successful tips & techniques for raku firing

how to select raku pottery clays, glazes, kilns, and combustibles
Successful Tips and Techniques for Raku Firing:
How to select raku pottery clays, glazes, kilns, and combustibles

Raku firing is expressive, exciting, and fun. Whether you’re raku firing in your own studio or taking part in a group raku firing at a school, workshop or community center, raku offers many rewards. Raku firing is one of the most exciting processes in ceramics. After you place your pottery into a hot raku kiln, the anticipation builds as you wait for that final moment when the intense heat begins to melt the raku glazes. When you remove the pieces, you can feel the heat and hear the pings of your red hot work rapidly cooling, then it’s into the raku combustibles for a round of flame and smoke. Many surprises await you as you clean the surface and reveal the wonders of raku pottery.

**Tips for Successful Raku firing** by John Ramer Sherrill

Raku pottery is tremendously popular. The wide range of raku glazing and raku firing methods, and the surprises that come from every firing hold the interest of potters everywhere. While many achieve consistent results, many potters as well as students have been unhappy with their raku attempts. Here is a rundown of the basics you need for success at firing raku.

**Raku Pottery Clay** by Bill Jones

The raku firing process requires a porous non-vitrified clay that can withstand rapid heating and cooling without cracking or breaking from the thermal shock. By this definition, any clay that can withstand such stresses can be considered a raku clay; however, some clays will provide a greater degree of success. When deciding on a suitable raku pottery clay, your chances for success increase with bodies specifically formulated or adjusted for the raku pottery process.

**What’s a Raku Glaze** by Steven Branfman

A raku glaze is any glaze you use in the raku pottery method. It doesn’t have to be a glaze specifically designed for raku, formulated to fire at the temperature you fire your raku ceramics to, nor homemade or commercial. Read how your raku glaze can be most anything. The key to success is understanding the raku firing process and the ability to predict how a particular glaze reacts to that process.

**Buying a Raku Kiln**

There are many configurations for raku kilns—top loaders, front loaders, top hats, car kilns, and clam shells. Some top hats have pulley systems, springs, counterweights, and guiding tracks to raise and lower the chamber. Without the lifting mechanism, a large top-hat kiln requires two people to safely lift the body off, while smaller kilns require only one person. Here’s a brief overview of what you need to know to buy the raku kiln you need.

**How to Build a Portable Raku Kiln** by Daryl Baird

You can make a portable raku kiln from a gutted electric kiln or a metal trash can lined with Kaowool™ Cerablanket®, outfitted with a weed burner and fueled with propane from a barbecue tank. Take raku kiln building to the next level and you can create a low-cost, sturdy, lightweight, efficient, and safe raku kiln made from readily found materials that’s easy to construct using ordinary tools.

**Finding the Right Combustibles for Raku Firing**

The most commonly used combustibles for raku post-firing reduction are paper and sawdust. Although there are many types of paper, the most popular are shredded office documents and shredded newspaper. Newspaper can help you get the colors in a luster glaze to appear more intense while sawdust burns much slower and creates a speckled surface. Here’s how to test for leaves, grass, and other natural combustibles that would give different results.
Raku pottery has become tremendously popular in the United States. The wide range of glazing and firing methods, and the surprises that lurk in every firing hold the interest of potters year after year.

Many achieve consistent results, but I’ve talked to dozens of established potters as well as students who have been unhappy with their raku attempts. Most complained that they had been unable to find specific information to properly guide them in their efforts.

For my own early efforts, I obtained several books on the subject, but found them frustratingly long on philosophy and short on technique. I still couldn’t properly fire a raku pot, but I could use my new-found knowledge of Zen to cope with the situation. I don’t believe there are many raku enthusiasts who are interested in my philosophy, wondrous as it may be, but I know for certain that some want to know how to do raku.

Selecting a Raku Clay
A wide variety of clays can be used to make raku pottery. Be aware, though, that the clay used determines much of the character of the finished piece.

As a general rule, earthenware clays should be avoided if you like dark, bold crackle effects. The closer a clay body gets to vitrification, the less effect carbon will have on it in reduction. Iron content also resists carbonization, so terracotta clays should be avoided.

We are then left with the light-colored stoneware clays, and nearly all of these will work well. A stoneware body with just enough iron to give the fired piece a light tan color will have a pleasingly warm appearance. Some of the white-
firing clays have an attractive ivory appearance. Experiment with different bodies to find one you like.

Most suppliers sell a body designated as “raku” clay, which is usually a grogged clay that includes Kyanite. It is the clay of choice for really massive raku pieces. Suppliers also usually have bodies that are designated as “ovenware” clay. These clays, which contain less grog (easier on the hands), often make an ideal raku body. I use ovenware clay almost exclusively.

**Forming and Drying Raku Pieces**

Raku pots are usually wheelthrown or handbuilt. I’ve heard from several sources that cast pieces cannot be raku fired, but I’ve never had a problem with them although you’ll need to test them.

