

BRONZclay™ – Information Update February 2010

There have been many changes and conflicting advice since the launch of **BRONZclay™** in 2008. It has been difficult to stay abreast of all the new things that continue to be discovered about BRONZclay™ and even more difficult to give definite answers to questions because of the differences in experience, techniques, results and opinions available.

I have tried to take the most current information available on BRONZclay™ and consolidate it into to single document printable document. There is no doubt that there will be further discoveries with BRONZclay™. As I type this, there are new firing methods being trialed.

I give credit and recognition to all of the sources of the following information. To those who so freely offer their own experiences, experiments and results with the metal clay community. These people are Celie Fago, Hadar Jacobson, Mardel Rein, Tonya Davidson, Marco Fleseri, Lora Hart, Gail Lannum, Bill Struve, LaceyAnn Struve, Angela Baduel-Crispin, Gordon Uyehara and Kevin Whitmore. I would like to give special thanks, recognition and credit to Margaret Schindel for her excellent BRONZclay™ Squidoo blog. Margaret has worked hard to make available all of the most current information on BRONZclay™ which has been invaluable for those of us involved with metal clay.

Conditioning BRONZclay™ - Celie Fago's Method.

This method works very well. Conditioning or "wedging" clay is a ceramic/pottery term which means compacting and forcing air bubbles out clay. It is important to note that wedging BRONZclay without adding and kneading in the olive oil will dry out the clay as you're kneading it. This is not recommended. However conditioning/wedging BRONZclay™ using Celie Fago's method with Olive Oil (below) helps to solve the problem of stickiness as well as improving workability.

- Coat hands generously with olive oil.
- Use fresh clay straight from the packet and roll it into a ball.
- Use the heel of your hand (or your thumbs) to roll and press the edges of the clay towards the centre (This rolling motion helps to avoid trapping air inside a fold.)
- Repeat the rolling/pressing motion until all the clay from the edges has been moved into the centre of the ball and the moisture in the clay has been distributed as evenly as possible.
- If the clay is crumbly or cracks when you press it into a ball or roll it out, knead in a little water alternately with the olive oil until the clay has absorbed enough moisture to eliminate the problem.
- Continue to knead additional olive oil into the clay until it is smooth, pliable, and has lost its stickiness.

BRONZclay™ - Temperature Issues

Early trials appeared to indicate that chilling improved BRONZclay's pliability. Using Celie Fago's conditioning method has shown that temperature has no effect on the clay's workability once it had been conditioned properly with sufficient olive oil. The important points are conditioning the clay with generous amounts of olive oil and then keeping the clay well hydrated.

The Best Hydrating Environment for BRONZclay™

- Place a moist (not ringing wet) paper towel or a dampened sponge into a Zip-lock bag or food storage box with airtight lid. Wrap the conditioned and wedged clay very loosely in sandwich wrap and place it inside the bag or box. Leave the top of the clay **completely exposed** to the surrounding moist air.

Important Note: The sandwich wrap is used only to prevent the BRONZclay™ from coming into direct contact with the damp sponge or paper towel. Metal Clay artists and teachers are accustomed to wrapping metal clay very tightly in plastic wrap for storage, but for BRONZclay™ expose as much of the clay as possible to the humidity created by the dampened sponge or paper towel.

Oxidisation and BRONZclay™

Bronze is an alloy comprising approximately 90% copper and 10% tin. When copper is exposed to oxygen, two types of copper oxides can form, depending on the conditions: cuprous oxide and cupric oxide. Copper oxides interfere with bronze clay's sintering or fusing process and unsurprisingly a lot of emphasis has been placed on minimizing the clay's exposure to air.

However, recent experimentation has proven that **the oxidation process is reversed completely when the clay is fired under activated carbon.** To test his thesis, **BRONZclay™** inventor Bill Struve made up two batches of clay using the same method as for BRONZclay and COPPRclay, but he substituted cupric oxide and cuprous oxide for the bronze or copper metal particles. ***Both clays made from copper oxides produced pure copper after being firing under carbon!***

This successful experiment was designed to prove that oxidation in unfired clay or slip is not a cause for concern. It proved conclusively that any copper in the clay that oxidizes prior to firing under carbon will revert completely to copper during the carbon firing.

