



Impact of emissions from soldering processes on occupational workers' Health.

Different industries have for several years been subject to increasing legislative requirements towards the development of "Cleaning Technologies". This is the situation of electric and electronic industries and the imperative implementation of lead-free soldering processes. This change has been caused by the European Directive 2002/95/EC RoHS. According to it, the use of lead, mercury, hexavalent chromium, cadmium and others will be banned from next July 2006.

Although the main objective of the LEADOUT project is to provide technical support to the European electric and electronic SMEs during the removal and change of lead from the tin/lead solder used to join electronic components to the PCB, the principal reasons of this project should be taken into account:

- The importance of the potential environmental impact (the lead waste from the manufacturing process and the disposal of lead containing electronic equipments at the end-of-life could contaminate the landfills and subsequently, the Environment) and,
- The relevance of the social issues (it is mandatory the maintenance and preservation of the involved soldering process worker's health)

Removal of this source of contamination will have, therefore, a considerable positive impact in terms of quality of the working conditions and, also in the environment as a whole. Effectively, the threat to human health by lead accumulation in the body due to the occupational exposure is becoming a greater concern. The continuous inhalation of gases containing lead over limits causes chronic intoxication affecting mainly the Central Neuronal and Peripheral Neuronal Systems. Also anaemia and Renal and Cardiovascular problems can be produced.

Although, the use of lead in the electronic industry seems to be minimal, the contamination potential for lead exposure during soldering processes through the inhalation of lead vapours is the reason to perform generated emissions measurements. The aim is, therefore, to determine the emissions of hazardous substances susceptible of to be inhaled by the workers at the assembling companies that use tin-lead alloys and, after this, to make a comparison to the emissions from the industries that use lead-free solders.

With this aim and within the framework of the LEADOUT project, several measurements of the chemical agents emissions generated during the soldering process have been performed. Also, a further analysis and evaluation of its potential hazardous characteristics for the workers' health have been made. As it has been mentioned, at the moment, measurements at different companies participating in the LEADOUT project have been carried out. These enterprises used until now, tin-lead based pastes and solders. Once lead free processes (mainly wave and reflow) are implemented and running at the optimal conditions, measurements of emissions using lead-free solders will be done.

Research Centres participating in this LEADOUT Project are in close contact with different SMEs participating in the project and made the measurements during a habitual work-day. For this purpose, sampling pumps (see photos 1 and 2) are put on the own worker close to the breathing zone. The usual activity and the movement of worker at the soldering facility are allowed by the pump that gets samples of the breathed air by workers during the several tasks that they are making.



Photograph 1



Photograph 2

The organic compounds mainly from the fluxes (formaldehyde, isopropyl alcohol and methanol) and the lead vapours are picked-up by the personal pump during the different steps of the process (at reflow and wave soldering). The samples are analyzed at the laboratories of the research centres according to the corresponding standards NIOSH and the composition of the gaseous emissions inhaled by the worker during the soldering process is determined. In all cases, it has been demonstrated that the carried out measurements performed at facilities using tin-lead alloys have values under the levels allowed by the German normative TA LUFT as it can be seen in following table:

Company	Process	Type of flux	Isopropyl Alcohol (mg/m ³)		Formaldehyde (mg/m ³) ⁽¹⁾		Methanol (mg/m ³)		Pb (mg/m ³ N)	
			Measured Value	Limit values (TWA)	Measured Value	Limit values (TLV-C)	Measured Value	Limit values (TWA)	Measured Value	Limit values (TWA)
Assembler 1	Wave	Organic Flux	2.3	983	<0.3	0.12	< 3.0	266	<0.01	0.1
Assembler 2		Organic Flux	< 1.0		<0.3		< 3.0		<0.01	
Assembler 1	Reflow	Organic Flux	< 1.0		< 0.3		--		<0.002	
Assembler 2		Organic Flux	< 1.0		< 0.3		--		0.003	

NIOSH values. TLV-TWA: average for 8h/day, TLV-C: peak

(1) Used fluxes does not contain formaldehyde

Next measurements of the emissions at the same facilities when the change to lead-free solder has been made, will allow quantifying the change of those values after the conversion to lead-free soldering process. As the fluxes to be used with lead-free solder will be very similar to the ones used for present SnPb alloys, results of Occupational Exposure Measurements are expected very comparable.

If you are interested or you have a question about these measurements, do not hesitate to contact to:

Dr. Patricio Aguirre
paguirre@inasmets.es

Don't forget to see the webpage of the Project: www.leadoutproject.com