Textures
Hand Crafted Jewelry by Hadar Jacobson
918 Ventura Ave, Berkeley, CA 94707, (510) 528-4193
hadar@pacbell.net • www.artinsilver.com

Updated 12/26/2009

Instruction Manual for Hadar's Clay™

Storage and Shelf Life

The powder clay does not require special storage. As long as it has not been mixed with water, it has an indefinite shelf life. Mixed clay should be refrigerated, wrapped with plastic food wrap inside a closed plastic box. Because Hadar's Clay is a new product, its shelf life when refrigerated is still uncertain, but it has been shown to last at least a few months when properly kept.

The shelf life of **un-fired** pieces is very long. There is no need to fire them right away.

Toxicity

None of the ingredients of Hadar's Clay is toxic. It may be unhealthy to inhale any powder of any kind. Use a protective mask and goggles when handling the powder, as well as when handling carbon.

Mixing Instructions

Also available as a video clip at this link: http://www.youtube.com/watch?v=sPER4UJvbmo

What you need:

- Small metal or ceramic bowl
- Kitchen knife or any other mixing tool
- Distilled water in a spray bottle
- Olive oil in a spray bottle
- Plastic report cover (or work surface and plastic bag)
- Rolling pin (the wider the better)
- Scraper

Mixing the clay (takes less than 5 minutes):

1. Shake the metal clay powder container.
2. Pour the desired amount of powder into the bowl.
3. Spray the powder with distilled water while mixing with the knife. The powder will gradually form into small balls and then into bigger lumps.
4. Keep spraying and mixing until the lumps separate from the walls of the bowl.
5. Oil your work surface and pour the lumps onto it. Use the scraper to scrape it off the mixing tool.
6. Roll the lumps under the plastic cover using the rolling pin. The lumps will turn into a somewhat grainy layer.
7. Fold the layer in half and roll again. Use a scraper to separate it from the surface. Keep folding and rolling until the layer is soft and smooth. You can add water to your preferred consistency.

The Consistency of the Clay

The clay can be prepared to the desired consistency by adding more or less water. The clay is soft, pliable, does not crack when bent, and sticks well to itself. Discoloration (marbling) in copper clay is normal, and does not necessarily mean that it is mixed with bronze clay.

The photo on the right shows how readily the clay drapes when mixed to the right consistency.

Lubrication

The clay does not stick to the hands. As a release agent use olive oil only!

Drying

The clay, especially in thick pieces, does not dry well in the air. Dry it on a heating pan at 220-250°F. Corian blocks, unglazed tiles and pieces of sheet metal are better surfaces to dry on than playing cards.

Warping

A lot of shrinkage occurs while the clay is drying. That causes the clay to warp. It will happen even if you leave it to dry in the air or in a dehydrator. Don't leave the flat pieces unattended while they are drying. They will curl within seconds. As soon as they curl, turn them over and tap them down. They will most likely curl again. Keep flipping them until the warping stops. At 220-250°F, this doesn't take long. Alternatively, once the textured side is dry, you can tape your piece to the drying surface using Scotch® tape.



When flat pieces are dry they have already shrunk by about 10%.

Reconstituting

It is not recommended to reconstitute clay powder that is derived from sanding and filing. You can reconstitute solid pieces that have not been fired, after sanding the oxidized layer off of their outer surface. Always use distilled water to reconstitute clay. It can be reconstituted by grinding the dry piece it in a dedicated coffee grinder and repeating the mixing process as described above.

Flexibility and Strength of Dried Clay

When dry, the clay is flexible like high-shrinkage silver clay and not as brittle as low-shrinkage silver clay. You can still move it (to open links, for example). The surface is hard and resistant, and is best sanded with 150-grit sandpaper or fine-grit sponge sanding pad (do not use medium grit!).

Shrinkage

After drying, flat pieces of both copper and bronze clay shrink by about 10%. Pieces that are dried over a mold will not shrink while drying. They will either stretch and thin around the mold or develop cracks. If cracks occur, fill them with clay and continue drying.

After firing, bronze flat pieces shrink by 25%. **Copper** flat pieces shrink by 15%.

Three-dimensional pieces of both bronze and copper clay shrink less than low-shrinkage silver clay. Three-dimensional copper pieces shrink less than bronze.