Some consideration needs to be given to proper drying. As a general rule, drying pots of 3 pounds or less does not require special handling. I often force dry and bisque fire the same day. Flat pieces and large pots must be dried slowly and evenly, though. Large ovenware pots will often survive fast drying, but the stresses that are thereby induced will cause them to crack at a later stage.

**Decorating Raku Pottery with Slips**

If you want a colorful pot, you may use oxides or stains in the glaze, but they may mask the dark crackles to some degree; some almost entirely obliterate them. For that reason, I use colored slips under a clear glaze. My slip base is simple—1 part ball clay to 1 part EPK kaolin. Just mix it with water to a cream consistency and add stain. I use commercial stains in percentages ranging from 2% (dark blue and green stains) to as much as 30% (pink stains).

In order to choose the stains that will work well, it is good to know their chemical components. Most commercial stains will block carbon to some extent, with the worst offenders being those that contain iron or vanadium. Vanadium is present in most warm-tone commercial stains, so you should use titanium yellow, praseodymium yellow or zirconium yellow in combination with other vanadium-free stains to formulate your own palette.

Ideally, the slip should be brushed or dipped on at the leather-hard stage, but it works on bisqueware as well. When brushing, you should apply three coats for dark colors (when you don’t want the body showing through) and two coats for lighter colors (a warm-tone body showing through some, such as pale green, can be very attractive). The pot should then be bisque fired in the cone 08 to cone 04 range.

**Glazing**

After bisquing, the pot is ready for glazing and the final firing. Glaze should be applied fairly thickly. If you dip, the consistency should be about that of thick cream, and one dipping should suffice. If you brush, the glaze should be somewhat thicker, and two or three coats should be applied. Evenness of application is not particularly important.

It is somewhat traditional to leave the area near the base unglazed. This will turn quite black in a good post-firing reduction, when carbon penetrates the still-hot pot. Other areas may be left unglazed as well. These areas may be random or symmetrical, and can greatly enhance the beauty of the finished piece.

**Selecting a Raku Kiln**

Because red-hot pots are removed from the kiln, it is apparent that many models simply are not appropriate for raku firing. Large kilns of any type, when opened at temperature, radiate heat so fiercely that it would be foolhardy to attempt raku firing. Top-loading kilns are not ideal since you must position yourself above the kiln in order to reach inside, and the rising heat can be overpowering.

Small (2 cubic feet or less) front-loading electric kilns may be used, but most raku firing is done in gas kilns especially constructed for that purpose. They can be purchased commercially, or they are easily homemade.

**Firing a Raku Kiln**

Raku kilns, unlike conventional kilns, are usually loaded on a single level, and spaces between pots are left...
a bit wider in order to facilitate their removal. It is certainly possible to use multiple levels, but it isn’t worth the hassle, as far as I am concerned.

Traditionally, the maturity of the glaze is determined visually. The kiln is opened, and the pot surfaces are examined for complete glaze melt. If mature, the glazes will appear wet and reflective. I strongly recommend using a pyrometer in conjunction with this technique, noting the temperature at which maturation occurs. After a few firings, you will need to look only at the pyrometer to determine unloading time. There is some medical evidence that prolonged or repeated staring into a red-hot kiln can damage vision.

When examining the pot for complete glaze melt, look for bubbles in the glaze, as these can mar an otherwise perfect pot. Even if the bubbles burst when the kiln is opened, unsightly craters will remain. Bubbles are almost always present on my pots because I fire rapidly, so I simply assume their presence, and take steps to remove them.

To accomplish this, partially open the kiln just long enough to drop the temperature by 200°F or so (I give it about a 10-second count). Close the kiln and bring the temperature back up to near maturity. Give it a couple of minutes for the craters to heal. If you have clusters of bubbles, you may have to repeat the procedure.

Post-firing Reduction in Raku Firing

The final phase of raku firing requires the still-hot pot to be placed in combustible materials inside a fireproof receptacle that can be covered, the tighter the better. The combustible material can be sawdust, straw, leaves, newspapers or anything else that readily catches fire. I prefer a bed of sawdust covered with crumpled newspapers, but I suggest trying different materials to discover what best suits you. In any case, the bed of combustibles should be prepared in advance of the firing.

Post-firing reduction is where the novice usually runs into problems. It is potentially a dangerous process, so always take precautions and exercise extreme care. You will be working closely with temperatures up to 1800°F, so you must train yourself to touch nothing without first considering whether or not it may be hot. After a long raku session, I actually catch myself hesitating before entering my home, considering whether or not the doorknob is hot. It is a useful habit to cultivate.

Cover as much of your body as possible (always wear long sleeves), but don’t wear polyester. Taste in clothing is not the problem; the problem is polyester will melt and conform to your body like hot glue. Heat-resistant gloves are a must. A hat and face mask are not absolutely necessary, but are a good idea. I prefer to remove large pots by hand, but for this, special heat-resistant insulated gloves must be used. For smaller pots, long metal tongs are suitable.

Reduction techniques vary quite a lot, so I will simply describe my own; modify as you wish. I remove the pot and place it on a fire proof surface, then wait for cracks to appear in the glaze on the rapidly cooling surface. In bright sunshine, these cracks generally appear as shiny lines. They will announce their appearance with audible pings or pops.

