

EPA Design for the Environment Lead-free Solders Partnership

Core Group Conference Call

August 1, 2002, 1:30 EDT

Participants

Anne Brinkley, IBM
Brenda Baney, Delphi Delco
David Bergman, IPC
Fern Abrams, IPC
Holly Evans, EIA
Jack Geibig, UT
Jerry Gleason, Hewlett-Packard
Jocelyn Siegel, Abt Associates Inc.

Kathy Hart, EPA
Maria Socolof, UT
Time Mann, IBM
Todd Brady, Intel
Tom Korpalski, Hewlett-Packard
Dr. Townsend, University of Florida
Ulrika Kindedjo, University of Lund

Update on the Life-Cycle Stages

Jack Geibig of the University of Tennessee (UT) stated that UT has been focusing their energy on the end-of-life and manufacturing life cycle stages. He provided an update on the activities in the following stages:

- **Cookson Electronics:** Cookson hosted UT at two of their facilities. Jack and Maria Socolof, UT, were able to collect a sizeable amount of data. They visited a lead-smelting plant, a part of Cookson's facility in Pennsylvania. This visit provided a good explanation on two major aspects which they will be able to incorporate into the methodology:
 - the effects of bismuth; and
 - the recycling of circuit boards at the end of life.Jack will not be able to discuss the process until he has sorted the confidentiality agreement with Cookson.
- **Omega:** UT will visit Omega's facility in Mexico on the 15th -16th of August. This is another lead-smelting facility, presenting an additional opportunity to learn about recycling issues. They have a brand new reclamation facility and also process other industrial waste.
- **Ulrika Kindedjo,** University of Lund has information on copper smelting and reclaiming conducted in Sweden. UT is working with her to compile a process flow diagram for the end-of-life to be included in the final report.

Discussion of the Leachability Testing Methodology

Dr. Townsend of the University of Florida has drafted a 3-page methodology that was distributed to the core group. Dr. Townsend described the methodology he reported. His task involves conducting leachability tests on the 4 solders defined by the core group in order to

determine what environmental risks they might pose. He will use two of the most common leachability testing procedures:

- Toxic Characteristic Leaching Procedure (TCLP), and
- Synthetic Precipitation Leaching Procedure (SPLP).

He outlined the procedure described in his methodology.

Lee Vroom, Thompson Multimedia, and Todd Brady, Intel, had previously submitted written comments on Dr. Townsend's methodology via e-mail.

An inquiry was made regarding the philosophy behind the decision to use Pb-free solders with a HASL finish, its advantage, and whether this was an expected manufacturing trend for the future.

- ? Jack responded that David Hillman of Rockwell was donating 3,500 HASL finished boards, which was the biggest driver behind the choice of board type.
- ? Jack described the donated boards. He believes they are tin (Sn)-lead (Pb) boards, however he cannot be certain until they have been tested.
- ? Jack proposed obtaining additional board types. Brenda Baney of Delphi Delco suggested unfinished boards, which they could finish with an Organic Solderability Preservative (OSP), a common circuit finish for PCBs compatible **with most solders**. There was general agreement over this suggestion.
- ? David Bergman, IPC, voiced concern that after the leachability study was conducted, it was possible that they would find lead contaminants in it that would confound the results. Fern Abrams, IPC, added that the concern was not of lead alone, but of leachate from all other foreign alternatives. A possible solution to this was using a palladium finish on the board, however it remained uncertain whether palladium would become a popular alternative for Pb-free solders over the following years. This was true for any alternative solder as it remained ambiguous which option manufacturers would develop.
- ? It was suggested that the art work be obtained from David Hillman's boards, should the group decide to have them made.
- ? Todd Brady, Intel, stated that Nortel's website presents a graphic representation of the quantity of solders contained in their board which could be used by the group. The breakup of the contained solder is:
 - 5% - from coating on the component;
 - 25% - from HASL on the circuit board; and
 - 70% - from the applied solders.

There was an inquiry regarding the processing of the board, whether they would be processed at UT or elsewhere.

