CHEMCUT
CORPORATION

Technical Information

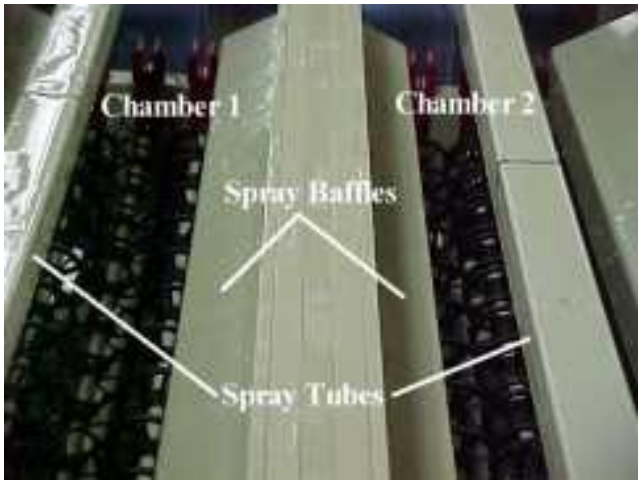
Cascade Rinse Effectiveness

There is no doubt that the most efficient way to rinse a circuit board panel after etching is through the use of multi-stage counter-current cascade rinses. By adding fresh water into the last stage of the rinse and letting it flow forward towards the first stage, against the flow of the work, we can get the maximum amount of rinsing with the least amount of water. In addition to cutting costs by using less water a cascade rinse will cut treatment costs since it is more cost effective to treat a low flow of water with a high concentration of copper than a high flow of water with a low concentration of copper.

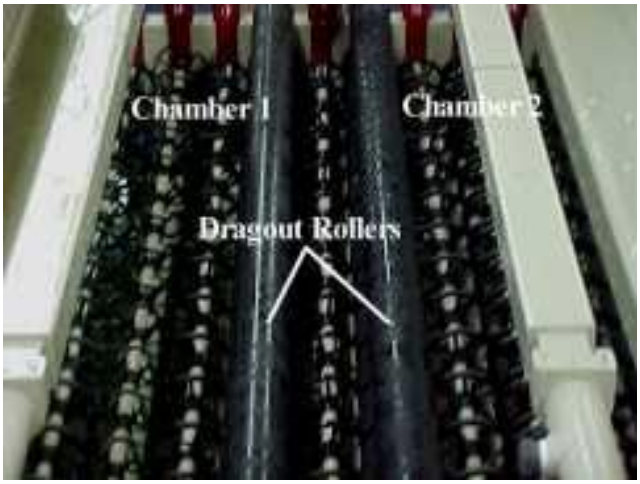
One thing that can greatly reduce the efficiency of a cascade rinse is cross-contamination from one rinse sump to the next. If solution can get from a higher concentration sump to a lower concentration sump by some means other than drag out on the panels to be rinsed then the effectiveness of the cascade rinse can be severely compromised. For best results the sumps should be completely isolated from one another so the only possible source of contamination is the solution carried out by the panel to be rinsed. This can be difficult to achieve since the sumps are usually spaced quite closely together to facilitate gravity flow from sump to sump and to save space. In this situation poorly designed drag out roller placement and baffling can lead to contamination of one stage to the next by the spray nozzles or by out of round rollers that can actually allow solution to flow along the board surface and into the next chamber when the board spans both chambers during the rinse process.

There are two ways to combat this problem. One is to use a little more space and well designed drag out rollers to provide better isolation between chambers and the other is to simply add more chambers to the cascade train in order to compensate for the overall inefficiency until the rinsing is satisfactory.

Chemcut has focused on the former solution, opting to improve the efficiency of the cascade rinse in order to reduce the number of pumps, motors and nozzles required to get good rinsing. The photograph below shows the transition between two of the sumps in a 4-stage cascade rinse with and without the spray baffles.



Chamber Transition with Spray Baffles in Place



Chamber Transition with Baffles removed

The spray baffles, shown in place on the left photograph, are designed to shield the upper and lower conveyor openings from the spray so the higher concentration solution from chamber 1 is not sprayed directly on the conveyor opening and into chamber 2. The baffles are removed in the right photograph to show that there are a pair of drag out prevention rollers between the two chambers to prevent solution flowing along the panel surface from one sump to the other. A single roller will not prevent this from happening.

In addition, the rollers are molded around a steel rod and then the molded material (TPN) is machined round. This method ensures the roller starts out round and straight and the embedded steel rod will keep it round and straight despite repeated heating and cooling cycles and chemistry exposure. The manufacturing tolerances are such that the straightness of the rollers do not deviate by more than 0.010" (0.25 mm) over the length of the roller.

Test Results

Two cascade rinse systems, a 3-stage rinse and a 4-stage rinse, were separately tested by placing each behind a cupric chloride etcher and etching typical signal/signal inner layers for several hours. Each rinse was filled with clean water and samples taken from each sump. The etch process was started and samples were taken from each sump every thirty minutes. At the end of three hours the etching was terminated and the final samples taken. The panels were 18" x 24" (460 mm x 610 mm), 10 mil (0.25 mm) fiberglass cores with 1 oz. (35 µm) copper. Conveyor speed for the single chamber etcher was 24 inches/minute (0.61 m/min.) and approximately 234 panels or 700 ft^2 (65 m^2) were passed through each of the rinses during the test period of three hours. The flow rate of fresh water into the last stage of each rinse was 10 gal./hr. (38 liters/hr.). The table below shows the copper concentration in each sump at the end of the three hour test period.

Copper Concentration in Each Rinse Stage after Three Hours and 700 ft^2 of Inner Layers

	Stage 1	Stage 2	Stage 3	Stage 4
3 Stage Cascade	6620 mg/l	117 mg/l	0.68 mg/l	NA
4 Stage Cascade	6960 mg/l	118 mg/l	0.65 mg/l	0.64 mg/l

The test results show that the extra space used for spray baffles and extra drag out rollers to isolate the cascade rinse sumps from each other was well worth the effort. The rinsing is essentially complete by the time the panels exit the second stage with the third stage serving as the final clean up. The fourth stage in the 4-stage rinse doesn't do any more rinsing but does serve as extra insurance to be sure beyond any doubt that the panel is rinsed clean.

Conclusion

Chemcut offers 2-, 3-, and 4-stage cascade rinses to cover most process situations. **With an efficient design and well isolated sumps any number of cascade stages beyond four are only adding additional expense in terms of operating cost and initial purchase price for little, if any, gain in rinse effectiveness**.