Firing with Core Material

If you follow the firing schedule to the letter (see below), firing with core material – including cork clay – is possible. However, it is not recommended to fire too many pieces with core material in one batch.

It is recommended to add 15 minutes to the first phase of firing.

Flexible clay

Mixing the clay with glycerin makes good flexible clay. See instructions for making flexible clay in my book: *The Handbook of Metal Clay: Textures and Forms*.

When firing flexible clay, it is recommended to add 15 minutes to the first phase of firing.

Flexible clay allows you to weave, fold, and knot with dry clay.

Repair

After firing, pieces can be repaired and re-fired like silver clay. However, fresh clay does not stick well to fired metal. When it dries, it tends to peel off. After mending a piece, stick it in the carbon while still wet. It can be fired immediately or wait there until your next firing. The added clay will stay intact whether it was fired wet or dry.

Pitting

Pitting (as opposed to blistering) is common, especially with bronze clay. The best way to avoid it is to fire all pieces, even flat ones, positioned vertically in the carbon.

Pitting occurs mostly with bronze clay and on the back of pieces. This piece was fired with its back lying on the carbon. Note the carbon granules that got stuck in the pits. It seems that the softness of the metal when it's hot, combined with the weight of the pieces, caused the carbon granules to penetrate the back side.

Firing Hollow Forms

Hollow forms should be fired with their narrowest side up. Prior to firing, fill them about a third of the way with carbon to avoid trapping oxygen inside them. If they have no holes to feed the carbon through, they may require re-firing.

Combining Clays

Copper and silver clay can be fired in the same box when not in contact, or even linked. To fire them in the same piece, fire the copper part first.

When **bronze and silver** clay are fired together sintering may not be complete and alloying may occur. (See more information in the book: *Silver and Bronze Clay: Movement and Mechanisms*.)

Copper and bronze clay that come in powder form are compatible and can be fired successfully in a single piece.

When firing copper and bronze clay in a single piece, two points should be considered:

1. In multi-layered and 3D pieces, the tension caused by the different shrinkage rates of copper and bronze may end up causing cracks in the fired piece. The cracks can be repaired and the piece can be re-fired.

2. Flat pieces that combine copper and bronze shrink at the same rate as copper. Apparently the bronze stretches itself to the dimensions of the copper.

Firing

Precious metals such as pure silver and gold are fired in open air. They don't react with the oxygen in the air, and the oxygen ensures the complete removal of the binder.

Base metal clays such as copper and bronze cannot be fired in open air because they do react with oxygen to create oxides, which prevent proper sintering (the final bonding of the particles together). They are fired buried in activated carbon, which reduces the amount of oxygen in the kiln and inhibits this reaction. However, most organic binders used in metal clays need oxygen to burn off. If there is not enough oxygen (because it has been reduced by the carbon), the binder will not burn off completely. If the binder is not completely removed, there will be no proper sintering. This problem can be solved with a proper firing schedule.

However, not all kilns fire the same way, and different kilns require different firing schedules. Described below are two reliable firing schedules for two different kilns – a front-loader muffle kiln, and atop-loader brick kiln.

In both kilns, use a stainless steel box, 2½" tall. Place the box on posts, so it's as close as possible to the top of the kiln. If you are using a taller box (4½"), fill ¾ of the box with carbon so that the pieces are as high as possible in the kiln, where the temperature is most likely to be highest. When the bottom of the box is above the lowest heating element, the heat can flow underneath the box and upwards. Fill half the smaller box with activated carbon, and stick the pieces in it. For the first phase of firing cover the pieces with only ½" - 1" carbon. **Don't use a lid!** If you have a venting hole, leave it open. After cooling, remove or vacuum the ash on top of the carbon and add carbon to fill the box. Cover the box loosely with a lid and move on to the second phase of firing. You can plug the venting hole, but it's not necessary.

In both kilns, arrange the pieces as follows:

- In one layer only
- Vertically
- With pieces separated from each other by ½"; more for thick or big pieces
- As high as possible in the kiln

Front-loader muffle kiln. This kiln has heating elements on three sides only. The temperature near the door is considerably lower than the temperature near the back wall, and the temperature on the bottom is considerably lower than on the top. The thermocouple, which is supposed to sense the temperature in the kiln, is located on the back wall, and the temperature displayed on the control panel reflects only the temperature around the thermocouple. The temperature displayed on the control panel is not necessarily the temperature near the door, or on the bottom of the kiln. Moreover, carbon is a poor heat conductor, so the temperature inside the firing box is lower than what is displayed on the control panel.

