

Joys of Firing Porcelain

by Teresa De Santis

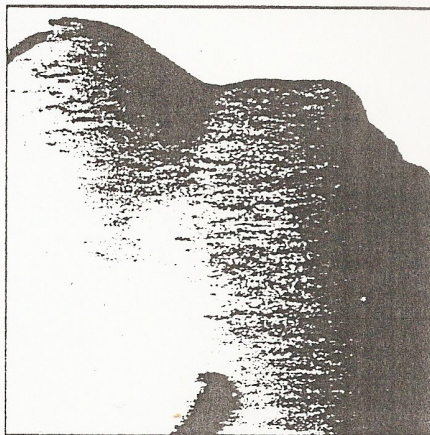
THIS ARTICLE WILL DEAL WITH THE JOYS of firing porcelain and includes detailed advice on how to fire your ware, as well as information on how to avoid underfiring or overfiring conditions.

Porcelain slip is primarily composed of three materials: clay, feldspar, and silica. The clay provides plasticity and greenware strength to the casting, provides easy release from the mold, and helps the porcelain to resist warping in the kiln. Clay also aids in the suspension of the slip in the container, minimizing settling. Feldspar gives the porcelain translucency and a smooth surface. Silica helps to bind the clay and feldspar together in the firing process and contributes to fired strength and toughness in the bisque. Most antique porcelain dolls were bisque fired in large wood, coal, or oil burning kilns for 20-30 hours or more, to the cone 10 range and beyond (2380°F, 1305°C). Contemporary porcelain for dollmaking is slightly different in composition than that of the antique porcelain because it is designed to mature in the lower cone 6 temperature range.

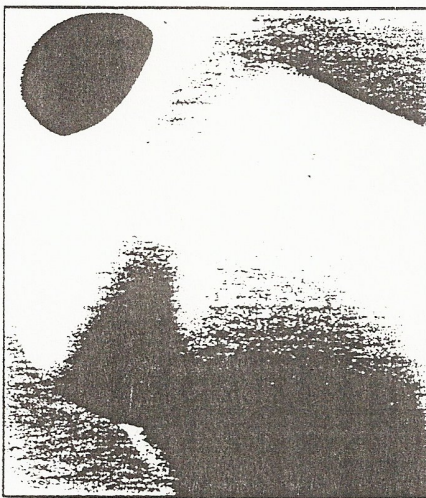
I asked three of our expert D.A.G. instructors what they considered to be the signature of perfect porcelain. They concurred that perfect porcelain bisque is translucent, well vitrified, and has a very slight sheen or glow to its surface. Sheryl Williams responded further by saying, "The feel of the fired ware is important as well as its appearance: they correspond to each other. If the bisque is too chalky, it feels rough. If it is too shiny, it feels glazed."

Underfired ware has a chalky-looking, dull surface with no glow to it. The more underfired it is, the more chalky it looks. Very slightly underfired ware may not be that obvious in the bisque, but will show its presence in the china firing. Tiny black specks form all over the piece wherever it has been painted, a phenomenon known to dollmakers as "mildew."

Slightly overfired ware looks shiny or



Mildew effect after china firing, caused by underfired bisque.



Overfiring results in raised bubbles in the bisque, referred to as white specks.

"sweaty." The color of the bisque also fades, making it bleached out or pale in appearance. A hotter overfiring results in raised bubbles in the bisque, which are referred to as "white specks," pinhead blisters, or pimples. These small, raised pimples create an unusual rough feel to the bisque. (One characteristic of these pimples is that, after sanded with a bisque sander, a small hole remains in the center.) The greater the degree a piece is overfired, the more pimples appear. An even hotter overfiring may result in warpage and slumping of pieces.

If you see overfiring or underfiring occurring, do not load up the kiln and fire again in the hopes that the problem will just go away. You need to follow the steps outlined here so you can restore your kiln and your sanity.

Five basic factors affect the maturity of porcelain. They are:

The type of porcelain being fired.

- What cone you use in the kiln sitter.
- How the cone is positioned in the kiln sitter.
- The calibration of your kiln.
- The length of your firing cycle.

The type of porcelain being fired affects the maturing point of the porcelain. One of the characteristics of dollmaking porcelain is that it has a short firing range when compared to, for instance, a white earthenware hobby slip. Most doll porcelains fire in a very narrow range of a few cones. Compounded with this is the fact that many manufacturers' slips mature at different temperatures within this range. While the majority of porcelain for this range is designated to fire at or around cones 6 and 7, there are some manufacturers whose slip fires to cones 4, 5, or 8. To resolve this dilemma, it is best to fire only Seeley's slip in your kiln load at any given time.