Only then do I place the pot into the reduction receptacle. This action takes place for a small pot, such as a bud vase, in as little as 10 seconds. A very large vessel (5 pounds and up) may require 90 seconds or even longer. This timing from kiln to post-firing reduction is very important, as it will, in large part, determine what kind of crackle effect will be achieved. I find that the sequence I have described gives deep, dark, widely-spaced crackles usually interspersed with networks of finer lines. Varying the timing should soon show you how to get the effect you prefer.

How to Quench a Raku Pot

A lot of pots are lost in the raku step called “quenching.” After reducing for a minute or more, the pot is removed with tongs and submerged immediately in a container of water. The water hisses and bubbles, and the hot pot rolls about as if in pain. Those with narrow mouths will gyrate wildly, and will sometimes rocket themselves clear out of the container. All this commotion by a suddenly animated pot is undeniably a lot of fun, but I no longer enjoy it because I no longer do it.

These days, I just leave small pots in the tightly covered reduction chamber for about 5 minutes, remove them and place them on the ground to cool. I leave large pots in reduction for up to 30 minutes, long enough for them to drop below the quartz-inversion temperature (1063°F), because that is when a large exposed pot is in serious danger of cracking. As far as I’ve been able to determine, the only thing I lose by not quenching pots are pots and, yes, a bit of fun.

After the pot cools enough to handle, all that remains is to scrub it vigorously with a metal pad or wire brush.

recipes

The following gloss glazes are dependable and work well with underglazes and colored slips.

<table>
<thead>
<tr>
<th>Clear Raku Glaze</th>
<th>Cone 06</th>
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<tbody>
<tr>
<td>Gerstley Borate</td>
<td>70 %</td>
</tr>
<tr>
<td>Plastic Vitroclay</td>
<td>30 %</td>
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<td>100 %</td>
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<tr>
<th>Translucent White Raku Glaze</th>
<th>Cone 08</th>
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<tbody>
<tr>
<td>Gerstley Borate</td>
<td>80 %</td>
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<tr>
<td>Cornwall Stone</td>
<td>20 %</td>
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<td></td>
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<table>
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<tr>
<th>Clear to Cloudy Raku Glaze</th>
<th>Cone 08</th>
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<tbody>
<tr>
<td>Gerstley Borate</td>
<td>75 %</td>
</tr>
<tr>
<td>Feldspar (Soda or Potash)</td>
<td>25 %</td>
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<td>100 %</td>
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The raku firing process requires a porous nonvitri-fied clay that can withstand rapid heating to low-fire temperatures (approximately 1700º–1950ºF) and rapid cooling without cracking or breaking from the thermal shock. By this definition, any clay that can withstand such stresses can be considered a raku clay; however, some clays will provide a greater degree of success, especially those with a high fireclay content. It is important to recognize that when deciding on a suitable raku clay, your chances for success increase with bodies specifically formulated or adjusted for the raku process.

Additions
Most clay bodies can be used for raku by adding up to 50% grog. Grog, which is crushed, fired clay, opens the body thus making it less prone to thermal shock. Other materials you can add to increase the ability of a body to withstand thermal shock include silica sand and kyanite. Silica sand can be used as a substitute for grog, especially at the lower raku temperatures. Because it’s not as absorbent as grog, you may recognize some gains in plasticity. Kyanite is a refractory material that matures at about cone 36. One of the characteristics of kyanite is that it expands when heated, which counteracts some clay shrinkage. It also creates a network of needle-like crystals allowing you to make larger forms. Commercial raku clay bodies contain one or a combination of these ingredients depending on other qualities you need in a body, such as the ability to make large work, or whether you’re throwing or handbuilding. You can add any of these materials to an existing body simply by wedging them in. Using a pug mill or clay mixer provides a more homogenous mix, and dry batching provides a more consistent mix.

Bisque Firing
Most raku clays can be fired as high as cone 6–10 since they are formulated as stoneware clays. But clay is clay and it should be noted that when bisque firing for raku, you should not bisque fire higher than cone 04 (1950°F). Between approximately 2000°F and 2200°F the material becomes more dense and glasslike, thereby losing some of its ability to withstand thermal shock.

Tips for Buying Raku Clay
Most clay suppliers offer a range of raku clay bodies that can usually match the qualities you’re familiar with in your regular body. They will be able to guide you either through their product descriptions or in consultation, and many clay producers will even custom blend a clay from your own recipe.

- **Plasticity:** Clays with coarser grog are more suitable for handbuilding, while finer grog makes a better throwing clay. Some commercial clays are suitable for both.
- **Thermal shock:** The larger and thicker the pieces, the more suitable and shock resistant the clay has to be. Increasing the shock resistance means adding more nonplastic refractory material, which may decrease plasticity.
- **Color:** The color of the raku clay body influences the colors of your glazes. Light-colored or buff bodies produce lighter, more brilliant glaze colors and bring out subtle shades, while darker clay bodies have a more muting affect. Raku clays made from buff stoneware, kaolins and ball clays produce lighter colors, while adding earthenware clays and colorants like iron oxide or burnt umber will create darker bodies.
- **Texture:** Adding grog to a clay body affects the texture since the grog is already fired and does not shrink. While this is not much of a factor with fine or medium grog, it is more noticeable with coarse grog. If you’re looking for smooth texture, you’ll want a body with fine grog, sand or kyanite. You can also create unusual textures by wedging in sawdust or paper pulp, which also opens the body and increases resistance to thermal shock.

