TUTORIAL & WORKSHOP PROGRAM SUMMARY

I. Life Cycle Assessment and Design for Environment: Useful Electronics Applications

The objectives of the tutorial are to introduce Life Cycle Assessment (LCA), illustrate its value by use of examples, describe recent developments worldwide, explore how LCA is useful for electronics designers, and describe how to develop in house applications. The target audience includes those new to LCA and experienced practitioners and users who would like an update on current trends and applications.

The tutorial will present an overview of LCA including methodology, dealing with myths and making LCA timely and cost effective. LCA case studies on mobile phones and the use phase of automotive electronics will demonstrate the utility of LCA. Tools available for design for environment can incorporate LCA profiles with disassembly, recyclability, toxicity and cost information.

LCA activities vary by geographies and worldwide developments in Japan, North America and Europe will be described, as well as activities by organizations such as SETAC/UNEP, ISO, etc.

Finally, the tutorial will cover application of LCA in the business environment as part of management strategies, who does it, and how are LCA results used for product development and marketing, as well as how companies can start to use LCA by building product life cycle awareness, mapping life cycle footprints of product systems, and initiating pilots.

Instructors

Harald Florin, **PE Group** – Mr. Harald Florin holds a Master of Chemical Engineering from University in Stuttgart. Since 1994 he was a research engineer at the IKP (Chair of Metals and Materials), University of Stuttgart. IKP has developed GaBi software www.gabi-software.com for LCA and LCE and provides one of the largest databases. Since 2000 he has been involved in the operative management of EP Product Engineering Ltd. a worldwide operating consulting company in the fields of Life Cycle Assessment (LCA), Life Cycle Engineering (LCE) and Design for Environment (DfE).

Harald Florin is with the PE Group, headquartered in Germany but with offices in Japan, USA and Canada. PE Product Engineering GmbH was founded in 1991 in Stuttgart Germany, and is one of the leading consulting companies in LCA, LCE, DfE and Green Supply Chain Management worldwide.

Andrea Russell, Five Winds International - Ms. Russell has specialized training and applied experience in Design for Environment, Life Cycle Assessment and Environmental Management Systems in Europe and North America. Other areas of applied expertise include Environmental Supply Chain Management, Corporate Benchmarking, Waste Minimization Plans, and Environmental Trade & Policy. She has prior work experience at General Motors as a Production Technician. As a

communicator and educator she has experience training individuals on LCA, related methods and their applications.

Ms. Russell is with Five Winds International, an international management consultancy providing business services to integrate product sustainability. Products cover manufactured equipment to financial products to professional services. Integrating means that we strive to embed product sustainability into the organization, fitting it into existing strategies, systems and management processes, to provide maximum business value. See www.fivewinds.com for more information.

II. Transition to Lead-Free Solder in Electronics

This tutorial will address the drivers, transition issues, general materials, assembly and equipment issues with lead-free electronics manufacturing. This session is intended for design, development, process engineers, technical managers and others with responsibilities for electronic processes and manufacturing.

Human health concerns over lead (Pb) toxicity have fueled a global trend towards creating a lead-free environment. Although Pb usage for electronics is only a small percentage of the total, it is estimated that consumer electronics constitute 40% of the Pb found in landfills. Market forces have emerged as the primary driver for the global electronics industry. Particularly in Southeast Asia electronics manufacturers are making aggressive investments in lead-free solutions and putting the necessary manufacturing capability and infrastructure in place. Since Pb-free/Pb reduction is now being driven primarily by market forces it is imperative to understand and anticipate customer requirements and the emergence of lead free products into the electronics market. The current published Pb-free/reduced time tables, roadmaps and niche products will be reviewed.

The Sn/Pb solder joint has gained paramount importance as the size of the solder joint has decreased with package and system miniaturization. With the trend towards lead reduction from electronic products, the industry is faced with a tremendous challenge to redesign its materials, assembly processes and manufacturing equipment in a relatively short time frame. The lead-free alloys under consideration have a melting temperature which is significantly higher than that of eutectic Sn/Pb solder material thereby resulting in higher processing temperatures. The material sets in use may not function equivalently at these elevated temperatures. This gives rise to significant assembly issues and concerns which may lead to sub standard product reliability. Along with the material and process changes, it may be necessary to reengineer assembly equipment to perform satisfactorily with new material sets.

In 1997, the National Center for Manufacturing Sciences (NCMS) Lead-Free Solder Project completed its four year program to identify and evaluate alternatives to eutectic tin-lead solder. Since 1997, research groups from the European Union and Japan, and, most recently, the NEMI Pb-Free Task Force in the US have looked at broader manufacturing and reliability issues in the implementation of lead-free solders including properties of lead-free solders and how they affect the processing/manufacturing

window and their reliability with specific applications. The basis for the original conclusions of the NCMS Project will be discussed, as will their extension based on data from these recent studies.

