BRAZING Q&A

Q: We tried water quenching some parts during our semi-automated induction-brazing operation. The joints don’t look good, and some are weak, showing poor filler metal solidification around the joint. We spray water onto the part, immediately after the induction coil is turned off, to get the maximum quench effect. Can you tell us why the filler metal looks so bad?

A: Brazing filler metals (BFMs) should never be quenched while they are still molten during any brazing operation (be it torch, induction, or furnace brazing). It does not matter what kind of quenching medium you are using, because the “negative” effect of rapid quenching a BFM, while it is still molten, will be the same — Fig. 1.

Thus, rapid quenching of molten BFM with water, air, or inert gas makes no difference. Brazing filler metals must simply never be quenched while they are still molten. Rapid impingement of water or gas on the molten BFM disturbs the solidification process, causing the metal to move and shift while trying to solidify, resulting in excessive voiding and cracking in the joint being brazed.

Fig. 1 — A typical photo of how water quenching can be used to rapidly quench a metal part immediately after induction heating. Note: Instant quenching should never be done immediately after brazing. (Image provided by Dan Kay, Kay & Associates.)

A few years ago, the same thing happened at another company that was induction brazing carbide tips onto the ends of some specialized tooling. When the power was turned off to the induction coils, they immediately sprayed water onto the tool tip to quench it, believing that they could increase their production rate. Although they did, in fact, produce more parts per hour that way, they also noticed a significant increase in parts failures in the field. When I was called in to help them, I watched their brazing operations and immediately saw this quenching-while-molten phenomenon. I told them this was a poor practice. Because they did not know that, they immediately changed their quenching, so that it was done a few seconds later after the BFM had fully solidified, and their reject problems related to this rapid quenching disappeared.

Please remember it is very important to be sure that the molten BFMs be completely quiescent (i.e., quiet, still) while solidifying to give good brazing results. Immediately after the induction coil is “turned off,” the part being brazed should be allowed to remain very still for just a few seconds, so it can cool down and solidify naturally in the open air. Be sure that no quenchant is used until the brazing operator can physically see the BFM has fully solidified. Only then should you use a quenchant to quickly bring the part down to room temperature.

Today’s key for successful brazing is do not disturb the joint in any way while the BFM is still molten. Allow it to solidify completely before quenching or moving. Careful adherence to this principle will prevent a lot of braze-quality issues in your brazing operations.