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Improving Reliability - One Batch at a Time
by Michael Konrad. Aqueous Technologies

The decision to remove flux and other residues from post-reflowed circuit assemblies has been the subject of debate for years. While some assemblers are satisfied with leaving residues on assemblies, growing numbers of others have decided to implement or maintain a post-reflow cleaning program to remove flux from boards. Within fast-growing post-reflow cleaning circles, the debate of which technology to use has become a popular topic - namely batch or inline formats. Each technology possesses advantages and disadvantages, strengths and weaknesses.

Let's begin by identifying the two main automated flux-removal technologies: batch and inline formats. Batch-format de-fluxing systems have been around for decades. Batch-format cleaning systems clean one batch of boards at a time. Inline-format cleaning systems, like their batch counterparts, have been available for years. An inline-format de-fluxing system cleans boards on a conveyor using an inline process.

Inline cleaning systems represented conventional wisdom. The majority of automated de-fluxers on the market used an inline-format technology. This was logical as volumes were high, boards were less populated, chemicals were cheap, and environmental laws were less severe. Batch-format de-fluxers were little more than converted dishwashers, and normally were relegated to cleaning small volumes of non-critical assemblies.

Modern times have rewritten conventional wisdom. Today, batch-format de-fluxers represent the greatest market share in automated de-fluxing equipment. Batch-format de-fluxing systems are no longer the dishwashers of yesterday, but contain technologies that were not only unavailable on earlier models, but remain exclusive to batch de-fluxer formats.

Batch-format de-fluxing equipment provides several unique features not available on inline de-fluxing technologies. Batch-format de-fluxers can be equipped with real-time, cleanliness testing capabilities. Because a batch format de-fluxer provides independent control over wash, rinse, and dry functions, cleanliness testing can be performed after each rinse to ensure the absence of flux and wash chemicals from rinse water. If contamination is detected in the rinse water, additional rinse cycles are added automatically until cleanliness is achieved. Because inline de-fluxing technology is based on a constantly moving conveyor, it is not possible to detect contamination automatically and provide extra contact time in the rinse cycle. All boards, clean or contaminated, move through the inline wash, rinse, and dry process at the set conveyor speed until they reach the end of the conveyor.

On all inline-format de-fluxers, the ability to clean and dry assemblies effectively is based on contact time. Contact time is determined primarily by the speed of the conveyor and, secondarily, by conveyor length. Conveyor speed determines how long each board will be subject to wash, rinse, and dry functions. If a difficult-to-clean board requires extra time in the wash section, conveyor speed may be reduced. With reduced conveyor speed, the board not only spends more time in the wash section, but also spends more time in rinse and dry sections. If throughput is an issue, it may not be possible to reduce conveyor speed to meet cleaning requirements. In this case, a longer machine is required to allow increased conveyor speeds, while providing adequate contact time in each zone.

As a result of more complex, difficult-to-clean boards, inline-format de-fluxing machines have lengthened. Increased pump, heater, and blower ratings also have ballooned power consumptions to alarming levels. With

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average full-time annual operating costs peaking at $40,000 to $ 70,000, it is no wonder why batch-format de-fluxers have reemerged as a dominant technology.

Batch-format de-fluxers provide independent control over wash, rinse, and dry cycles, meaning that a difficult-to-clean board can receive additional wash time without affecting rinse and dry cycles. If the onboard cleanliness tester determines that there is still flux and wash chemistry on the boards, the cleaning system can add rinse cycles without impacting wash or dry times. A batch-format cleaner has a variable cycle time that allows constant cleaning results. Because batch-format de-fluxers control cleanliness results, many also offer statistical process control (SPC) data logging - a must for meeting ISO standards.

Because a batch machine expands or contracts its cycle times, rather than its footprint, to meet specific cleanliness requirements, the annual operation cost is significantly lower than an inline cleaner. Batchformat de-fluxers, in full-time use, maintain an average annual full-time operating cost of $3,000 to 4,000.

The downside of batch-format de-fluxers is throughput. Inline machines, with constantly moving conveyors, offer tremendous throughput capabilities. However, advances in batch-format de-fluxing technologies have provided increased throughput capabilities. Multi-chambered batch-format de-fluxing systems provide throughput capabilities that meet or exceed inline throughput while maintaining individual cleanliness control.

As the introduction of lead-free solder paste increases the emphasis on cleaning, and modern batchformat technology lowers the cost of cleaning, more companies are choosing to clean their assemblies, increasing reliability while reducing liability.

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