As with any clay or glaze, you should test a raku body before you invest a sizeable amount of energy in forming work. Many suppliers offer samples that you can test, or you can try out different additions to your existing body. Mark all of your samples and keep good records of your results.
In my workshops, I get asked many questions but never “What is a raku glaze?” Why? Because everyone knows what a raku glaze is. Right? It’s a glaze that is labeled “raku.” Wrong. It’s time to expand your thinking and understand exactly what this whole raku glaze thing is about.

A raku glaze is any glaze you use in the raku method. It doesn’t have to be a glaze specifically designed for raku, formulated to fire at the temperature you fire your raku to, nor homemade or commercial. It can be most anything. The key to success is understanding the raku firing process and the ability to predict how a particular glaze reacts to that process.

Raku, as practiced in the West, is a low-fire method in which we quickly heat the ware, remove the ware from the kiln when the glaze has melted, and perform some type of post-firing process to the piece. The post-firing phase is usually an immersion in an organic combustible material to affect the final outcome on the glaze and the raw clay. Deciding when the glaze has melted takes practice and is best done by observation, though many potters use pyrometers to aid in making that decision. Raku is exciting, often unpredictable to the novice, and fun to do.

Applying Raku Glaze

Glazing work for raku can be done by all the methods known—dipping, pouring, brushing, spraying, splashing, dripping, sponging—you name it. Glazes also can be used alone or in combination. Keep in mind that the application of a glaze has a direct effect on the result.

Dedicated Raku Glazes

Glazes specifically designed for raku fall into two categories—homemade and commercially prepared. If you mix your own, you’ll find scores of recipes. Search the internet, ask friends, look in any book on glazes or raku, and look in magazines. In no time you will find more glazes than you could use in a lifetime. Of course, to mix
your own glazes you must have a stock of materials, mixing paraphernalia, knowledge, and interest. If this doesn’t turn you on there are myriad manufacturers that produce almost as many raku glazes. The advantage of using commercial glazes is that you are given instruction on how to use the glaze, you have a sample of the fired glaze to help guide your results, and the formulation (although not the results!) will be consistent time after time. Of course, commercial glazes are a bit more expensive than mixing your own.

Low-Fire Glazes for Raku Firing

Glazes used in the raku process need not be “raku” glazes at all. At its core, raku is a low-temperature firing method. The fact that we remove the ware from the kiln while the pots are hot and the glaze is molten is irrelevant. Understanding this opens up a whole new world of glazes. Any glaze that’s formulated to fire at the low temperature of raku can be used. First, you must decide at what temperature you are firing. Most raku is done in the cone 010–06 range. Begin by choosing glazes that both appeal to you in color and that fire in your range. You will have to experiment but I have never found a glaze that I couldn’t use successfully.

High-Fire Glazes for Raku Firing

We are not limited only to glazes that melt at the low temperatures. With greater understanding of the raku process, even mid-range and high-fire glazes can be used in the low-temperature range of raku. Try using your regular stoneware glazes as slips. Over the glaze, apply a clear or white raku or other low-temperature glaze. The low-temperature glaze causes the high-fire glaze to melt giving you a new palette of colors to work with.

Other Glazes for Raku Pottery

In addition to glazes, slips, engobes, underglazes, overglazes, china paints, underglaze pencils, oxides, and stains are all viable in the raku process.

Raku Pottery Food Safety

No matter what type of glaze or decorative material you use, raku is inherently unsafe for use as domestic ware. The rapid firing, removal of the ware, and subsequent post-firing phase all contribute to fragility, porosity, and thin, easily flaked glaze surfaces. Not all materials used in raku glazes are toxic. In fact, most are not. Confusion arises when you realize that over the centuries some of the most prized teabowls by tea masters have been raku fired. Be safe, and think of your raku ware as decorative and not functional.
Buying a Raku Kiln

Raku firing is expressive, exciting, and fun. Whether you’re rakuing in your own studio, or taking part in a group firing at a school, workshop or community center, raku offers many rewards. But the process requires more than just enthusiasm; you need the proper equipment and tools to make the event successful. If you’re interested in getting started with raku or in adding raku to your program, here are a few pointers for getting off to a good start with the right kiln—the most important tool you’ll need.

The Basic Raku Process

With raku you begin by placing your work in a cold kiln and bringing it up to temperature, approximately 1800–1900°F. The rate at which you attain this temperature is based on a variety of factors: size of the work, size and type of kiln, burner output, etc. A raku session usually consists of firing more than one load, so the ability to preheat the waiting work, unload the hot ware safely, reload, and then reheat the kiln all need to be considered. The choice of fuel—natural gas, wood, electric or propane—is important because each of these carries limitations as well as benefits. You’ll need to consider the physical location of the kiln so that it can be placed with ample space around it for safety and space to work. And finally, consider whether you’ll be firing alone, with an assistant, or with a group.

