

Vince Pitelka, 2016

Loading and Firing the Soda Kiln

A Few Essentials:

1. Bisque-fired ***draw rings*** must be used in all salt and soda firings to gauge surface development.
2. All wares must be ***wadded***. Pay attention to the aesthetics of wadding as discussed below.
3. ***Soda solution is caustic***. Wear safety goggles or a face shield while mixing your soda solution and while charging the kiln. Never spray soda solution through the burner ports and avoid getting it on the burners or plumbing. After preparing soda solution or cleaning the sprayer, flush and wash your hands thoroughly with soap and water.
4. Unless you want very heavy soda accumulation on your wares, fan the spray of soda solution across the left wall and floor of the firebox and never directly towards the bagwall. Move the wand constantly to keep from spraying in one area and causing the refractory to pop and scatter bits all over your wares.
5. Never charge this kiln with dry or moistened soda, because soda does not volatilize like salt and will fall directly to the floor and damage the kiln.

Check the Condition of the Bagwall and Rebuild When Necessary

Everyone who uses the soda kiln is responsible for their share of maintenance. Salt and soda kilns characteristically go through bagwalls pretty quickly, so check carefully to see if the bagwall is leaning appreciably, and if so, knock it down and rebuild it, and if it falls during your firing, rebuild it after unloading the kiln. It's not a difficult task, especially compared to having it fall into the firebox, stalling your firing, or far worse, falling towards the set and ruining your wares. The most important part of a secure bagwall is the base, so if necessary chip/grind the floor to get a flat surface (wear eye protection and respirator), and then seat the first course of bricks with a generous amount of wadding. Use only proper wadding mix as explained below.

In the first course of bricks in the bagwall, don't leave any gaps – butt them right against one another and against the front and back wall. On the second course use half-bricks and leave a $\frac{3}{4}$ " gap between each brick. On the third course use third-bricks and leave about a $1\frac{1}{2}$ " gap between each brick. Use wadding to securely seat each brick on the ones beneath. The bagwall should be very secure and steady and perfectly vertical. Don't build it any higher than three courses.

Wadding and Shelf Wash

For both salt and soda, wadding and shelf wash are made from the same recipe – 40 EPK, 10 OM-4, and 50 Alumina. Pull an exhaust ventilation nozzle down above a stainless steel bowl on the counter, turn on the ventilation system, add and dry mix the materials, and then start adding water, mixing with a spatula or your hand. As soon as the whole mass is damp you can shut off the ventilation system. When the wadding starts to reach plastic consistency, wedge on the counter until it feels like plastic clay, adding more water if necessary. Mix a generous amount, and once you are done wadding your pots, keep the leftover in a plastic bag. Even if it dries out, it is very easy to re-hydrate because it contains 50% non-plastic materials and absorbs water easily. Alumina is expensive, so don't throw away extra wadding, and ***do not use it to seal the door***.

Use the thin nitride-bonded silicon-carbide shelves for salt and soda firing, and **do not** coat the shelves with wash. Both contact surfaces on every kiln post should be coated with shelf wash. If the previous coat is still in good shape you do not need to recoat. If the mating surface of a kiln post is rough or irregular, clean it up with the bench grinder or angle grinder. When chipping or grinding posts or shelves always wear appropriate safety goggles and if grinding wear a respirator.

Door Sealing Mix

Do not use wadding to seal up the cracks in the door. Mix equal parts by volume recycle slurry, sand, and fine sawdust, stiffened with additional sawdust if necessary to get appropriate paste consistency. With a spatula, smear this mixture into any gaps in and around the edges of the door. There is no reason to apply this mixture to joints that are a tight fit.

Making and Using Draw Rings

Always use draw rings in salt and soda firing. Plan ahead, because they must be bisque-fired. When making draw rings, use the same clay that is in the wares. Roll out coils 3/8" in diameter, wrap them in a loop with a 1" hole, overlap the ends side-by-side, and press down with your finger inside the hole so that the overlapped ends make a wide, stable base and the rings stand up vertically. If you are planning a lot of salt or soda firing, make a big supply and include them in your next bisque-fire. Before you start loading the kiln, coat the bottom surface of your bisque-fired draw rings with kiln wash.

