Troubleshooting Zinc Electroplating Baths In the Laboratory

By Richard E. Painter, CEF

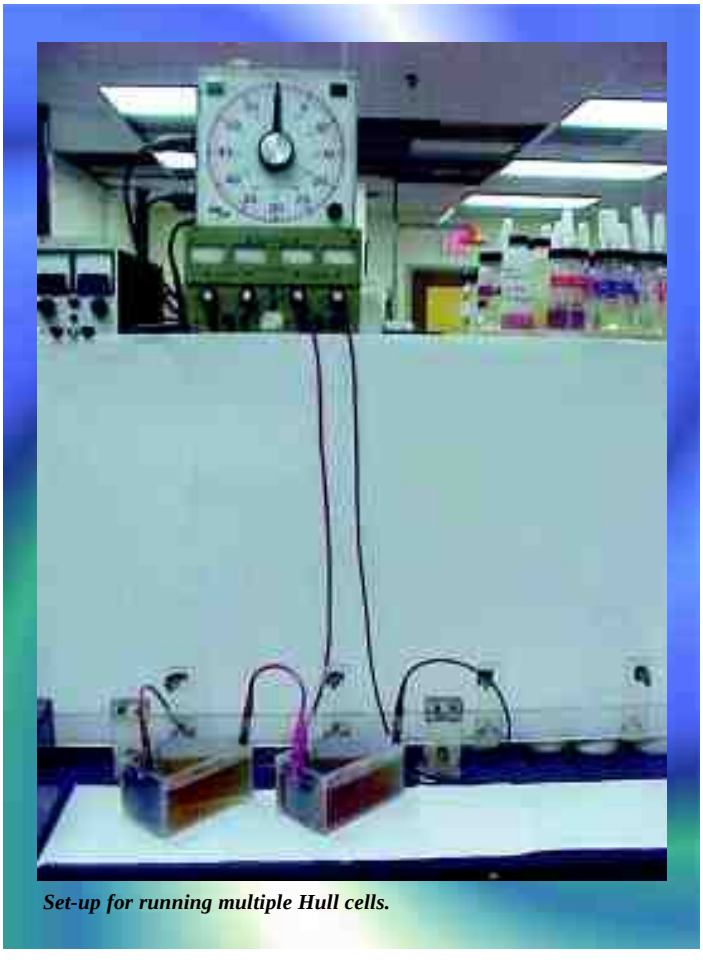
When things go wrong on a zinc electroplating line, quick solutions can save thousands of dollars. If the answer is not pre- or post-treatment, the laboratory is the place to troubleshoot the plating bath. A quick analysis and a few Hull cells may be all it takes to put the operation back on its feet. This paper deals with the investigative process in the laboratory.

First Things

Experience is by far the most valuable tool a troubleshooter can possess. So, successful troubleshooting begins when the line is at its best. Build experience by walking the line when everything is running smoothly. Take note of solution color, smells, gage settings, etc. Intimate knowledge of your plating line and its idiosyncrasies will expedite the solution to future problems. If a problem has developed, you must walk the line looking at temperature gages, current, anode baskets, pumps, etc.

You must rule out the cleaning section of the line and the post-plate section of the line. These steps may take some time, but they must be done. Ninety-five percent of plating problems have nothing to do with the plating bath.

Occasionally, however, a problem develops that persists despite experience.



Set-up for running multiple Hull cells.

Into the Lab

Once the problem has been determined to be a result of the plating solution or the material being coated, the troubleshooting should be done in the laboratory.

Before starting a laboratory investigation, ship samples of the plating bath and reject work to your supplier. Suppliers often have sophisticated labs with experienced people. Follow up with a phone call to your supplier. Speak directly with a technical service representative and discuss your problem and investigation.