The number of the cone which you use in the kiln sitter also affects the matur-

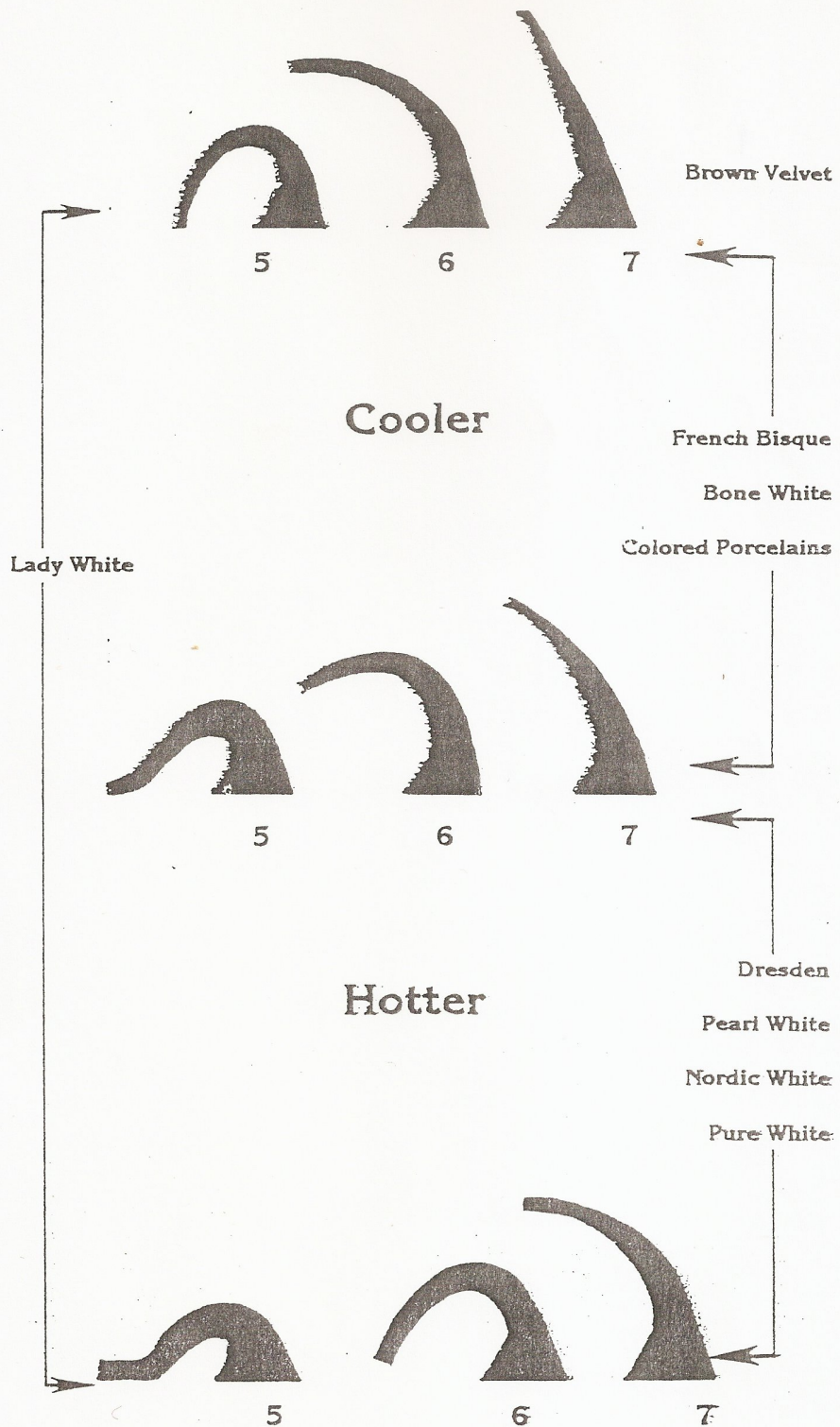
True Cone 6

ing of the porcelain. Seeley's porcelain slip fires in two areas within the cone 6 range; that of a "cooler" cone 6, and that of a "hotter" cone 6 (cooler or hotter refers to witness cone maturity). The cool cone 6 colors use Orton Junior cone 6 in the kiln sitter, while the hot cone 6 colors use Orton Junior cone 7 in the sitter. Seeley's colored porcelains (including French Bisque and Bone White) fire to a cool cone 6, while Seeley's other whites (including Dresden Flesh) fire to a hot cone 6. (The two exceptions to the rule are Lady White, which can fall into either category and Brown Velvet, which some dollmakers may prefer to fire to a cone 5.) The best way to understand this is to look at the enclosed cones chart. Your fired witness cones should look like those in the diagrams.