When bricking up the door, remember to leave at least one 2.5"-square port for draw rings. Some people like to have a set of draw rings both low and high in the kiln, while others have just one set located in the center. Whenever possible these ports should be placed just above the level of the nearest kiln shelves. If it is not convenient to do so, you may need to build up a platform with posts and broken pieces of kiln shelf to support the cone packs and/or draw rings, but if this structure has significant height, make sure the bricks are very well-seated on one another with wadding and the tower of bricks is stable and perfectly vertical.

Place the draw rings in a row of four to six rings, staggering them back and forth sideways. This facilitates identifying and snagging the nearest draw ring when the kiln is yellow-hot. Make sure that the closest draw ring is at least four or five inches from the door in order to ensure that it receives good soda deposition and thus serves as an accurate indicator. Keep in mind that you always have the choice of placing draw-rings or conepacks in the front or back of the kiln, depending on the particular stacking arrangement, with the caveat that placing them in the front requires that you incorporate appropriate ports while stacking the door.

Charge the kiln at least twice (see the section on "charging" below) before pulling the first draw ring. When pulling draw rings, wear gloves and protective tinted goggles or glasses, and use a long, thin steel rod with a very small hook bent on the end to snag a single draw ring and withdraw it from the kiln. A length of 1/8" steel gas-welding rod works well. Have a plastic bucket of water handy, and lower the draw ring into the water. Don't just drop it in, because it can easily melt through the bottom of the bucket before it cools sufficiently. Give it a minute to cool, and then dry it off completely and check the surface for the amount of soda glaze. Draw rings only show salt or soda

deposition, and give no indication of fired clay color or flashing, because they have been cooled instantly. Clay that normally flashes beautifully in soda firing will be a dull, cold gray on a quick-cooled draw ring.

Loading the Kiln and Wadding the Furniture and Ware

In salt and soda firing, we use brick pieces as furniture to guarantee stability. Standard hardbrick soaps serve as 9" posts, with cut pieces of hardbrick as 4 ½" posts and 2 ½" posts. Use two short, parallel 3/8"-diameter rolls of wadding below and above every kiln post. Do not let the wadding extend beyond the edges of the kiln post or the shelves.

As you wad your wares, remember to think about the aesthetics of wadding, since it leaves distinct, visible marks. Roll your wads into balls or cigar-shapes, place them carefully, and use wads of an appropriate size for the piece being wadded. Use wads about 3/8" to ½" in diameter for small and medium-sized vessels, and larger wads as needed. Vertical forms like mugs, cups, bottles, vases, covered-jars, pitchers, etc. generally only need three wads. Larger-diameter forms like sculptural pieces, flat slab pieces, plates, casseroles, and bowls must be supported by more wads in order to avoid warpage, and the wadding should be sufficiently stiff so that it does not collapse completely when a heavy piece is placed in the kiln.

Bowls and plates require more than three wads in proportion to their size, and the wads must be evenly spaced around the foot or outer bottom. For large flat pieces without raised feet or a foot ring, place an evenly spaced network of wads to support the whole bottom in order to prevent warpage.

All lids and any form requiring three wads can be wadded in advance. Forms requiring more than three wads must be wadded when loading the kiln so that the wads will still be soft, allowing them to settle down and support the form equally when it is placed on the shelf. To wad in advance, dispense a small amount of white glue into an appropriate dish or cup. Dip the very edge of each wad in glue and place on the bottom of the piece. Set the piece down upright so that the wads are pressed down slightly and the piece sits level. Keep in mind that dry wadding is fragile, so show appropriate care in handling the pieces and placing them in the kiln.

Very small lids (2" or smaller) can be supported by three wads, but all other lids need more wads in proportion to their size in order to keep them from warping. Use small rolls (sometimes slightly flattened) rather than round balls when wadding lids. Make sure that the wads really do support the lid and prevent it from touching its seat at all. If a lid has an overhang that extends even slightly beyond the body of the pot, it generally does not need to be wadded at all in soda firing unless you are doing a very heavy soda effect, and even then, alumina-wax usually works to prevent sticking. People who do light soda often use alumina wax on all their lids with no wadding, but some people simply like the pattern of wadding on the lid seat and thus always wad the lids.

Don't pack the kiln too full. That's not an issue in regular oxidation or reduction firings, but in atmospheric vapor-glazing processes you need room for the vapors to circulate. Leave at least ½" clearance between wares. Don't hesitate to place wares close to the arch, because that will just help

to pull the vapors through the set. If you have small items and want a heavy effect, wad and place them right on the bagwall. Do not place wares in the flue.