Configurations

There are many configurations for raku kilns—top loaders, front loaders, top hats, car kilns, and clam shells. Some top hats have pulley systems, springs, counter weights, and guiding tracks to raise and lower the chamber. Without the lifting mechanism, a large top-hat kiln requires two people to safely lift the body off, while smaller kilns require only one person. After gaining experience, most raku potters gravitate to one specific style and design. The important thing with any kiln is that you are comfortable with its workings. It must accommodate your work. It must be possible to safely open the extremely hot kiln, remove the contents, reload, and close it up again losing as little heat as possible. Before buying or building a kiln, do as much observation, participation, and research as possible.

Temperature

Even though most raku firing takes place in the cone 010–04 range some of the kilns on the market are rated for higher temperatures—up to cone 10. While some kilns are designed specifically for raku, others were originally de-
signed as stoneware kilns that can be used for raku or were modified for raku. You’ll need to check with manufacturers about the full capabilities of their kilns.

Fuel

Raku kilns can be fired with natural gas, wood, propane or electric (see page 36). If using propane, you’ll need to purchase or rent a tank. While a 20 lb. tank works on warm days or with smaller kilns, it is recommended that you get a larger, refillable tank, or purchase two or three smaller tanks and gang them together with the appropriate connectors. You can take 30, 40, 60, 70, and even 100 pound tanks in for refilling. With propane, more surface area in the tanks means more gas will be produced assuring a steady supply. This is especially important as you get into larger kilns with bigger burners. With natural gas, you are limited to the available pressure and location of a gas line, but there is some flexibility because you can lead a gas hose to the burner.

Burners

Burners are rated by their output, which is measured in Btu’s (British thermal units). Natural gas and propane use different orifice sizes so you’ll need to specify which kind of fuel you’ll be using. Kiln manufacturers have done the engineering for their kilns and have matched the appropriate burner(s) with the unit, taking size, insulation, and temperature range into consideration. Many manufacturers also offer regulators, gauges, and safety features with their burner, which are described in their literature. If you’re building your own kiln, instructions should include burner specifications. If not, consult with a burner supplier. Kiln size, construction materials and type of gas being used is all the information they will need.

Electric

While any electric kiln can be used for raku, there are some electric kilns on the market specifically designed for raku. Regardless, you’ll need to either locate the kiln outside, or near an outside entrance so you can unload the kiln and quickly move your pieces outdoors for the subsequent post-firing phase. One hazard with using a standard electric kiln is that the power must be shut off before reaching into it with metal tongs to eliminate the possibility of accidentally touching a live element. Some electric kilns are built with a lifting mechanism, which raises the entire body of the kiln, including all the electrics, up and out of the way when loading and unloading.

The Do-It-Yourself Option

One option is to build a raku kiln from one of the many plans available in books and online. We have two plans on our website at www.potterymaking.org, one for a fiber-lined wire-frame design, and the other a small fiber-lined barrel. Another inexpensive option for the DIY route is to purchase a kit. Some kits, which include all the materials needed to not only build a kiln, but also essential extras like tongs, furniture, gloves, etc.

Safety

Raku is inherently a dangerous activity, but no more so than working around a bonfire. If you purchased a commercial kiln, you’ll need to read, understand, and follow all safety instructions provided by the manufacturer because their warnings are based on experience and following them assures an accident-free experience. If building your own, be sure that you’re comfortable and confident in your design and experience. The appropriate clothing, gloves, and eye protection are critical for protection against the kiln’s heat for any of those handling the work, and in both solo and group situations, attention must be paid to the “choreography”—the dance—of the raku firing process. It is certainly not the time to be tripping over one another.

Cost

Many commercial raku kilns are priced under $1000 with a few fetching more than $2500 because of the need for higher end functionality. Building your own raku kiln from a kit or rounding up all the pieces and parts can lower your costs. It is similar to buying a computer or any other major appliance; determine what’s in your budget and then look around, but don’t forget to factor in tongs, gloves, goggles, shelves, and the other equipment you’ll need. We’ve listed most of the manufacturers and their website, and several of these sell through distributors, which may be closer to home so you’ll pay less for shipping.

Test Drive

If you haven’t tried raku, but have always been fascinated by the spontaneity, immediacy and simplicity of the craft, by all means, sign up for a workshop. You’ll be amazed at what a great activity this is and why it’s one of the most popular clay studio techniques around, enjoyed by thousands of potters of all ages.
I began raku firing at my local community college using a gutted electric kiln. Later, I put my own kiln together using a metal trash can lined with Kaowool™ Cerablanket®, outfitted with a weed burner and fueled with propane from a barbecue tank. This design was fairly inexpensive, simple to construct, and easy to transport and set up. But, good as it was, this kiln had several drawbacks.