- ? Jack stated that Intel had offered to run the boards to enable UT to collect process data, allowing them to model the application stage.
- ? Todd confirmed this. He noted that it might be time consuming if the group decided to process Sn-Pb as well as 3-4 alternative solders. If time was a priority he proposed approaching companies that possessed boards containing Sn-Pb as well as Pb-free

solders. He stated that Intel did not possess such solders but would be able to provide the components.

It was noted that should David Hillman's boards be used, testing would still require two other board types. It was suggested that they use a single board design with four different solders; one with Sn-Pb and the remaining to consist of the alternative solders. This would present a control for the Pb-free solders.

- ? Anne Brinklev, IBM, noted that a 100g sample of a populated board would increase the **difficulty in making a comparative analyses across types**. This would allow a determination of what is leaching, however we would be unable to pinpoint which alternative solders proved to be a better option.
- ? Kathy Hart, EPA, suggested conducting an experiment on the side comparing Pb-free with leaded components in order to observe how the results would compare.
- ? Dr. Townsend suggested using a bare board. This would allow them to weigh the board before and after the tests in order to make a comparison across solder types, following which they could place alloys onto the board.
- ? Jerry Gleason of Hewlett-Packard suggested considering the alloy used by Texas Instruments, nickel (Ni)-palladium (Pd) or Ni-Pd-Au for the components. This would resolve the concern of lead contamination, and they could use Pb-free solders on them.
- ? Jack suggested that a duplicate sample be ground and analyzed to determine the mass of solder in each sample type so that results of the leaching could be correlated to the mass of available solder in the individual samples.

There was some discussion over whether the boards should be cut, ground, or shredded. Dr. Townsend stated that the TCLP and SPLP procedures did not define a protocol for this. However, the TCLP procedure requires a size reduction to less than 1cm.

- ? Jerry and Anne were in agreement that component densities would differ depending on where the boards were cut. To account for the variability of local features of the boards, he suggested grinding the board in order to obtain a homogenous sample.
- ? There was concern raised that grinding (rather than shredding) would result in increased surface area and consequently, increased mobility of metals. Jack stated that **grinding is permitted within the TCLP protocol, however, industry has questioned the applicability of results generated in this method**.
- ? There was general agreement that unpopulated boards might be the best option as it would prove challenging to work around the components on a populated board.
- ? Todd stated that most components are not Pb-free, thus if they were to add components to these boards they must confirm them to be Pb-free. Additionally, he stated that the packaging itself may be a source of lead contamination.
- ? David voiced agreement. He stated that there exists a potential that the components would affect the results. He suggested the use of a bare board heavily loaded with an alloy. After which a selected component could be added and the board could then be shredded. Additionally, this would also eliminate the need for the reflow process.
- ? Kathy questioned whether it was possible to separately test what effect a component would have on the board, but added that this may be an entirely different study.
- ? David suggested adding each component they wish to test while shredding the board itself. Fern argued that this would be far from reality as circuit wires, etcetera, leach

when the board is eventually discarded in a landfill. Further, she noted that should this data be fed into the life-cycle assessment it would be important to stay close to real world results.

Conclusions and Next Steps

- The group will look at sampling similar areas across boards in order to obtain consistent samples.
- Boards would be shredded to obtain the samples as this more closely represents the conditions under which leaching would occur. A duplicate sample will be ground and elemental analysis performed to determine the mass of solder material present in the actual samples being tested.
- Boards will be unpopulated and have the solder applied using wave soldering techniques.
- The group is in some agreement that they should obtain a number of OSP coated boards would be preferable to HASL coated boards to limit the effect of the surface finish on the results.
- Jack and David will look into places that would donate OSP boards to the study. The group is in some agreement that if necessary, they should look into purchasing these boards.
- They will hold open the possibility of using David Hillman's boards with an Sn-Pb strip if necessary. They will obtain the artwork from David Hillman as they may require using the board design.
- Kathy asked Dr. Townsend to revise his methodology reflecting the changes as discussed by the core group. Jack will forward this revised version to the technical workgroup. Comments will be accepted until August 14th.

The next call will be as scheduled on **Thursday, September 5, at 1:30 EST.**
