casting the Piece

Pour casting slip into the mold and allow to set until you achieve the desired thickness (figure 3). Drain the slip from the mold and allow the piece to set up for awhile.

After draining the slip (figure 4), you’ll want to fill in the openings in your form left by the drain holes, otherwise the finished piece will have holes in the bottom. Squeeze a small amount of slip into the pour holes using an ear syringe (figure 5). Plug the holes to keep slip contained within mold then flip the mold over to allow slip to fill the pour holes and finalize the casting (figure 6).

When it’s time to de-mold the piece, blow pressurized air into the molduct tubing and through the plaster, forcing a separation from the slip cast form and the mold (figure 7).

Cleaning Up and Decorating

Allow the slip cast form to become firm enough to work on (leather hard) then remove it from the mold (figure 8). Use metal scrapers and sponges to clean the edges and any other irregularities that appear on the surface of the form. Using a small drill bit, poke two holes in the bottom of the form to allow air movement between the inside and outside of the piece. This prevents the piece from exploding in the kiln as the air contained within the double walled form expands during the firing process.

To create a subtle decorative element for the surface of this piece, I decided to use mishima, a slip inlay technique. Using Adobe Illustrator, I create geometric patterns which I then project onto the cast form, tracing them in pencil and finally carving out the lines with a needle tool (figures 9 and 10). Colored slip is then pushed into the incised lines using a brush (figure 11). Once the slip is dry, the surface is scraped flush with a metal rib (figure 12) removing all excess slip from the form. What remains, is a clear and clean pattern with the colored slip remaining in the incised lines.

Firing

After bisque firing to cone 06 I spray all of my glazes and fire them to a very hot cone 6. All of the double-walled pieces are down-fired as well, a process by which cooling is slowed through the gradual lowering of the temperature within the kiln. It allows for a more even cooling of the inside and outside of the form, which produces less stress on the overall form. Larger forms are glazed both inside and outside to maintain a balance of surface tension. The use of both of these techniques has reduced the amount of loss I experience in the creation of these double walled forms.

I’ve found that the shape and size of the forms I design greatly impacts their survival through all stages of my entire making process, from casting through firing. This is particularly true for my double-walled plates. Should the interior walls of one of these castings touch, the chances that piece will survive decreases substantially. My failure rate goes up, with losses happening in the casting process itself and in both the bisque and glaze firings. Therefore, I have to remain aware from the very beginning—in the sketching and drafting phase—how thick the walls will be and how that affects the form.

Then, during the casting phase I must be diligent with my casting times to ensure the wall thickness is consistent and accurate, always trying to preserve the integrity of the negative space within the pot and preventing the walls from fusing.

Being a designer, mold-maker, and manufacturer brings me great joy. I enjoy the challenge of creating unusual, well-defined forms for use. The wooden patterns that I create for mold making and the slip casting process enable me to successfully achieve my intent. I have never had formal training in slip casting or in mold making. Working in diverse artist communities I’ve been exposed to a great variety of artists who have shared their tricks and techniques.

It’s through this sharing and this collaboration of sorts that I am able to do what I do.
How to Make Casting Slip from Your Clay Body

by Paul Andrew Wandless

A common studio challenge is trying to keep the number of different clay bodies you have on hand to a minimum. Throwing, handbuilding, casting, and surface design techniques often require different clay bodies to suit the demands of how your work is created. Sometimes the clay bodies also need to be in different forms such as regular moist clay, slip or casting slip. If I’m handbuilding with a cone 6 clay body and want to add a slip-cast element to it, I’d be hard pressed to find a commercial cone 6 casting slip with the exact same shrinkage and absorption characteristics. A singular work made of multiple clay bodies can cause several problems. Disparate shrinkage rates, maturation points, iron content, etc., can all have a negative effect on the final outcome of the work when using different bodies. When possible, it’s always best to stick with the same body.

My sculptural work combines moist clay for general construction and casting slip for volumetric elements or for use with various image transfer techniques to address the surface. My solution is to use the clay body I’m working with and turn it into the different types of casting slips I need. This assures that all the parts and surface treatments shrink the same, fire to the same cone, and all the glazes work the same on all the different parts. The great thing about this approach is its simplicity. All you need is a 5-gallon bucket, a drill with a paint mixer attachment, a deflocculant, and the clay body you want to use as a casting slip.