The time arrived to build a new raku kiln, so my engineer-potter friend, Robin Smith, and I went to work. Our first task was to list what we wanted in the kiln, then we pulled together the best design elements we’d seen in other kilns over the years and made up a list of requirements. The kiln needed to be:

- Low-cost, sturdy, lightweight, efficient, and safe
- Made of readily found materials
- Easy to construct using ordinary tools
- Capable of handling a pot 15 inches high
- Easy to access when removing pots
- Safe to look inside during firing
- Portable and easy to set up

Note: We built a cart for this but you could just set the kiln up on software that are on top of a layer of concrete blocks.

Raku Kiln Construction

For a 19-inch diameter kiln, cut 64 inches of fencing material from the roll. This allows for a 4-inch overlap
(figure 1). Roll and shape the cylinder, check the diameter, and then use J-clip pliers to install J-clips down the length of the frame (figure 2). Twisted wires also work, but they bend the ends inward.

Carefully flatten the remaining fencing for the top, and trim it to a 20-inch square. Center the piece on top of the kiln, mark lines at a 45° angle just outside the edge of the kiln frame on each corner (figure 3).

Bend the corners to make the lid’s “feet.” These feet elevate the inside of the lid and protect it from damage when setting the lid on the ground (figure 4).

To provide a nice view of the kiln’s interior, install the 6×6 Pyrex window on the overlap six inches down from the top of the frame (figure 5).

Stand the kiln frame on the floor and loosely fit the fiber blanket inside of it. Mark the excess material to be trimmed leaving less than an inch of overlap. Note: The fencing and fiber are both 24 inches wide. If the fiber is a little longer than the fencing, do not trim it. With repeated firings, the fiber will likely settle down for a better fit. Lift the fiber out and lay it on a table, and cut it to length using a sharp knife and the carpenter’s square. With the Pyrex window in the 6 o’clock position, reinstall the fiber in the frame with the seam at 3 o’clock. Cut a piece of wire that’s 3–4 inches long. Bend it into a U-shape (figure 6a) and push it through the fiber until it’s snug against it (figure 6b) and the wire tips protrude through the kiln frame. Hold the
button in place with one hand and trim the tips so they protrude only ¼ inch past the frame. Back the wire out and measure its new length, then cut the remaining wires to length.

Put four buttons on one side of the seam, locating the first one an inch from the top and an inch in from the seam. Push the wires through and use the needle nose pliers to bend each tip into a tiny hook that attaches to the kiln frame. Install two buttons in the 12 o’clock position—one an inch from the top and the other 8 inches below. At the 9 o’clock position, insert four more buttons. At the 6 o’clock position, place a button an inch from the top, then place one so that its bottom edge is located just above the viewing window (figure 7).

Push a wire into the blanket at each corner of the viewing glass and use the pen to mark where the wire comes through. Draw straight lines to connect the four marks and you will know where to place the button. Later these marks will help you know where to cut out the fiber to reveal the window. The third button in this column goes an inch or two below the window and the last button just about an inch off the bottom. Place a button on either side of the blanket area covering the window. Return to the 3 o’clock position and put in four more buttons down the other side of the seam.

For the burner port, cut a 4-inch wide by 5-inch high hole on the side opposite the viewing window. Secure the fiber with a button on each side of the port. Use a
half-height button to secure the fiber under the burner port (figure 8).

Before lining the lid, remove the eight center-most rectangles with wire cutters to make a 4×4-inch flue opening. Cut the remaining fiber piece down to 20×20 inches, then press it into the lid frame and trim the excess. Do not cover the upturned corners of the lid frame. Use twelve buttons on the lid, with eight around the perimeter and one on each side of the flue opening (figure 9).

Building a Raku Kiln Cart

This kiln can be placed on a base of insulating fire bricks (ISBs), located on top of a concrete slab or concrete blocks. We wanted portability so Robin designed and constructed a simple cart. This cart makes it easy to move the kiln out of the way, even while it’s still very hot. Building the cart requires basic skill with a metal-cutting saw, stick welder, angle grinder, and welding clamps.

Constructing a Raku Kiln Cart

Cut four pieces of angle iron (a) to the same length for the ISB frame. Cut 45° angles on the ends, weld them from the outside, and smooth the welds with an angle grinder.

Cut the center brace (b) to length and weld it into place, then weld a gusset (e) over each of the front corners to complete the frame.

Weld the two back legs (c) and the front leg (d) into place. The front leg needs a brace (f) to give it strength. It’s welded on a diagonal from the bottom of the leg up to the center brace. Thread the two nuts (g) onto the leveler rod (h), adjust the nuts to line up with the brace and the leg, and then weld the nuts into place.

Weld the axle (j) approximately ½ inch up from the bottom of each back leg. Add a washer (k) to each end of the axle, slide on the wheels, then use the nuts (l) to hold them in place.

Two carriage bolts (m), with the heads protruding ½ inch from opposite sides of the frame, are welded on the back of the frame. The burner mount wire (q) will be anchored to these.