Placement of Proper Cone Packs

The only unfired clay in your kiln should be the cone packs, and they should be made properly from as little clay as possible and thoroughly perforated with needle-tool holes to eliminate any chance of blowing up during the firing. If you are unsure of how to properly make cone packs, consult the conepack handout or the instructions in *Clay: A Studio Handbook*.

There should be a cone pack about six inches up from the bottom of the kiln and another about six inches down from inside top of the arch. Cone packs are usually placed inside the rear spyholes built into the kiln, but if the size and shape or particular stacking challenges make that impractical you can incorporate appropriate spyholes in the front as you stack the door. If the kiln contains very large vessels or sculpture, you may have to construct a tower of hardbrick to support the upper conepack. As mentioned earlier, seat each brick securely with wadding and make sure the tower is very stable and perfectly vertical.

Make sure to place the conepacks four to six inches into the kiln. The hardbrick hotface absorbs a great amount of heat, and if the conepacks are too close to the wall or the door, the hardbrick surface will cool them down and cause inaccurate readings.

A cone-pack and a row of draw rings can be placed inside a single spy port if desired. Just place the cone pack off to one side, and the row of draw rings angled off to the opposite side. Make sure to check with a flashlight from outside the port to make sure you can see all the cones and reach the draw rings.

Because this kiln sometimes approaches maturation with the temperature uneven from top to bottom, it is a very good idea to incorporate an “early-warning” cone in each conepack. For midrange firing the conepacks should include cones-08, 3, 5, 6, and 7. For highfiring they should include cones-08, 7, 9, 10, and 11.

Before Lighting the Kiln

- ***Start the firing with the regulator at 5 PSI*** (pounds per square inch). This is necessary in order for the pilot burner to work properly and to minimize chances of the pilot flame being extinguished by drafts.
- ***Do not ever change the setting of the primary air shutters/spinners*** on the back ends of the burners. They are set exactly as they need to be. As the gas pressure is turned up, venturi burners such as these naturally pull in more primary air through the existing opening. It may seem like a very small opening, but a wider opening simply admits excess air and cools the flame.
- Through the early stages of the firing and all the way up to body-reduction temperature, make sure there is no reduction, as per instructions in *Clay: A Studio Handbook*.

Lighting the Kiln

- Check to make sure that all three burner valves are closed, and the T-handle on the regulator has been unscrewed counter-clockwise until it is loose.
- Open the gas shutoff valves on the supply line.
- Screw in (clockwise) the regulator T-handle slowly until pressure reads on the gauge and set it at 5 PSI.
- Press and hold the button on the Baso valve, light the pilot with a propane torch, and continue to hold the button down for one minute to heat up the thermocouple.
- Once the pilot is lit, open the burner valve slowly until the burner lights.
- Light the other two burners with a propane torch and adjust all three burner valves very low, just above the point where the flame would go out. The center burner will self-ignite from the pilot if it goes out, but you may have to relight the two side burners once or twice until you get the setting right.

Firing the Kiln With an Overnight Preheat

- Keep the three burners on very low (just above the point where they go out) for one hour.
- After one hour, open the burner valves just until the burners emit a soft roar, and close the damper until you can feel only the very slightest backpressure at one of the bottom spyholes and then open it a little. Make sure there is no smell of reduction at the upper spyhole. If there is, open the damper slightly.
- This setting will bring the kiln to dull red heat overnight, and it can be left for up to twelve hours without worry that it will exceed body-reduction temperatures.

Firing the Kiln Without or After an Overnight Preheat

- Follow the instructions above, and after one more hour or after the overnight preheat, open the burner valves all the way and screw in the regulator handle a bit until the pressure reads 7.5 PSI. If after an overnight preheat, check the kiln frequently after this because it may reach cone-08 fairly quickly, or it might take a few hours. From a cold start without an overnight preheat, it generally takes at least six hours to reach cone-08.
- When cone-08 goes down, turn the regulator handle clockwise until the pressure reads 10 PSI. Open the damper until you can see only the slightest wisp of flame at the bottom spyhole. In salt and soda-firing there is no need to do the kind of body-reduction as is generally done in gas-reduction firing.
- Check the kiln hourly until one of the early-warning cone starts to bend (cone-3 for a midrange firing or cone-7 for a highfiring). This kiln is all hardbrick on the inside and that represents a huge thermal mass, so after body reduction expect it to take at least four hours to reach cone-6 and several more to reach cone-10.
- When the early-warning cone starts to bend in the top or bottom of the kiln, adjust the damper to put the heat where it is needed – close the damper a little to focus more heat at the top of the kiln, or open a little to pull heat to the bottom. If the difference is considerable, back off the regulator pressure to 7.5 PSI and give it time. Be sure to adjust the damper accordingly to get appropriate backpressure.