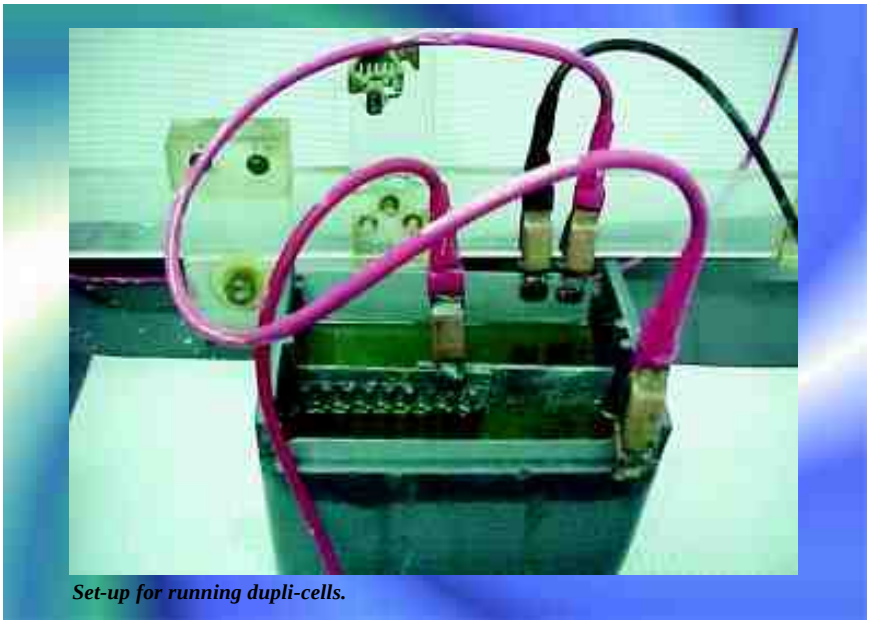
Once in the laboratory, define the condition of the bath with a routine analysis and a routine Hull cell. Correct any chemistry problems found by the routine analysis.

The routine Hull cell should be one you're used to looking at. Suggested conditions for a routine panel are:

1. A two-A, five-min, unagitated panel for acid zinc.
2. A one-A, 10-min, agitated panel for alkaline zinc.

Compare the routine Hull cell panel to ones from when the problem was not present. Measure thicknesses across the panel and again compare them to past Hull cell panels.

If the routine Hull cell panel appears normal, chances are the



Set-up for running dupli-cells.

problem lies outside the plating bath. Re-walk the line and review your observations. Pay particular attention to the electrical portion of the plating bath, because poor electrical connections will make the plating bath appear to be at fault. Investigate the material of the parts exhibiting the problem. Again, material problems will not manifest themselves in the lab.

If you are still convinced that the plating bath is the source of the problem, continue with the lab investigation. The next step is to use a Hull cell to generate the problem. Make sure the conditions and time that all Hull cells were run are clearly marked on the resulting panel. Vary the conditions in the Hull cell to give yourself the best opportunity to produce the problem. Some variations, which may prove useful, are:

1. Panels run at low amperage.
2. Panels run at high amperage.
3. Bent panels to create a shelf area.
4. Bent panels to create an extreme low-current-density area.
5. Panels run at a high temperature.
6. Panels run for 30 min, then scribed with an exacto knife (to reproduce blistering).

Knowing how your bath appears when operating normally will make the interpretation of these Hull cells easier. Once the problem has been produced, we can proceed to the next step.

Target Identified

With the ability to produce the problem, one now needs to know how to remove it. The problem probably will fall into one of several broad categories:

1. Organic contamination.
2. Metallic contamination.
3. Poor filtration.
4. Imbalance of proprietary chemicals.
5. Unknown.

With an unlimited supply of solution, take the opportunity to begin multiple treatments. After each of the following treatments, rerun the Hull cell test that produced the problem.

First, for organic contamination, treat 300 mL of solution with two grams of activated carbon. Mix the solution continuously for at least 30 min, then filter and run the Hull cell.

Second, for metallic contamination, treat 300 mL of solution with one-half gram of zinc dust. Again, mix the solution continuously for at least thirty min, then filter and run the Hull cell.

Third, filter the solution thoroughly. The solution must be clear after this step. Use a filter aid if necessary.

Fourth, if the solution is an acid bath, metallic or organic contamination may be affected by adding one-tenth of a gram of potassium permanganate to 300 milliliters and mix the solution for five min. Filter thoroughly and run the Hull cell.