Preparing the Slip

The process of slaking clay to make it into slip is a simple one. Step one is to have a 5-gallon bucket filled 60–75% with your bone-dry clay then add water until it’s a few inches below the rim (figure 1). Let it slake for 24 hours then mix it by hand a little with a stick (figure 2). Once you’ve mixed the slip for about 5 minutes, use a drill with a paint mixer attachment to mix it into a smooth slurry, which should be the consistency of thick cream. Use the stirring stick to check the consistency and find any lumps of clay that didn’t slake down (figure 3). Keep mixing until the lumps are gone.

Measuring Specific Gravity

At this point, I normally fill a quart container with the slip to use as a joining or brushing slip. The rest I use for casting slip. You’ll need to measure the specific gravity of the slip to determine if the water to clay ratio is correct before deflocculating it with liquid sodium silicate or Darvan. To determine specific gravity, which is a comparison of the weight of 100 ml of water (which is 100 g and therefore has a specific gravity of 1) with the weight of 100 ml of whatever liquid or slip you are working with. First tare (zero out) the weight of a graduated measuring container on a scale then fill it with 100 ml of slip and see how much it weighs in grams. Once you know the weight, you divide it by the weight of an equivalent volume of water (100g). This works out, in essence, to moving...
the decimal point in your weight measurement to the left by two places to get the specific gravity. Example: 183 g = 1.83 specific gravity.

In general, a specific gravity of 1.80 to 1.85 provides good balance of fluidity and strength for most casting purposes. This number can vary, though, depending on exactly what is being cast. I’ve used it as low as 1.74 for volumetric casting and as high as 1.90 for casting flat slabs. Different clay bodies have different optimal specific gravities that are determined by good old-fashioned trial and error. Specific gravity is simply a tool for you to adjust your slip to meet the needs of your particular casting project. Once you find a number that works, write it down and stick with it for that clay body. If you have a specific gravity that is higher than 1.85 and you want to bring it down, add a little water (only a few drops at a time), to your slip, mix and re-test. If the specific gravity is lower than 1.80, let the slip sit 24 hours, skim the water off the top, remix, and measure the specific gravity again.

**Deflocculating the Slip**

Once you have the correct specific gravity, you need to add a deflocculant to the slip to make it more fluid so it can be poured. Typically just a few small drops of liquid sodium silicate or Darvan is needed to achieve the appropriate fluidity. Clay bodies with high iron content will require less deflocculant than others. Use the drill to mix the deflocculant into the slip and use a ladle or pitcher to scoop some of the slip out to see how it pours. The consistency of cream is what you’re going for so be careful not to over-deflocculate the slip, which will cause slow uneven drying and soft spots in the finished piece. Just add a few drops at a time to achieve fluidity and remember a little goes a long way with deflocculants.

**Using What Works**

I’ve done this process with commercially bought clay and with home made clay. I’ve also had the exact same success slaking down clay that started off as moist clay fresh out of the bag or as 3-day old bone dry clay. I keep a 5-gallon bucket around to throw all my scrap clay into and when it gets about 65–75% full, I turn it into casting slip. I also just slice up a 25-pound bag of commercial clay into 1-inch cubes and fill an empty bucket with them and use that to make my casting slip. I’m aware of the different opinions regarding initial water content of the clay and its effect on the speed of water absorption/saturation while slaking. In my personal experience, I’ve found if you let clay in any state of moisture slake for 24 hours, it all mixes up just fine. I suggest you simply slake your clay in the state of moisture that you typically have in the past.

Paul Andrew Wandless is a studio artist, workshop presenter, educator, and Vice President of the Potters Council. He authored the book *Image Transfer On Clay* and co-authored *Alternative Kilns and Firing Techniques: Raku, Saggar, Pit & Barrel*. His website is [www.studio3artcompany.com](http://www.studio3artcompany.com) and he can be emailed at paul@studio3artcompany.com.