DRYING & FIRING
solutions

by **Cameron Harman, Jr.**

Q How can we determine if our ware is dry enough to fire?

A Dryness can be determined through three methods: 1) non-destructive testing, 2) destructive testing, and 3) inference. In every case, we must know how dry the ware needs to be in order to fire properly. So, the first problem is to identify the level of dryness required.

Some manufacturers use the kiln as a dryer in order to finish the drying sequence. This, of course, makes for a very expensive dryer. The kiln itself must not see any more than hydroscopic moisture—water absorbed on the surface of the ware as a result of exposure to the presence of water in the atmosphere. If the ware is completely dry and is later exposed to moisture in the air on a humid day, for example, this is not generally harmful when the ware is inserted into the kiln because the water can be driven off very quickly.

However, the same percentage of water (say 1-2% weight) can be very destructive if it is still locked inside the ware. If the ware is not completely dry, steam can build up within the ware as the kiln's temperature increases. If the rate of heating in the beginning of the firing cycle is very fast, it can result in anything from small pieces popping off the surface of the ware to complete shattering of the ware.

You must also consider that very thin pieces will dry more easily than very thick pieces, and ceramics high in very fine particles such as bentonite will take longer to dry than coarse-grained ceramics. So, all the discussions that follow should be tempered with the understanding of how inherently difficult the material is to dry. The less difficult it is to dry, the simpler the tactics you can use.

Non-Destructive Testing

The first test is to check the surface of the ware to see if it is as hot as the finishing air in the dryer. If any water is evaporating from the surface, it will lower the surface temperature of the ware. However, even if the surface is hot, there can still be water in the interior. In some cases it is possible to use an ohm meter and measure the resistance of the surface. You must place the two probes at the exact same distance apart at each measuring. The results should then be compared to a standard measurement made on the same shape of ware known to be completely dry. The resistance measured will be inversely related to moisture, because of the conductivity of the water and dissolved salts in the body. This is a quick test just to determine whether there is surface water. If we find moisture at this stage, there is likely to be moisture in the body.

Another method of determining the dryness non-destructively is to weigh a particular piece and compare it to another piece of ware of the same size and shape that is known to be completely dry. This method will also determine the actual amount of water remaining. For example, an extruded piece may weigh 1200 grams, and when completely dry it may weigh only 1000 grams. The amount of water in the piece would be 200 grams (1200 grams-1000 grams). If you divide 200 by 1000, you find that the ware contains 20% moisture. If a particular piece in question measures 1010 grams, you could determine that it still has 1% moisture in it. This method can be very precise if the measurements are taken carefully, as long as the pieces are precision formed and dry weights are near identical for like pieces.

Destructive Testing

A very common method of destructive testing is to take a sample, either a whole piece of ware or a shard of dried ware, and weigh it. Then carefully crush the sample and place it under a heat lamp. The piece is weighed at intervals until it stops losing weight. (Devices are available that place the sample on a plate with a built in scale and heating lamp for continuous reading.) When the piece stops losing weight, you can calculate the percentage of starting moisture in the same way as described in the previous section. That is, wet weight minus dry weight divided by the dry weight.

Sometimes an operator will take a large piece and break it through a large cross sectional area. It is sometimes possible to observe directly whether or not drying has finished inside this section. If the inside is cooler (feels wet) or even in some cases looks wet, then drying is not complete.

Inference

If the dryer is monitored and is working properly, then once testing is made on a standard piece, it can often be assumed that all other pieces will dry to the same extent when subjected to the same drying conditions. This is the most common method of determining dryness. Then, if problems occur, the operator will look for changes in the dryer or the drying cycle to determine the source of the problem.

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