Electrolytic Regeneration of Cupric Chloride Etchants

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The subtractive method of etching PCBs dissolves as much as 80% of the copper from the surfaces of the work. In the process, the active, oxidizing etchant is progressively converted to an inactive, reduced state until the solution is eventually rendered completely ineffective and must be discarded.

Cupric chloride is one of the more popular etching solutions, offering good etching characteristics and also lending itself to an automatic chemical-addition system that provides a steady etching rate and consistent product quality. Chemical replenishment, however, does not fulfill the parameters of complete etchant regeneration in that reoxidation of the inactive reduced etchant does not take place and dissolved copper remains in the spent solution.

Additions of strong oxidizing agents and acids are needed to convert the spent, inactive solution to active, oxidized etchant. The net result is the in situ manufacture of large volumes of excess etchant, which must accumulate before being freighted away for disposal at ever-increasing prices.

These inherent disadvantages have been eliminated with the development of an electrolytic regeneration cell by Finishing Services Ltd. (FSL) of Great Britain, a long-established supplier of conveyorized wet-processing equipment. The cell was developed in cooperation with the Electricity Council Research Centre of Great Britain, based in Capehurst, Chester.

The configuration of the cell is shown in Fig. 3. As etching occurs, the dissolution of copper into the etchant reduces the Redox potential, which triggers a power supply from the transformer/rectifier to the regeneration cell. In the anode compartment, electrolytic oxidation regenerates the inactive cuprous ions formed in the etching process, converting them to the active cupric valence state. Simultaneously, copper ions migrate through the dividing semipermeable membrane into the catholyte compartment, where the cop-

FIGURE 1: Pure copper metal, plated out in the Regeneration Cell in dendritic form, collects at the base of the cell.

FIGURE 2: Coupled to the rear of an etching machine, this model of the FSL Regeneration Cell plates out 13 lbh of metallic copper while holding etchant concentration constant.
per ions plate out on the cathode as elemental dendritic copper—a reaction occurring at the same rate as copper is being etched from the PCBs. An automatic scraper mechanism removes the copper from the cathodes and allows it to fall and collect at the base of the cell for removal at a convenient break in production.

Monitored by the Redox instrument, power from the transformer/rectifier continues to be supplied until sufficient solution oxidation and copper plate-out has occurred within the cell to yield an etching solution restored to peak condition. The Redox instrument then cuts off the power supply.

The operation of the FSL regeneration system for cupric chloride etchant results in a number of advantages over conventional replenishment methods:
- The electrolytic system is a complete regeneration process, providing a continuous supply of etchant in prime condition at all times.
- The metallic copper reclaimed in the process is of high purity and can be sold at market price, eliminating its status as a hazardous chemical.
- Since chemical oxidizing agents are not used in the regeneration process, the handling and storage of these hazardous materials are eliminated.
- No storage facilities for excess spent etchants are needed.
- Freight and disposal charges for spent solution disposal are eliminated.
- Only very small quantities of addition chemicals are needed to replenish dragout losses.
- The regeneration process is completely automatic and incorporates many safety features.

Regeneration Cells have been successfully used in maintaining acidic cupric chloride etching solutions in UK PCB shops for over a year. At GSPK Circuits in Yorkshire, the FSL/cupric chloride system replaced the alkaline etching system that had previously been used for etching panel-plated circuit boards.

The FSL Regeneration Cells are available in a number of sizes based on the hourly etch rate of the etching line. Cells can be fitted to any style of etching machine and, if necessary, can be installed in multiples to handle very high etching capacities.

Please direct inquiries to Allan McKinnon & Associates, Irving, TX.

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