BRONZclay™ - Storing leftover paste

BRONZclay paste can be stored at room temperature or refrigerated. Originally, darkening on the surface of the paste was believed incorrectly to be oxidation. At that point it was not understood that oxidation is reversed during carbon firing. Slip and paste that was more than a few days old was routinely discarded. The dark layer on the surface of slip and paste is not oxidation at all, but is tin that has separated out from the clay after water has been added to make the paste or slip. Paste and Slip stored correctly will be fine to use – just stir well before using in case any tin may have separated out.

BRONZclay™ Oil Paste

BRONZclay oil paste takes a long time to dry. Allow the piece to air-dry for several days, or dry it at 32°C for 24 hours. Fully-dried oil paste joints or repairs should be reinforced with fresh BRONZclay™ before re-firing the piece.

Mardel Rein's BRONZclay™ Oil Paste - mix undiluted pure essential lavender oil into BRONZclay™. Start by mixing the lavender oil into a small piece of BRONZclay with a palette knife, add and mix only one drop at a time. Continue mixing in drops of oil until the paste is the consistency of *soft* peanut butter - slightly less thick than regular bronze clay paste.

Note: Some people substitute olive oil for the lavender oil.

Drying BRONZclay™

BRONZclay can be dried in similar ways as silver metal clay, except that BRONZclay is prone to warping, especially if it is dried directly on a cup warmer, hotplate or other direct heat source. Drying with direct heat is recommended only if you want to achieve some warping and cracking.

Recommended methods of drying are air-dry, food dehydrator (on low heat or no heat), or using Mardel Reins suggestion - dry in the refrigerator or freezer.

To reduce the amount of warping in any type of metal clay. Roll out and texture the clay on a piece of non-stick sheet. Cut out the desired shape and dry it without moving or turning it from the non-stick sheet. If you use heat, don't turn the piece until the side facing the heat is completely dry. The friction/tension between the fresh clay and the non-stick sheet helps the clay adhere to the sheet. This helps to counteract any warping. If a flat piece does warp, flatten it by spraying the concave side with a little water. Allow the water to be absorbed into the surface for 30-60 seconds. Sandwich the clay between two pieces of non-stick sheet. Weight it down with a large book for approx 20 minutes. Repeat the process if necessary.

Firing BRONZclay™

This has been a difficult area because there have been no hard and fast rules that have produced consistently successful results every time in all types of kilns or for all pieces, regardless of size or shape. The original Rio Grande BRONZclay™ firing schedule is still favoured amongst many in the Metal Clay community. Below is the original method plus other tried and tested methods of firing BRONZclay™ by some of the most experienced Metal Clay teachers and artists.

Original Rio Grande recommended BRONZclay™ Firing Method

BRONZclay pieces up to and including 3mm (6 cards) thick*:

Program the kiln as follows:

Ramp at 278°C per hour to 840°C

Hold for 2 hours.

The total firing time, including ramp-time, will be between 4 and 5 hours.

Cool before removing lid/unloading.

BRONZclay pieces thicker than 3mm (6 cards)*:

Program the kiln as follows:

Ramp at 250°F (139°C) per hour to 1550°F (840°C).

Hold for 3 hours.

The total firing time, including ramp-time, will be about 9 hours

Cool before removing the lid and unloading.

Note: If firing thin and thick pieces in the same kiln load, use the longer, slower firing schedule needed by the thickest piece.

Rio recommends allowing the firing pan to cool completely before removing it from the kiln and, especially, before lifting the lid. They also recommend wearing heat-resistant gloves when touching the pan and removing it to a heat-resistant surface, such as a soldering pad or ceramic tile.

Celie Fago's Recommended Firing Schedule for BRONZclay™

This schedule requires approximately 9 to 9-1/2 hours excluding cooling time. Celie Fago has fired hundreds of pieces this way and has found this method produces strong, fully sintered pieces consistently. She uses the same firing schedule regardless of the thickness of the pieces being fired.

Program the kiln as follows:

Ramp at 139°C per hour to 825°C.

Hold at that temperature for 3-1/2 hours.

Cool to at least 150°C or cooler before unloading.

Celie Fago recently converted from using coal-derived carbon to using only coconut shell-derived carbon because she finds the results with coconut carbon to be more consistent.