- When the warning cone starts to bend (cone-5 for midrange or cone-9 for highfire), prepare your charging solution as described below. Do not prepare it earlier or it will cool and the soda ash will crystallize out of suspension.

Shutting Down the Kiln

- When the firing cone is down top and bottom and at least fifteen minutes after the final charging, close the damper and then shut off the main gas valve. Back off the regulator handle and close all three burner valves. There is no need to close the pilot light valve on the Baso valve.
- After two hours, open the damper all the way. This two hours acts like an oxidation cleanup and helps the glazes to mature and allows any bubbles to heal. There is no need to cover the burner ports.

Mixing the Soda Solution and Charging the Kiln

Caution: soda solution is caustic. Wear eye protection while mixing your soda solution and while charging the kiln.

You can weigh out the soda ash in advance if you wish, but wait until just before charging to mix the solution and fill the sprayer tank. Use a standard garden sprayer of at least 2.5 gallon capacity and with a metal spray wand. Put exactly two gallons of very hot tap water in a plastic bucket, and with the drill-impeller mixer running in the bucket pour in the measured amount of dry soda ash (sodium carbonate). The solution will go cloudy, and keep mixing until it is clear again. The reason for exactly two gallons of water and a measured amount of soda is so that you will know how much soda you are charging during the firing and thus can repeat your results. ***NOTE: Never fill the sprayer tank completely full.*** It needs air space at the top of the tank to compress when you pump it up.

Pour the solution into the sprayer tank through one of the small kitchen sieves to catch any undissolved soda crystals or other contaminants that might clog the nozzle. If the solution starts to cool, soda crystals will begin crystalizing out, changing the concentration of the mix and possibly clogging the spray wand. If charging is delayed for any reason, put the tank in a sink filled with very hot water and periodically spray a little solution through the wand. The objective is to have a ***saturated soda solution***, so that you are not charging any more water than necessary in proportion to the amount of soda, and hot water will hold far more soda in suspension than cold.

A pound equals 454 grams. For a fairly light soda effect, mix 3 pounds of soda ash (sodium carbonate) with 2 gallons of hot water and expect to charge 1 to 1 ½ pounds of soda. For a heavy soda effect, mix in four pounds and expect to charge 2 to 3 pounds. Always mix more than you need, and then decide how many times to charge based upon the draw rings. Always use a measured amount of water and a weighed amount of soda and carefully record each so that you will know exactly how much you use during each firing and thus will be better able to repeat the results or adjust accordingly in subsequent firings. Also, if something happened to your draw rings during the firing, you will be able to charge a known amount of soda in the hopes of getting the desired effect.

Regulating the Damper While Charging the Kiln

If you specifically want asymmetrical unidirectional soda effects on your ware, open the damper an additional inch or two while charging, and accept the fact that it will take more soda to achieve the desired effect as gauged by the draw rings. If you want a more even effect, close the damper most of

the way during charging. That holds the soda vapor in the kiln longer and circulates it more evenly. Don't close it all the way because that will severely reduce the turbulence that circulates vapors through the kiln. If you do close the damper part way while charging, as soon as no soda fumes are visible in the kiln exhaust or at the spyholes, open the damper to leave only a wisp of flame at the bottom spyhole.

Charging the Kiln and Pulling Draw Rings

When charging the kiln, poke the nozzle into the charging port quickly and immediately squeeze the valve to start the spray. The nozzle will overheat very quickly if it is not being cooled by the soda solution passing through it. At the same time, try to minimize the amount of soda sprayed on the walls of the charging port. As soon as you insert the wand and start spraying, fan the sprayer back and forth in order to avoid spraying in just one place, which can cause the refractory to pop and scatter particles on your wares. ***Keep the wand moving!*** – Do not allow the surface of the sprayer wand to touch the refractory surface inside the kiln any more than necessary or it will quickly melt through the brass tubing. Fan the soda spray across the firebox floor and up and down the inside wall of the kiln on the side where the burner ports are located. If you spray soda towards the bag wall you risk heavy deposition directly on the wares. Just think about where the soda is going as you spray. Obviously it vaporizes very quickly, but most intensively where the stream of soda solution hits a solid surface. Always avoid spraying any soda on the burners or plumbing.

