DRYING & FIRING
QUESTIONS & ANSWERS

by Cameron G. Harman Jr.

Q *I am firing my products in a small gas-fired kiln, and energy costs are taking an increasingly large bite out of my profits. Can you suggest some ways for me to reduce my fuel consumption?*

A You are not alone. Just about everyone in the ceramic industry—whether operating a single small pottery kiln or several large industrial kilns—faces the challenge of increasingly higher energy prices. Factors such as weight, insulation, kiln condition, combustion efficiency, setting pattern and the correct use of the kiln can all affect energy consumption. Fortunately, making some minor changes in these areas can often help you save a significant amount of energy, no matter what size kiln you're operating.

Weight

Every kiln fires weight—i.e., the total weight of the items being fired, the kiln furniture and the insulation or lining material. Kilns constructed with insulating firebrick (IFB) weigh about $^1/_8$ the amount of a kiln lined with hard brick, and a fiber-lined kiln is lighter still.

Some potters believe that kilns with lightweight linings cool too quickly and are therefore susceptible to cooling problems. While this can be true for poorly designed kilns, cooling problems typically do not occur in well-designed kilns with modern controls. The only exceptions are with certain crystal glazes, which require a very slow cooling curve, and very large pieces, which require a slow annealing curve. Industrial producers of very large items—such as 36-in.-diameter grinding wheels—typically keep the burners on to aid the slow annealing process. Even in these situations, the fuel savings provided by a lighter weight lining can often outweigh the drawbacks of having to adjust your firing curve.

If relining your kiln isn't an option, or if your kiln already has an energy-efficient lining, make sure you are using the least possible amount of kiln furniture. You might also consider replacing your traditional large, heavy furniture with some of the newer lightweight systems. Although the newer kiln furniture often has a higher initial price tag, it can offer significant energy savings.

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Kiln Condition

Many kilns have gaps or cracks around the door, flue openings and/or view ports that are large enough to allow heat to escape. These areas should be filled with ceramic fiber or a refractory cement to minimize energy loss. Any broken or missing bricks in a brick-lined kiln should also be replaced.

Combustion

Many different types of burners and combustion system configurations can be used for gas kilns. Although space does not permit an in-depth discussion of combustion systems in this column, several basic guidelines can be followed to ensure an energy-efficient system. For example, burners that are sealed to the kiln wall (i.e., a burner block is fastened to the burner, and the block is installed in the kiln wall) are much more efficient than burners that are open and allow air to pass into the kiln's interior. Even more efficient are burners that have all of their air for combustion provided through a pipe from a blower.

If your kiln uses vertical, open burners, you might want to talk to a kiln engineer or consultant to determine your energy-saving options. Retrofitting your kiln with more efficient burners could be a rather extensive (and expensive) project, and might not be advisable if the inside of your kiln does not have sufficient room to allow free movement of the burner gases and avoid flame impingement on the ware. However, you should be able to adjust your existing burners for the best flame, which can often save quite a bit of fuel.

If your kiln already uses sealed burners, check the efficiency of your combustion system. The most efficient system is an "on-ratio system," in which the combustion air and gas flow are maintained at a constant ratio set at the exact proportions required for complete combustion. It is important to know that different kilns firing different kinds of products may require some variation to this rigid standard. Several different on-ratio systems are available, and the requirements will vary according to kiln type. You should consult with a kiln engineer to determine the best system(s) for your situation.

If you have a gas kiln with sealed burners, you should also examine the amount of excess air that the burners are set up to use. Many times you can use less excess air and save a lot of fuel.

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Setting Pattern

The ware inside the kiln is heated by convection from the products of combustion emanating from the burners, radiation from the products of combustion of the burners, and radiation from the walls and roof. If the ware is very closely packed together, a longer amount of time will be required for the heat to uniformly penetrate the center of the load. By opening the load a little bit, you might be able to improve the way that heat gets to the center of the load, which will enable you to fire more quickly with better results. Kilns that are designed to draw the products of combustion into the load center typically perform better than updraft kilns or electric kilns.

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If your kiln has vertical burners that fire into areas along the sides and middle of the ware, make sure you allow enough space in your setting pattern for the heat to move upward through the load. If you pinch off the pathway for the heat to rise, uneven heating of the load can occur. The kiln might also require more fuel to complete the firing.

Drying

Finally, do not use the kiln as a dryer. It will use a lot of unnecessary fuel and will not necessarily do a good job. A dryer is another, completely different tool and is constructed to use very little energy. A kiln used as a dryer will always use too much energy and give you no control over the humidity. A ceramic dryer, however, will dry your ware quickly and thoroughly without much energy or effort.

Editor's note: Links to other articles discussing firing and energy savings can be found with this article online at www.ceramicindustry.com.