Tonya Davidson's Recommended Firing Schedule for BRONZclay™

Tonya collaborated with the experts at kiln manufacturer Paragon Industries to see how kiln ramp rates could be shortened successfully. Based on their experiments, they determined that the last 150°C of the heat work (the combination of heat and time that cause the material sinter fully) are the most important. They found that a very slow ramp is needed during the last 150°C of reaching the target temperature in order for BRONZclay™ to sinter or fuse fully. Tonya's schedules take into account both the thickness of the clay and the type of kiln (brick vs. muffle).

Firing BRONZclay in a top-loading brick kiln:

Program the kiln as follows:

Ramp at full speed to 643°C

Ramp at 139°C per hour to 810°C.

Hold at 810°C for 2 to 3 hours, depending on the thickness of the thickest piece in the load (2 hours for thinner pieces, 3 hours for thicker ones).

Cool.

Firing BRONZclay in a front-loading muffle kiln:

Program the kiln as follows:

Ramp at full speed to 644°C.

Ramp at 139°C per hour to 825°C.

Hold at 825°C for 2 to 3 hours, depending on the thickness of the thickest piece in the load. Hold 2 hours for pieces 3mm/6 cards and thinner, 3 hours for pieces thicker than 3mm/6 cards.

Cool.

Open Air Firing Schedules for BRONZclay™

The initial recommended firing schedules for BRONZclay were for carbon-only firings. However BRONZclay inventor Bill Struve asked several people to help test a new firing schedule that included a preliminary open-air firing.

Key advantages of adding a preliminary open-air firing phase include:

- Helps the binder to burn out completely.
- Enables cork clay and other combustible cores to be used successfully with BRONZclay.
- Enables sintering temperatures in the carbon to be reduced which eliminates blistering and other heat-related problems.
- Enables complete sintering and eliminates crumbly/powder interiors.
- Removes the wax or other resist used for the water etching technique.
- Bangles are stronger when fired with a schedule that includes a preliminary open-air firing phase.
- If clay cracks or breaks, it can be repaired at the open-air firing stage.

Open-Air Firing Schedule for BRONZclay™ - Angela Baduel-Crispin

Angela Baduel-Crispin's Open-Air Firing Schedule has been producing reliable and consistent results.

Phase I: Place the BRONZclay greenware directly on a kiln shelf. Ramp the kiln at 250°C per hour to a target temperature of 290°C and hold for 1 hour. Allow to cool.

During the preliminary firing, the pieces will turn black from the oxidation of the copper in the clay. This is to be expected and the oxidation will burn off completely during the subsequent firing in activated carbon. After the preliminary open-air firing, the pieces will be fragile much like green ware. Be careful when transferring pieces from the kiln shelf onto the activated carbon. Important - Remove the kiln shelf and elevate the firing container on kiln posts before programming the kiln for Phases II and III.

Phase II: Transfer the partially-fired pieces onto a layer of activated carbon in a stainless steel firing pan and cover with additional carbon and the lid. Ramp at 290° per hour to 250°C or to 370°C if firing BRONZclay with a copper clay inlay. Hold at that temperature for 1 hour.

Phase III: Ramp the kiln to 940°C to a target temperature of 800°C or to 850°C if firing BRONZclay with a copper clay inlay. Hold 3 hours. Cool.

Note: Depending on your kiln controller, you may be able to program Phases II and III at the same time. This means you can transfer the pre-fired pieces to the carbon, program the kiln, and allow Phases II and III to run overnight

Open-Air Firing Schedule for BRONZclay™ - Bill Struve:

Place the BRONZclay green ware directly onto an open kiln shelf. Ramp the kiln at 111°C per hour to a target temperature of 293°C and hold for 15 minutes. The pieces will turn black from the oxidation of the copper in the clay, but all oxidation will burn off completely during the subsequent carbon firing. Continue with the original BRONZclay firing schedule or one of the other schedules from the previous section.

Note: Take care when transferring partially fired pieces from the kiln shelf to the firing container. They have not sintered yet and are still fragile and breakable, similar to unfired green ware. Transfer the partially-fired pieces to the carbon while they are still hot or let them cool before transferring.

IMPORTANT: Activated carbon remains hot for many hours after the firing cycle has ended. NEVER ever use fingers to remove your pieces from the carbon. ALWAYS wear appropriate protective clothing and eye wear when working with hot kilns or firing pans.