by **Cameron Harman Jr.**

DRYING & FIRING

Q&A

I have tried several different ways of drying my tile, but they often crack and warp. I am extremely careful to avoid even the slightest bend. I drop the slabs (on a board) hard to "induce plastic anemia" before marking the tile. I cut them when the slab is near leather-hard, and I dry them between drywall sheets with a "dam" of scrap clay "sealing" the gaps between the sheets to protect the edges from drying too quickly. I stack the sandwiches four high and replace the wet boards with dry ones periodically, flipping the tile over as I do. When the tile are "white" dry, I put them on an open plastic grid for several days to completely dry before firing. I dry slowly and protected from drafts. The tile are not warped when they go into bisque firing, but a large portion of them are when they come out. How can I reduce these defects?

For potters who make tile and other flat objects, the drying process is often a source of great frustration. Defects such as warping and cracking are common, but little is understood about the cause of these defects. In many cases, incorrect drying methods are the culprit.

Many potters place their wet tile on plaster boards or between plaster boards, and sometimes they place weights on top the boards to make the pieces come out flat. Some potters make their tile by extruding a thin, flat strip and cutting the tile to shape. Often the tile are extruded onto a board so they do not have to be moved individually until they are much drier. Others make their tile by RAM pressing, take the tile off the machine on a board, and leave them on that board until they are dry. While all of these methods will work, they are all prone to defects.

An important principle to bear in mind with wet ceramics is that they will always dry where it is easiest to dry, and the action of drying will always cause the ceramic to shrink. No force on earth can stop the shrinkage. When you place the wet tile between plaster boards with a weight on the top, it looks like you have defeated this principle, but you haven't. The stresses merely build up inside the tile, causing cracks to occur during firing as the stresses relieve themselves.

One of the problems frequently encountered with any form of air drying is that the surface of the ware is dry while the inside remains wet. It takes a long time for the interior water to reach a dry surface. Another problem with air drying is that a change in the local climate can affect the drying process and cause warping or cracking.

Some potters might be able to successfully dry their tile using the methods described above. Two possible reasons for their success are 1) the ceramic is quite strong and the mix does not shrink much, or 2) the tile are actually drying somewhat evenly, and water is being removed from the top and the bottom of the tile at the same time due to the right mix of climate conditions. However, the fastest and safest way to dry the tile will also allow you to dry even the most difficult ceramic mixes in just about any climate with good results.

Using a controlled-environment dryer, tile can be dried completely overnight. With air drying, it often takes weeks to completely dry the ceramic.

Cameron Harman Jr. is a kiln and dryer consultant with Ceramic Services, Inc., Bensalem, Pa. He has been designing kilns for over 40 years and currently produces both kilns and conventional dryers. If you have a question about drying or firing, contact Harman at (215) 245-4040, fax (215) 638-1812 or e-mail charman@kilnman.com. Answers will be published in this column in future editions of *Pottery Production Practices*.

For these reasons, virtually every industrial ceramic manufacturer uses a controlled-environment dryer, in which the air velocity, temperature and relative humidity inside the drying chamber are controlled automatically. The environment is at first very wet to retard the rate of drying and make it easier for the water to move from the interior to the surface of the tile. Drying is accomplished very slowly, so that all sides stay wet on the surface. This ensures that the amount of drying is even and that warping will not occur. As soon as the drying has completed enough to get past the shrinkage stage, the temperature is raised slightly and the relative humidity is dropped gradually, thus increasing the rate of drying.

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Creating a controlled drying environment looks easy, but the calculations are actually quite difficult. It is usually best to purchase a commercial dryer, in which the manufacturer has done all the important calculations and has sized all the parts of the dryer to work together properly.

If you are having trouble with drying, just remember that empirical solutions are nothing more than a variety of Band-Aids and do not address the core of the problem. In the long run, the only satisfactory way to dry is in a well-designed environmental chamber.

Q *I want to install a kiln on my property. What do I have to do to satisfy the local government with their many rules and regulations??*

A I understand that the city governments can often sound overly tough, but the problem is that kilns can blow up and they can cause fires.

The regulations imposed by cities are almost universally based on the same requirements. In fact, the regulations are usually implementations of the same rules that the major insurance companies use. If you follow the advice of the National Fire Protection Association (NFPA), you will be in compliance with the law in almost every jurisdiction in the U.S. Although the source of the rules in Europe is different, the protective associations all communicate with each other, so you will find that the requirements are very nearly the same everywhere in the world.

Many people complain that it costs too much to follow the rules. However, if you look at it from another point of view, it is really like buying an insurance policy. The total cost of the equipment to protect a kiln may seem a lot of money, but over a few years it is really cheaper than an insurance policy on an unprotected kiln.

The requirements are really quite simple: You need to be certain that the burner flame is ignited and that you have not allowed any gas to leak into the kiln before it is started.

If gas leaks into the interior of a kiln while it is closed and a burner is lit, the kiln will explode. The rules today require a double main gas valve with a vent between the two valves. If the first valve leaks a little gas, it will vent outside the building. If the second valve leaks, it will pass air from the vent rather than gas from the main. In kilns that have blowers on the burners, a purge timer can be used to allow the blowers to run long enough to purge the gas from the interior before a burner is allowed to light.

Sometimes a burner will go out and the gas will keep flowing into the interior of the kiln. If the temperature of the kiln is above the ignition point of gas at the time the burner goes out, the gas will simply burn off inside the kiln. However, if the kiln temperature is below the ignition point of the gas, then the gas can build up inside the kiln until it finds a flame and explodes. A flame safety system that continually monitors the burner flame (or pilot flame) will shut off the gas if the flame goes out.

These are relatively simple precautions to take. While they might cost a little extra money up front, the cost of protecting the kiln in the first place should be looked at as an insurance policy to prevent a dangerous and damaging accident. The inspectors in a city may not be familiar with kilns, but they are familiar with the hazards of fuel-fired equipment. They are not trying to be difficult; they are simply trying to prevent bad accidents. I would urge all of you to give these serious problems some careful thought.