ATLANTA – Lead-free doesn't seem new, but many myths still pervade industry thinking. One expert tried to dispel them.
In a presentation during the Atlanta SMTA Show Thursday, Chrys Shea, R&D applications engineer manager at Cookson Electronics, posted statements about Pb-free and asked whether the audience thought they were fact or fiction. She made some strong points about the myths of Pb-free, showing a distinct passion for her research. Here are the key points of her presentation:

1. Modern Pb-free pastes print as well as SnPb.
2. Pb-free solder pastes produce fewer mid-chip solder balls and bridges than SnPb. She originally thought it was the flux, but said it is most likely the alloy itself. Cookson performed a test with 4,800 opportunities. The results: SnPb had 504 mid-chip solder balls (a 10.5% defect rate) and Pb-free had 62 (a 1.3% defect rate).
3. Pb-free has less voiding. "Pb-free has come a long way in the last three to five years. Previous generations of paste were not as good. The fifth or sixth generation is much better. You should discard studies from 2004 or earlier," she said.
4. Pb-free does *not* spread as well as SnPb pastes. ("Lose the lead; lose the spread.")
5. Pb-free water washable solder pastes have *not* been reported as harder to clean. (Tips: Clean after each thermal excursion; clean as soon as possible after excursion; hotter isn't always better with water temperature; with higher temperatures, flux could cook on.)
6. Inerting the reflow process with nitrogen *does* open the time-temperature process window – on both ends. (Wetting happens sooner. Flux does not get consumed as quickly, so it is active longer.)
7. Inerting the reflow process with nitrogen *does* improve joint cosmetics, *but* this is not necessary to get good cosmetics. (Most modern Pb-free pastes create good cosmetics in air – and "air is free." Inerting is *not* usually necessary to get good yields. Inerting's cost-effectiveness can be improved by using membrane-generated nitrogen. "You need nitrogen.")
8. Head-in-pillow (HIP) defects *are* more common in Pb-free. ("They are becoming epidemic." Factors: Smaller solder deposits; higher processing temperatures and longer pre-liquidus thermal exposure; more tenacious oxide films on molten solder; smaller spheres on BGAs and BGA package warpage. An oxide crust is created.)

Mitigating the HIP effect:

1. Open up stencil aperture by 1 to 2 mils. (Risk of bridges is low.)
2. Reach liquidus temperatures more quickly. (Preserve flux activity for soldering.)
3. Inert soldering process. (Limit opportunity for oxidation.)
4. Use a stronger or more thermally robust flux. (This avoids the issue altogether, but is not always possible.)

1. Maintenance intervals remain the same in Pb-free and SnPb solder pots. (Pb-free alloys with higher silver content are highly corrosive. Pb-free alloys that contain nickel are less aggressive.)
2. Failure analyses have *not* shown any correlation between attack sites and turbulent flow.
3. Pb-free solder pots *should* be sampled more frequently than SnPb.
4. Avoiding OSP surface finishes will *not* help curtail copper dissolution problems. (Exception: ENIG finish, but “ENIG has its own problems.”)
5. Small amounts of bismuth (<2%) *improve* fatigue strength of both Pb-free and SnPb.
6. Pb-free dross *does not* sink to the bottom of the solder pot.
7. Dropped tools *do* sink to the bottom of the solder pot (with Pb-free).
8. Stainless steel solder level float-type sensors *do* work with Pb-free solders.
9. Hot gas knives are *not* effective at debridging Pb-free solders. (Pb-free solders run closer to freezing than SnPb; nozzles are wider; the knife would run so hot, it could affect PWB reliability.)

So, “solder pot setup is more important than ever,” said Shea. We have to rely solely on peel-off mechanics. Run lowest possible lead clearances and pump speeds, but watch hole fill. Set back gate height to allow the trickle of solder if no PWB is present, and full backflow if PWB is present.

1. Raising the pot temperature by 5º *will* improve soldering. (But, raising it above 265ºC can impact laminate and component reliability, and can increase dross rate. “It’s a temporary fix,” she said.)

“The key is maintaining a balance,” she concluded.