Lay the expanded metal mesh (o) into the frame and tack-weld it into place. The bricks must lay perfectly flat in the tray. Smooth out raised areas with an angle grinder. Set bricks into the frame and set the kiln in place.

Burner Mount

We used a weed burner for our kiln and devised a method to attach it. (Devise another system for the type of burner you choose.) Now for the trickiest part of the whole cart: the burner mount wire (q) and the burner mount trough (r). File a notch in one end of the trough to fit over the axle. We clamped the trough in a vise and used a ½-inch round file to cut this. Note: The notch you cut should be deep enough to hold the trough on the axle, yet open enough that the trough can be removed easily.

The trough had to be bent so that it would hold the burner horizontally in front of the burner port. We put the trough’s notch back on the axle and then looked at the trough from the side to judge the height and angle of the bend. After marking the location of the bend, we put the trough back in the vise and made the initial bend. After a few trials we had it where we wanted it.
The burner mount wire (b) is 31 inches long. We marked the midpoint at 15 ½ inches and made a soft bend, a slight bend 2 inches in from each end, then, using needle nose pliers, formed hooks on the ends. Take your time here. The hooks have to be open enough to fit easily over the carriage bolts (m).

Hook the burner mount wire over the carriage bolts and let the mount wire rest on the floor. Next, put the notched end of the burner trough on the center of the axle, and then, while holding the trough horizontally, the mount wire was lifted until it touched the bottom of the trough. That contact point was marked so a notch, ½ inch deep, could be cut using a small round file. With the mount wire in this notch, the trough is held in place.

The burner was laid in the trough, positioned so the opening was just outside the burner port and clamped into place. With that, the burner hose was connected to the tank, we used soapy water around the connections to check for any leaks and, at last, we were ready for raku.

Using the Kiln

Before using the kiln, level it by adjusting the threaded leveler rod (h). After the first firing, we wired a couple of metal handles to each side of the kiln so it would be easy to move. We bought inexpensive gate handles and held them in place with the light-gauge wire. We also realized that it would be nice to be able to move the kiln out of the way while the kiln was still very hot so we attached a 4-foot pull chain (u) using a couple of ⅛ inch quick links (v). Place three 6-inch kiln posts in a triangular layout to support the kiln shelf. Locate one post directly opposite the burner at the back and widely space the other two on either side of the burner.
Notes on Building a Fiber Raku Kiln

1. We used a weed burner for this kiln, but a commercial raku burner equipped with a regulator is best. The burner will require an adjustable valve.

2. Any fairly new propane tank serves the purpose. The small, BBQ-size tanks for outdoor grills tend to freeze up as they empty, so consider a larger tank or several tanks connected with a manifold.

3. Farm fencing (not chicken wire) is available at farm supply stores and home centers. It’s easy to cut with a good, sharp pair of wire cutters.

4. J-clips and J-clip pliers are great for joining the ends of the farm fencing. Trouble is, you have to buy more than you need for just one kiln and the J-clip pliers are almost essential in order to use the clips. As an option you can join the farm fencing with short lengths of light-gauge wire.

5. Kaowool Cerablanket is available in 1- and 2-inch thicknesses, but the 1-inch is fine for this kiln. Purchase from a ceramic supply store.

6. Insulating fire bricks (ISB) are available at ceramic supply stores. Hard bricks are not suitable for this application.

7. High-temp, 16-gauge wire is one of the most expensive components of this kiln. Check your local ceramics supply store.

8. This is ordinary steel wire that’s easy to bend and twist. It’s used to hold the Pyrex glass window in place. Some ceramic supply stores stock an item called “stem wire,” which is used in glass ornaments, etc.

9. For fired buttons, use cone 6-10 stoneware clay, roll it to ¼-inch thick, and cut 3-inch squares. When leather hard, drill two ¾-inch holes a half inch apart. Use a damp sponge to smooth the edges of the holes on both sides. Use 24 buttons for the kiln frame, twelve for the lid and keep four spares. Make two half-size buttons but with the same hole placement. One goes under the burner port, and the other is a spare.

10. Purchase the Pyrex glass window from a local glass supplier/installer. We bought three for about $9 each.
Raku firing dates back to sixteenth-century Japan. The Japanese tradition was based on an oxidized firing and cooling method. The introduction of a combustible reduction atmosphere is a recent North American development, and it’s this process of doing something to a piece after it has been pulled from the fire that distinguishes Western raku from Japanese raku.

The most commonly used combustible for raku reduction is paper. I’ve used two types of paper—shredded office documents and shredded newspaper. My preference is newspaper because the colors in a luster glaze appear more intense and display greater color variety. This may be a result of the chemicals in the newspaper’s printing inks.

Another common raku combustible is sawdust. Sawdust burns more like cinders in a fire, much slower than paper, and the areas of contact between the sawdust and the glaze surface often become speckled.

In considering other natural combustibles, such as leaves and grass clippings (two materials that I have too much of in my yard), I wondered how these materials would affect glaze color and surface. A side-by-side test to measure the differences would be an interesting project.

