

Hot Air Levelling Technology Lead-free (SnCuNi und SnAgCu)!

The nearer the deadline draws to the compulsory implementation of lead-free regulations (ROHS), the greater the attempts to achieve lead-free solutions that are comparable to the “all-purpose answer” SnPb in terms of technology and cost. Two systems are particularly predominant: tin/silver/copper (SnAgCu) and, more recently, stabilised tin/copper (SnCuNi). Although the level of efficiency of both systems is not yet completely clear, the following presents the latest information:

SnAgCu

There is more experience in the field of silver systems. Here, differentiation is made between the Sn-3.5Ag-0.7Cu, Sn-4Ag-0.5Cu and Sn-3Ag-0.5Cu systems which vary in use from continent to continent.

However, the agreed expert opinion (IPC/Soldertech-Conference Brussels 2003) is that the technological differences between the three systems are negligible. Sn-3.5Ag-0.7Cu is the most common alloy in Europe.

SnCuNi

Although there are even fewer field results for the stabilised tin/copper system Sn-0.7Cu-0.1Ni, it shows a lot of potential. It is called “stabilised” because the addition of nickel is said to show an improved hardening reaction in soldering.

The creation of needle-structured crystals is said to alter to rounder structures, achieving an improved soldering flow for wave soldering of PCBs (reduction in torn soldering, less electrical bridging).

This alloy was developed in Japan and is supplied in Germany by the license holder, Balver Zinn.

The Printed Circuit Board Manufacturer

The SnCuNi system is particularly interesting for the PCB manufacturer as the investment needed to convert from conventional lead-tin techniques to tin/copper is far lower than for facilities providing the processing technology for chemically produced surfaces.

Because, this is also a melting pot procedure. And only the solder's tolerance with the dipping-container needs to be further researched.

Our company is already working on solutions with mechanical engineering manufacturers. From May 2004, we plan to offer our customers SnCuNi in series production.

Soldering Trials

As already mentioned, there has been insufficient field research. Therefore direct comparison of soldering characteristics has been undertaken in diverse trial campaigns by expert and work groups (BDF Germany, Boeing USA).

Both systems enable smooth, shining surfaces and reliable soldering joints, using wave soldering as well as reflow.

The tin-copper system promises advantages in terms of the copper's peeling reactions (leaching) on the circuit boards. The effect on the copper surface is halved.

	SnAgCu - Systems	Sn-0.7Cu-0.1Ni (SnCuNi)
Melting point (eutectical point)	217	227
Procedure characteristic reflow/convect	Tpeak = 230 C°	Tpeak 240 C°
Procedure characteristics Wave	Bath temp.: 255 – 265 C	Bath temp.: 255 - 260
Ecolog. disadvantages	Silver content	00
Metal Price	12 – 13 €	7 – 8 €
Leaching (CU peeling)	Agressiv, high Leaching - Rate	Leaching Rate 0,5 of SnAgCu
Soldering error rate compared with SnPB	Equal solder bridging, more non-soldering	Equal solder bridging, more non-soldering

Costs must be kept in mind. The silver system is approximately 40% more expensive than SnCuNi due to the use of precious metal; also, there is the ecological disadvantage.

Lead Sensitivity

The problem of lead sensitivity during the lead-free conversion phase in 2006 remains unsolved. Structural changes in lead-free soldering caused by remains of lead (even below 0.1% weight) in processing containers have been observed.

Structural coarseness occurs in SnAgCu if there are stressful temperature changes even well below 96 C° (degradation acceleration).

Lead secretion occurs in borderline grains in SnCuNi systems which, under mechanical tension, can create weak spots. Splitting is possible when soldering heat cools.

Conclusion

There is no doubt that the “good old” lead/tin still provides the best soldering results.

However, the two procedures presented above can be improved upon.

The temperature and processing profiles in wave and reflow soldering are two points where this could happen, so that almost the same quality could be achieved.

In spite of the limited experience in the field, in our opinion, the SnCuNi system offers definite advantages over the silver systems both in cost and quality.