How the cone is positioned in the kiln sitter also affects maturity. The triangular Orton Junior cones, which are most frequently used for firing in kiln sitters, can be positioned to adjust the total time and final temperature of the firing. Adjusting the cone so the thicker end falls underneath the sitter rod will result in a slightly longer and hotter firing; adjusting it so the thinner end falls under the sitter rod will result in a slightly shorter and cooler firing.

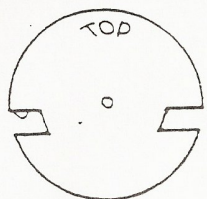
The calibration of your kiln also affects how far your witness cones bend. This is a life-size illustration of the kiln sitter gauge used to check the calibration of the kiln. To calibrate your kiln, you simply slide the kiln sitter rod through the hole of the calibration gauge and then slide the gauge onto the cone supports. Now adjust the kiln sitter weight by unscrewing the weight screw and moving the weight until the weight just barely clears the hook of the kiln sitter rod. After you have done this, retighten the screw while holding the kiln sitter weight in the proper position. Congratulations. Your kiln is now calibrated. It is very important to check the calibration of your kiln on a periodic basis (once a month is usually sufficient) as your kiln can slowly creep out of adjustment over a period of time.

Some people with overfiring or underfiring problems move the weight slightly up or down from the true, calibrated position. To do this, you mark in pencil the current position of the weight; then unscrew the weight while holding the weight in position with the other hand. Now, move the weight down or up approximately 1-2 millimeters, and retighten the screw. Moving the weight down slightly shortens the firing time and reduces the final temperature. Moving the weight up



Sitter Gauge/Weight Assembly

Kiln Sitter Gauge



Adjust sitter weight:

- down if kiln is overfiring
- up if kiln is underfiring
(all this does is lengthen/shorten the firing time slightly.)
- move the weight in small increments only
- fire test pieces in the kiln until kiln is adjusted perfectly

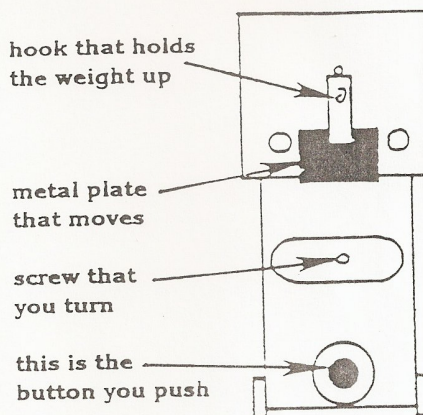
lengthens the firing time and slightly increases the final temperature. Make sure you only move the weight in small increments before retesting.

To check the calibration of a kiln with an electronic controller, put your pyrometer in the peep hole of the kiln, and watch the temperature as the firing progresses. If there is a great difference in temperature between the pyrometer and the digital readout of the kiln controller, your kiln controller probe may need repairing. To adjust the maturing point of a kiln with an electronic controller, simply do the following: raise the end point temperature 5-10°F if the kiln is underfiring, lowering the end point 5-10°F if the kiln is overfiring. (The end point is the peak temperature you set your kiln controller to fire to.)

The length of the firing cycle can also affect the positions of the witness cones. Generally, when an identical cone is used in the sitter, a longer firing cycle will result in a slightly hotter firing and more mature bisque than a shorter cycle. You can make your kiln fire slightly longer by letting it finish firing on a setting immediately below its highest setting. You can make the kiln fire shorter by reducing the time spent on low and medium settings in the firing.

A good retesting approach is to place a test head (something you would not mind losing) in the center of the kiln with Orton self-supporting witness cones 5, 6, and 7. Try one of the above methods for adjusting the maturing point of your por-

Kiln Sitter Weight Assembly



celain. After the firing, compare your cone positions with those on our chart. Record your fired results and what you did to get them in a firing notebook. A notebook detailing date, what was fired, cone positions, and results will help you in your quest. Keep repeating this method until your porcelain is perfect.

Here is a summary of what to do when your kiln is:

1. **Underfiring**
Check kiln calibration.
Recalibrate kiln, if necessary.
2. **Is the kiln still underfiring?**
Place the thicker end of the Junior cone under the sensor rod.
Let your kiln fire out on a lower setting.
Adjust your sitter weight up slightly.
Electronic control devices: raise your end point 5-10°F.
3. **Overfiring:**
 - Place the thinner end of the Junior cone under the sensor rod.
 - Shorten your firing cycle.
 - Adjust your kiln sitter weight down slightly.
 - Electronic control devices: lower your end point 5-10°F. ■

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