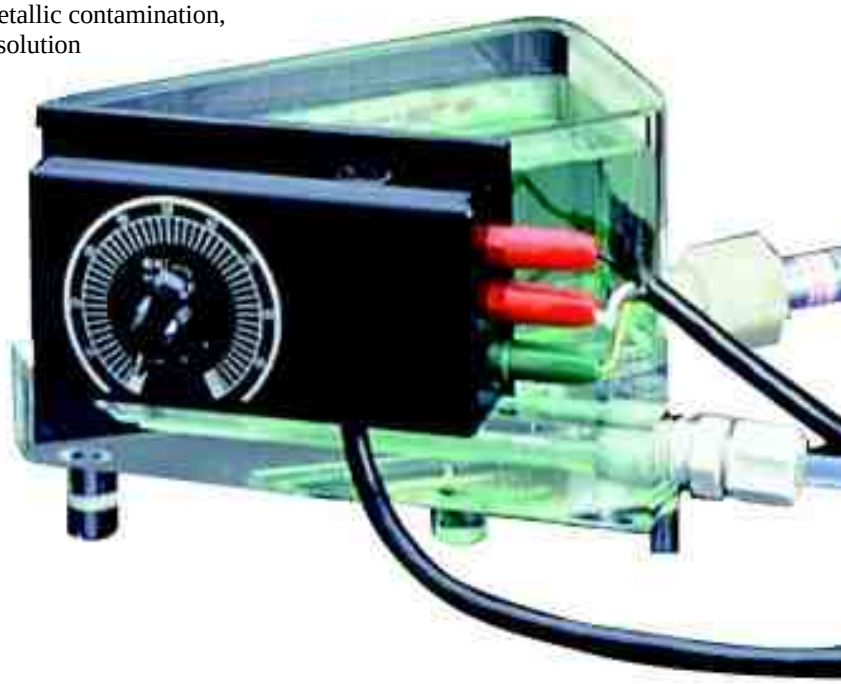
For an alkaline solution, freeze out carbonates by putting 300 mL in a lab refrigerator. Cool the solution to 30°F for 15 min. Decant the solution, raise the temperature, and run the Hull cell test. If one of these treatments affects the problem, you may be well on your way to solving it. Don't be too fast to give yourself a pat on the back. You now must translate the lab results to the production line.

You must also locate and eliminate the source of the contamination. The quick results in the lab may take a couple of days to accomplish in production, but don't give up. Plug away until the job is finished.

Unknown

If the above treatments did nothing to affect the problem, things just got a lot tougher. Get on the phone to your supplier and ask for assistance on-sight. Review their analysis of the bath. Is the bath low on carrier, high in brightener, out of balance, etc? Many suppliers have "doctor" solutions. By comparing notes, your supplier will be able to send in a new arsenal of weapons, along with technical assistance.

Meanwhile, there are still a few Hull cells to run.



For an alkaline bath try:
1. Adding 1% sodium hypochlorite to the Hull cell.
2. Adding one-half ounce per gallon of EDTA or Rochelle salts.
3. Diluting the bath by 25% with "virgin" solution.

For an acid bath try:
1. Heating the bath above the cloud point, then carbon treat.
2. Reducing the pH of the solution with 50% hydrochloric acid to kick out most organics. Usually a pH of 2.5 is sufficient. Filter the bath, raise the pH, and add carrier.
3. Diluting the bath by 25% with "virgin" solution.

Out of all these tests, something you can build on should have emerged. If not, you are into the rare problem, which falls into the "unknown" classification. This type of problem will take time and effort to resolve.

Calling in electricians, sending samples to outside laboratories, etc., are examples of the steps that may be necessary to solve the problem. In this case, the economics of dumping the bath and making a new one must also be considered.

Troubleshooting Basics

Troubleshooting a zinc-electroplating bath will be much easier if one takes the time to observe the line when things are running well. When a problem develops, split the line into a pre-cleaning section, the plating bath, and a post-plate section. Run tests to isolate the problem to one of the three sections. When the plating bath is identified, follow these steps:

1. Send samples and reject parts to your supplier.
2. Use the Hull cell tests outlined here to treat the problem. (Remember, even if you can treat the problem, you will also have to eliminate the source of the problem.)
3. Demand prompt service from your supplier.
4. Label or identify all tests run during the troubleshooting process.

Once the problem is solved, review the troubleshooting process and learn from it. This will improve your troubleshooting skills and shorten the duration of future problems. P&SF

About the Author

Rick Painter, CEF, has more than 20 years' experience in the electroplating field, the past 10 years with Pavco, 4450 Cranwood Parkway, Warrensville Heights, OH 44128. At Pavco, he manages the service laboratory, lends technical assistance to production, provides customer service, and is involved in the research of cleaning systems and non-metallic conversion coatings. He has published several papers, and speaks frequently at AESF branches, regionals, and SUR/FIN® technical conferences. He holds a BS in chemical engineering from Cleveland State University.