Instructors

Karl J. Puttlitz is a Senior Technical Staff Member with the IBM as the Program Manger of the Corporate Lead Elimination/Reduction Program. He has designed, developed and evaluated interconnections utilized in microelectronic packages since the early 1960s. He was instrumental in the development of IBM's ceramic ball and column grid array interconnection and rework technology. Karl received a Ph.D. in metallurgy from Michigan State University, has published numerous papers, and is created with over forty published inventions and patents.

Kathleen A. Stalter is a Senior Engineer in IBM's Microelectronics Division, East Fishkill, NY. Kathy is a key participant of IBM's Corporate Lead Elimination/Reduction core team. Previously Kathy managed OEM Systems in the Design, Applications and Engineering Dept. in Multi-Layer Ceramic Products. Prior to that she worked for 13 years in Interconnect Products developing new processes for flip-chip join and repair as well as second level (BGA,CGA) interconnection schemes. She has several publications, including an ISHM prized paper award, and 22 US patents in the area of interconnection and assembly. Kathleen received her B.S. degree in Materials Engineering from Rensselaer Polytechnic Institute in Troy, NY.

Mohammad Yunus is a packaging development engineer with the DSPS Package Development Group at Texas Instruments. Prior to that he worked as a research associate at Universal Instruments research consortiums conducting research in the area of lead-free solder materials, BGA/CSP assembly and reliability. He earned his undergraduate degree in Engineering Technology from the Birla Institute of Technology and Science, India and a Masters degree in Industrial Engineering from Binghamton University.

Carol Handwerker is the Chief of the Metallurgy Division at the National Institute of Standards and Technology in Gaithersburg, MD. Dr. Handwerker joined NIST in 1984 after graduating from MIT with Sc.D., S.M, and S.B. degrees in Materials Science and Engineering. At NIST she continues to be involved in lead-free solder research having served as the primary NIST representative to the NCMS Lead-Free Solder Project, and now serving on the NEMI Lead-Free Task Force.

III. International and Domestic Regulatory Product Requirements for the Electronic Sector

This tutorial will highlight the evolving domestic and international regulatory system that focuses on the environmental impacts posed by electronic products. The tutorial will examine categories of domestic and international product regulation that include design for environment requirements, chemical disclosure, and end-of-life recycling mandates. Mr. Hagen will present an overview of international and domestic legislative and regulatory developments, the industry representative will

provide perspective on how electronic manufacturers are managing these requirements, and Ms. Evans will highlight industry initiatives that are designed to help industry members navigate this very confusing maze of requlatory requirements.

Mr. Hoffman will review basic methods of handling and using regulations in the design of new products and will provide perspective on how electronic manufacturers are managing these requirements. Topics include where, how, and what information to collect. Ways to extract product requirements from the documents will be presented along with ways to present that data in an understandable way. Suggestions will be made on how to apply the collected requirements to products and set goals for product design. What to look at and for during a design review will be presented along with tools that can be used such as design checklists or software tools. Finally there will be a short discussion on product data requirements

Instructors

Paul Hagen is a Principal with Beveridge & Diamond practicing in the areas of U.S. and international environmental law. As the Chair of the Firm's International Environmental Practice Group, Mr. Hagen's practice includes counseling leading multinational corporations and U.S. trade associations on the negotiation and implementation of regional and global environmental agreements, with a particular emphasis on treaties impacting the chemicals, electronics and consumer products sectors. Mr. Hagen also advises clients on a wide range of environmental compliance and product stewardship matters in countries around the globe. Mr. Hagen is also an adjunct professor of law at the Washington College of Law at American University in Washington, D.C. where he teaches a course on environmental issues in international business. He has written on a number of domestic and international environmental law issues, including the Basel Convention, trade in genetically modified organisms, trade and the environment, the extraterritorial reach of U.S. environmental laws, and international controls on ship-generated marine pollution. He is a graduate of Providence College and the Washington College of Law at American University.

William (Bill) F. Hoffman III is currently leading Design for Environment programs within Motorola Advanced Technology Center, a part of Motorola Labs. Current projects include Design for Environment metrics system, Design for De-Manufacture and De-Manufacturing technology assessment. Bill is also a Co-Chairman of the Environmental Technology Steering Committee and Co-chairs the Environmental Session at the Motorola internal Advanced Manufacturing Technology Symposium. Bill is the Technical Activities Vice Chair of the Environmental Health and Safety Technical Committee of the Computer Society within the IEEE.He has a BS from Southern Illinois University and a Ph.D. from Illinois Institute of Technology.

Holly Evans is the Director of Environmental Programs and Deputy General Counsel for the Electronic Industries Alliance. Since January, Holly has represented the electronics industry on international, federal, and state environmental issues including take-back legislation, chemical bans, and voluntary design for the environment initiatives. Prior to joining EIA, Holly represented the printed circuit board and electronic assembly industry for four years on environmental, health, and safety issues. Holly received her law degree from the University of Connecticut School of Law, her master's in environmental science from the University of Michigan, and a master's in environmental

law from Vermont Law School. Holly's undergraduate degree in economics and political science is from Tufts University