Standard garden sprayers with metal wands come with a brass nozzle that is soldered to the tip of the brass sprayer wand. Generally, the solder melts and the tip falls off during the first few uses. When that happens, hammer the last quarter inch or so of the brass tube flat to create an appropriate spray. It does not have to be a very fine spray, but you also don't want the soda to drizzle out in a stream that goes straight to the firebox floor. Ideally the hammered end will emit a random fan of multiple jets that actually works far better than the original nozzle.

Pump the sprayer up enough that it delivers a good spray. Charge for fifteen seconds through the front charging port and then repeat through the rear charging port, and then wait about ten minutes before charging again. Charge twice before pulling the first draw ring, and pull another one after two more charges. Towards the end I sometimes pull a ring after a single charge.

If you want a heavy accumulation of soda on a particular part of a piece, when loading the kiln position the piece directly inside a spyhole. When charging the kiln, spray soda directly onto the piece, but just do a few quick, short bursts, repeating with each charging as you think necessary. If you choose to spray any soda directly on your ware, be cautious the first few times until you learn the results through a series of firings.

When to Start Charging and How Much Soda to Charge

I soda fire to cone 6 and try for a fairly light soda effect with a soft gloss and plenty of flashing on bare clay areas. I usually blend three pounds of soda ash into two gallons of hot water and charge half of that, but every firing is different and I go by the surface of the draw-rings. For a heavier soda effect, expect to charge two to three pounds of soda. For a light soda effect, start charging when the warning cone is completely down and the firing cone is starting to bend. For a heavier effect, start charging when the warning cone starts to bend. Charge every ten minutes, and don't worry about

having enough time for all the charges, because charging stalls the kiln. If for any reason the firing cone is down and you have not finished charging, back off the burner pressure to 5 PSI and adjust the damper accordingly.

When You Finish Charging

As soon as you are done charging, flush out the sprayer immediately and thoroughly. Unscrew the pump/lid very slowly to bleed off any remaining pressure. Rinse out the tank a few times, fill part-way with hot water, screw on the pump/cap, pump up some pressure, and spray a generous amount of hot water to thoroughly flush the hose and wand. Unscrew the pump slowly to bleed off any pressure, and then remove the pump. Rinse off the pump and all external parts of the tank, hose, and nozzle. When in doubt, rinse it some more. Soda is extremely corrosive and you can ruin a sprayer very quickly if you do not wash it thoroughly after each use. Remember that soda solution is very caustic. Flush your hands with plenty of water and wash with soap and water. If your skin is particularly sensitive, rub your hands with a little vinegar or Epsom salts and water to completely neutralize the soda, and then wash with soap and water.

Opening the Kiln

An all-hardbrick soda kiln has a great deal of thermal mass and will take at least twelve hours too cool enough to start opening the door. You can remove a few bricks from the top of the door as soon as every trace of red heat is gone, but keep in mind that the air coming out will be superheated. As soon as a newspaper twist no longer ignites when inserted in the top spyhole you can take out several rows of bricks, and then return in an hour and unbrick the door. ***When unstacking the kiln, be sure to set the shelves somewhere safe where they cannot be knocked over. Falling over a single time shatters these shelves.***

Cleaning the Shelves, Furniture, and Around the Kiln

When chipping posts or shelves, always wear a face shield and/or safety goggles. When grinding posts or shelves also wear a respirator. Chip off any wadding from the bottom of the shelves and from both ends of all kiln posts. If the deposits are stubborn use the angle grinder on shelf and the bench grinder on posts. With a wide metal scraper, scrape all soda-glass residue from all surfaces of the shelves including the edges. Chip off any wadding remaining on the floor of the kiln. Use an angle grinder if necessary to ensure a good flat surface in the spots where the posts go.

Please Complete All Cleanup Tasks Immediately After Unloading the Kiln

Make sure that the shelves are properly put away and never left out leaning against something. Falling over a single time shatters these shelves. Make sure the door bricks have been neatly stacked on the cart used for that purpose and the kiln posts and shelves have been put away. Sweep up all wadding and other residue and put it in the dumpster. If you use a ware cart to take your wares out to the kiln and bring them back inside, be sure to clean all wadding and other debris off the ware cart. You are not done with your firing until all of these tasks have been completed.