C32 Measuring the Hygroscopic Capacity of Integrated Circuit Packages and Circuit Boards

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After attending this presentation, attendees will understand: (1) that integrated circuit packages (computer chips) and printed circuit boards have the capacity to absorb water they come in contact with; (2) the variables affecting the amount of water absorbed; and, (3) the implications of hygroscopic capacity when addressing electronic devices that have been exposed to or damaged by liquids.

This presentation will impact the forensic science community by providing results from direct methods experiments guided by extensive research in other science disciplines, but with little previous research applied to digital forensic science. This presentation seeks to broaden the understanding of the impact of liquid exposure to electronic devices by examining the effect on the two primary discreet parts of electronic devices.

The electronics manufacturing and assembly industry has well-defined standards regarding moisture sensitivity of electronic device components related to manufacturing and assembly of electronic devices.[1,2] These known industry standards have yet to be applied and inform the manner in which digital forensic scientists are addressing electronic devices exposed to or damaged by water or other liquids.

Significant risk exists to data stored within integrated circuit packages if specific steps are not followed when addressing electronic devices that have been exposed to water or other liquids. Liquid absorbed within the integrated circuit packages may turn into a vapor, creating damaging expansion within the chip if the device is exposed to heat.[3]

In this study, integrated circuit packages (computer chips) and printed circuit boards were exposed to a variety of liquids to understand the amount of liquid the discreet devices will absorb over a defined duration. The hygroscopic coefficient is the equilibrium when the maximum amount of liquid can be absorbed. This study sought to identify the time duration at which the hygroscopic coefficient is achieved on integrated circuit packages and printed circuit boards.

By understanding the amount of liquid absorbed in a given duration, the results may inform digital forensic science practitioners on the duration of drying that will be required to safely remove the absorbed liquid from the devices. Additionally, different liquid types (e.g., freshwater, salt water, and brackish water) may absorb at different rates, requiring different techniques based on the type of liquid exposure.

Testing for this study included the use of laboratory-grade water testing equipment and analytical balances to measure the impact of liquid and duration against the materials composition of the electronic devices.

The results of this study may impact the direction provided to Forensic Service Providers (FSP) and the practices used by FSPs when addressing evidence that has been exposed to or damaged by liquid.

Reference(s):

1. IPC/JEDEC Joint Industry Standard J-STD-020E. Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices. Northbrook, IL, 2014.
2. IPC/JEDEC Joint Industry Standard J-STD-033. Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices. Arlington, VA: JEDEC, 2014.
3. Chen, Yuan and Ping Li. The "popcorn effect" of plastic encapsulated microelectronic devices and the typical cases study. *2011 International Conference on Quality, Reliability, Risk, Maintenance, and Safety Engineering*. June 17-19, 2011. doi:10.1109/ICQR2MSE.2011.5976658.

Hygroscopic Capacity, Liquid Damage, Water Damage

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