How to Test Raku Combustibles

I began by throwing four similar spheres from white stoneware clay and bisque firing them. I selected Del Favero Luster as the glaze because it has a sensitive range of color depending on the post-firing reduction. I wiped each sphere with a damp sponge to remove any surface dust before glazing. Each sphere was dipped upside down to ⅓ of its height into a well-mixed bucket of Del Favero glaze. When dry, I loaded an airbrush with Del Favero Luster and sprayed a transition band along the longitude of the sphere. Again, I kept the glaze well mixed by shaking the airbrush’s reservoir during the application. The sphere surface had both a thick, dipped application and a thin, sprayed application. The bottom third of the sphere was left bare (see above). This would provide a comparison of the carbonization on the surface.
With the glaze thoroughly dry, the four spheres were loaded into the raku kiln and fired to 1800°F. When the glazed surface on the spheres appeared glassy, the kiln was turned off, the lid was removed, and, in quick succession, each sphere was rapidly pulled and placed into four separate, but identical, galvanized trashcans. Three cans were filled ¹∕³ full with newspaper, grass clippings, and leaves respectively, and a fourth can was filled half full of sawdust since the density of sawdust prevents the sphere from submerging into the combustible.

When each combustible burst into flames, we waited 10 seconds before sealing the can with the lid. The sawdust sphere also received a coating of sawdust to cover the top surface before the lid was sealed. The lids were reasonably tight and very little smoke escaped. We did not ‘burp’ the lid during reduction to re-ignite the combustibles.

After an hour, the spheres had cooled down and each was removed. Under warm tap water, the surfaces were rinsed of any clinging, blackened combustible without scrubbing with a cleanser. After drying for a week, the four spheres were given a thin coat of sealer to bring out the blacks on the bare clay surface.

Ratings of Raku Combustibles

To say the least, I was shocked. The two main variables were the spontaneity of the combustible material and the amount of oxygen hidden within the layers of combustible. Both of these variables affected the strength of reduction occurring in each can.

Each sphere exhibited a very distinct look. If I hadn’t experienced the test myself, I wouldn’t have believed the variety of color in the results. The difference between the newspaper, the leaves, and the sawdust was very dramatic. The grass clippings appeared to be a visual blend of the results seen using newspaper and leaves. The carbonization on the bare surfaces was virtually identical on all four spheres.

When I raku, newspaper remains my combustible of choice with an occasional handful of sawdust for added texture just before the can lid is sealed.

Recipe

**Del Favero Luster**

| Gerstley Borate | 80 % |
| Cornwall Stone | 20 % |
| Add: Copper Carbonate | 2 % |

Del Favero Luster settles very quickly, so it’s important to remix this glaze preceding each dip.
Shredded Newspaper

I understand why newspaper is a preferred combustible choice—very strong reduction. Paper burns rapidly upon contact with the fired clay surface. The quicker ignition removes the oxygen rapidly from the air providing a strong reduction atmosphere. Less oxygen results in flashes of red from the copper in the glaze. Paper is a flexible material and compresses easily allowing a lot of paper to be packed into a can for a maximum oxygen burn-off. The paper left minimal markings on the final glaze surface. The surface showed no discernible difference between the thick and thin applications of glaze, and nearly all the paper that was in the can was ignited.

Sawdust

The sawdust sphere had a very strong reduction and an interesting speckled texture on the glaze surface. Each dot of black represented burned sawdust. The sphere was buried half-way into the sawdust. The upper surface was then covered with additional sawdust leaving no exposed glaze surface to receive oxygen. Had the surface of the glaze been exposed to oxygen, a very different outcome would have resulted. The surface showed no discernible difference between the thick and thin applications of glaze. The sawdust in the can that came in contact with the sphere surface ignited while the remaining sawdust was virtually untouched. A stiff brush was needed to dislodge the cindered sawdust from the glaze surface.

Dry Leaves

The leaves had minimal effect on reduction. The dry leaves were stiff and did not compress as readily as the newspaper, and there were pockets of oxygen, more than the other combustibles tested. During reduction, the availability of oxygen caused the copper to turn green. The leaves did not burst into flames with the same intensity as the newspaper; instead, it was more of a gradual build, igniting approximately half of the leaves. Leaves are similar to paper regarding surface contact—virtually no affect on the glazed surface. The glaze displayed a green mottling on the thick application but not on the thin application. Slight reduction occurred near the bottom of the sphere on the glazed areas. This is a result of the weight of the sphere pressing into the leaves and smothering out the oxygen.

Grass Clippings

The can filled with grass clippings provided a varied reduction. Some of the surface had a smoky bronze coloring and other areas had a green/white surface similar to the leaves. The grass clippings were reasonably dry, but did not ignite readily like the newspaper. It was more of a slow, smoldering burn with flames clearly visible, igniting approximately half of the grass clippings. Because the grass clippings did not burn readily, oxygen was not quickly consumed. The smoke was very heavy and thick, and may have contributed to the vertical areas of dark reduction up the side of the sphere. The glaze surface displayed a distinct green mottling on the thick glaze application but not on the thin application. The burning grass left a few black dashes on the glaze surface.