Was Lead-Free Solder Worth the Effort?

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From about 1995 to 2005 news reports and magazines ran stories about pollution caused by electronic waste. Many of these articles included photos of piles of old circuit boards, people in China disassembling printed-circuit boards (PCBs), and some living among pile of electronic waste.

As "disposable" electronic devices became more common, the European Commission (EC) adopted two proposals in 2000: First, a directive that requires producers of electrical and electronic equipment to take back end-of-life consumer products. Second, the EC required that member states ensure the use of lead, mercury, cadmium, chromium metals end by 2006. (Ref. 1)

The ban on lead in electronic solder caused the most controversy because as far as I can tell, no research showed environmentally significant amounts of lead leaching from discarded electronic equipment into groundwater in Europe, Canada, or the US. Granted, disposal and salvage techniques in third-world countries, where such studies are unlikely to occur, probably causes local pollution of water, soil, and atmosphere. Much of the push to eliminate lead from solder, though, stemmed from the public perception of hazardous wastes as portrayed in the news stories I mentioned above. In Europe, the "Greens" played upon environmental fears, pushed legislators to eliminate lead, and dismissed the need for a scientific understanding of heavy-metal pollution (if any). As best as I can remember, consumers didn't clamor for lead-free solder and little or no evidence surfaced to show lead contamination in potable water.

Recycled lead, mainly from car batteries, gets melted in a large crucible for refining and casting into ingots for sale to manufacturers. Courtesy of International Lead Association.

In 2005, the U.S. Environmental Protection Agency published a report, "Solders in Electronics: A Life-Cycle Assessment Summary," in which it "...assessed the environmental life-cycle impacts of selected lead-free solders as alternatives to tin-lead solder. The analysis also provides an assessment of the recyclability and leachability of the solders" (Ref. 2). The study considers leaded and lead-free solders from ore mining and waste recycling through refining and use to disposal and recycling again. Results show mostly small differences between the environmental impact of leaded and lead-free solders. After all, tin-copper, tin-silver-copper, and bismuth-tin-silver solders all require metal-ore mining and refining, fabrication, and disposal. And lead mining would continue because 80 percent of the metal still goes into vehicle batteries. I would bet less than one percent has gone into solders.

On his Signal Consulting Web site, signal-integrity expert Howard Johnson notes:

"Replacing tin-lead with pure tin is turning out to have been a huge mistake. There are two significant differences between lead-free assembly and lead-based assembly.

"1. Lead-free assembly is not better for the environment, it is worse. The additional tin mining required to produce high-purity tin alloys, plus the mining of other precious metals required to alloy with tin in substitution for lead is a poor trade for the use of existing lead, much of which comes from recycled products. This information comes from a study conducted by the U.S. Environmental Protection Agency (EPA). The study undercuts the primary basis for RoHS.

"2. Lead-free assembly is less reliable than lead-based assembly. The E.U. environmental commission admits this point. That's why they grant exceptions for military and high-reliability applications that still use SnPb solder. (Ref. 3)

Johnson's newsletter also explains the problems caused by tin "whiskers" produced by lead-free solders. It's worth reading

To delve deeper into the need for lead-free solder I talked with a knowledgable person at the IPC, formerly know as the Institute for Interconnecting and Packaging Electronic Circuits. When I asked about any follow-up studies that could show the benefits of lead-free solder, the spokesperson explained that such studies would simply waste money because they would show no changes in lead exposure in landfills and no changes in occupational exposure, either. Years ago companies recognized the dangers of lead exposure and took measures to protect employees. The problems in third-world salvage yards stem from improper waste management.

The IPC person also explained the EPA produced an overall hazard assessment that included aspects such as ozone depletion and global warming and did not provide an exposure assessment. So far, the EPA has done no additional research to determine the effects of eliminating lead from solder.

In the end, though, lead-free solder proved beneficial for solder and soldering-equipment vendors, but overall, the entire effort seems like a waste of time, talent,

and money.

References

1. "Lead-Free Soldering," Welding Technology Institute of Australia, April 2006.

2. ""Solders in Electronics: A Life-Cycle Assessment Summary," EPA-744-S-05-001, August 2005.

3. "Rollback the Lead-Free Initiative," High-Speed Digital Design Online Newsletter: Vol. 10 Issue 01. www.sigcon.com/Pubs/news/10_01.htm [1].

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