Arranging the Pieces in a Front-loader Muffle Kiln

Pieces should be arranged along the sides and the back wall (avoiding the center and front).

Firing Schedule

Phase I
Ramp at 1750°F (972°C) to 1100°F (593°C).
Hold 30 minutes .

Cool to room temperature.

Phase II
Full ramp to 1550°F (843°C)*.
Hold 3 hours.

* If bronze pieces blister at this temperature, lower the temperature to 1520° (827°C) .

Top-loader Brick Kiln. This kiln is made of kiln bricks and the door is on the top. The heating elements are on all four walls. Bricks keep the heat better than muffles. There is hardly any loss of heat and the distribution of the heat in the chamber is better.

Arranging the Pieces in a Top-loader Brick Kiln

Pieces should be arranged along all four walls of the kiln, preferably avoiding the center.

Firing Schedule

Phase I
Ramp at full speed to 1000°F (538°C).
Hold 30 minutes.

Cool to room temperature.

Phase II
Ramp at full speed to 1480°F (804°C)*.
Hold 2:30 hours.

* If bronze pieces blister at this temperature, lower the temperature to 1470°F (799°C).

Adjustments

These two kilns, of course, are not the only ones available, and the firing schedule may have to be adjusted according to the type, size, age, and structure of the kiln. Adjustments can be made to either of the phases by increasing or decreasing hold time and/or temperature. Before you start firing your art work, it is recommended to fire test pieces.

Test Pieces

Make test pieces that are as close as possible your style in size and thickness. Dry them, and fire according to the instructions.

After firing start buffing them with a buffing wheel. The photo on the right shows a piece with powder under a thin layer of sintered metal. This piece has not properly sintered.

You can also try to gently bend the pieces with your fingers. If they break easily, buff the cross section, where the piece broke. The photo on the right shows 2 different results.

The piece on the right shows a cross section that is full of powder. That means that the binder has not been completely removed. Adjustments may be needed for the first step of the firing.

The one on the left shows a cross section that is all metal. The fact the piece broke means that the sintering was not complete, i.e., the metal has not reached its highest density. Adjustments may be needed for the second step of the firing.

Whenever you are not sure of the results o a certain piece, it is recommended to fire a similar test piece along with it, placed in a similar spot in the kiln. After firing, test the piece as described above. If it is not fully sintered, re-fire your original piece. This time the first phase is not necessary.

Checklist

Question	Correct Answer
❑ Did I shake the jar before mixing the clay?	Yes
❑ Did I use distilled water when mixing the clay?	Yes
❑ Did I use any lubricant other than olive oil?	No
❑ Did I dry on a heating pan at 200-250°F or just in the air or in a dehydrator?	Yes
❑ Did I use core material or glycerin?	If you did, add 15 minutes to the first phase of firing
❑ Did I fill a third of a hollow form with carbon?	Yes
❑ Does the thermocouple stick into the chamber?	Yes
❑ Is the thermocouple older than 3 years? Could it be rusty?	No
❑ Did I use a small box (2½" tall) or a big box (4½" tall)?	Small box
❑ Did I elevate the box to the top of the kiln?	Yes
❑ Did I use a lid for the first phase of firing?	No
❑ Did I leave the venting hole open for the first phase of firing?	Yes
❑ In a front loader, did I remember to lay the pieces along the side and the back wall?	Yes
❑ In a front loader, did I remember to ramp at 1750°F to 1100°F at the first phase?	Yes
❑ In a top loader, did I lay the pieces along all 4 walls of the kiln avoiding the center?	Yes
❑ Did I overcrowd the box?	No
❑ Did I leave ½" space between pieces?	Yes
❑ Did I leave more than ½" for thicker or bigger pieces?	Yes
❑ Are there too many hollow forms in the box?	No
❑ Was there silver in the box?	No
❑ Did I mix different brands of copper and bronze clay?	No
❑ Did I fire a test piece?	Yes, if I am not sure yet about the right firing schedule for my kiln