Interpretation of Hull Cells, How & Why

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The Hull Cell has been around since 1939. It has stood the test of time and is still one of the most recognized tools for measuring a metal finishing bath chemistry—old and new. One of the first questions asked, whether it is in the context of troubleshooting, process evaluation, process development, process modification, or new process, is "What does a Hull Cell look like?" Some of the "hows" &"whys" are the subject of this presentation.

If this is your first introduction to the use of the Hull Cell, I would suggest to you that AESF has an updated diskette of the Hull Cell Lecture that goes into details involved in the mechanics, typical and specific processes, and troubleshooting for the more commonly used processes. This an excellent tool to have in your arsenal for present and future employees.

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WHY

Starting with the "WHY" of this presentation.—If we don't have a reason why, there is no reason to expect you to want to know "HOW."

With the Hull Cell, we have a tool that will allow us to utilize our senses and, through logical application, our mind in the friendly art of interpretation. For example:

SENSES

Touch: Does a panel have roughness? Roughness on shelf areas or all over the panel?

Smell: Are there excessive fumes from gassing? Gassing in the high or low current density areas of the panel?

Sight: Brightness or lack thereof? Uniform color? Blistering? Skip plate? Leveling?

Hearing: Does your bench rectifier have a different sound part way through the panel plating cycle?

First and foremost, you must have the chemical analysis of that particular bath.

Secondly, you must duplicate the conditions that are on that process line if you are troubleshooting a problem!

Back to more whys:

Whether we are using the Hull Cell for an existing or new process, we can obtain many of the physical and mechanical properties of the bath in question.

Physical & Mechanical Properties

Temperature—Modification effects.

Agitation—Needed? Air or mechanical? Work movement or solution movement? What is too much or not enough?

Adhesion— To different substrates? Stress (bend test), thickness limits (deposit from deposit).

Leveling Properties—High current density areas versus low current density areas?

Covering Power?

Throwing Power?—Yes, they are different. (We will talk about that under the how.)

Skip plate.

Blistering.

Things that affect the deposit properties & applications

Additives—Too much? Too little?

Chemical balance & operating parameters.

Impurities.

Carbon treatment.

Filtration.

Voltage & ampere limitations.

Comparison of the old versus the new improved product.

Slide-in conversion?

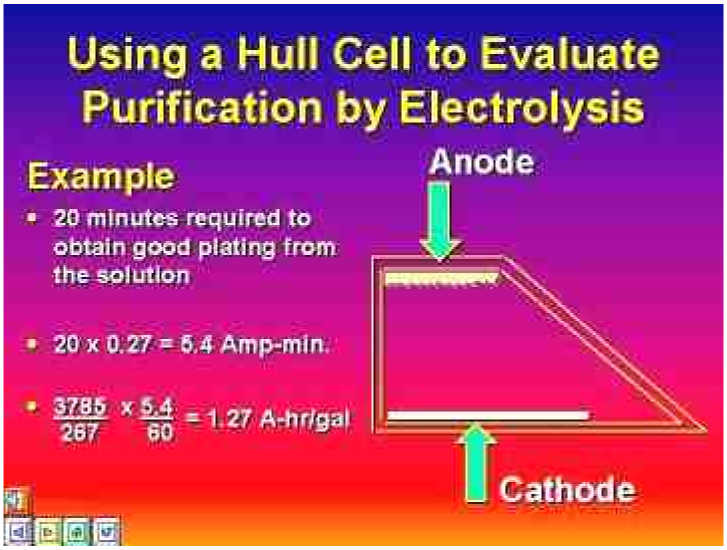
Pre- and post-treatment compatibility.

Interrupted and/or the many variations of rectifier manipulation (pulse current, pulse reverse current and all sorts of combinations thereof.

Overlooked areas

Electropolish—A quick check for bath balance.

Electropurification (dummying)—The exact time/current to remove.



Drag-in, Drag-out.

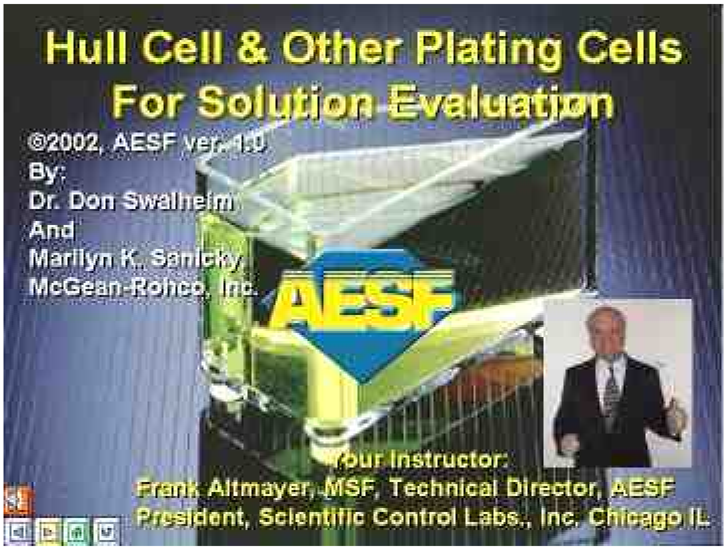
Waste Treatment

Contaminants.

Level of Iron in Zn/Fe Alloy (non-chromate black).

HOW?.

Start with the tool itself—Varieties in size.

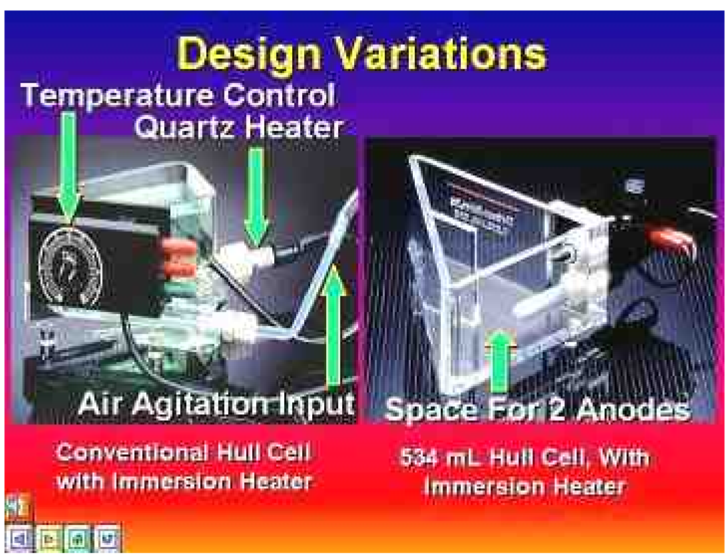


Size 267 mL Hull Cell—2 g/267 = 1 oz/gal. Also 2 mL/267 = 0.96 oz/gal.
<u>(This is not an accident, it was planned that way</u>!)

Size 534 is double 267 Hull Cell. With a chemistry that is critical, you can run twice as many panels before staring over.

Size 1000mL—7.5 g =1 oz/gal and 7.8mL = 1 fl.oz/gal

THE Cell itself: Design



Agitation?

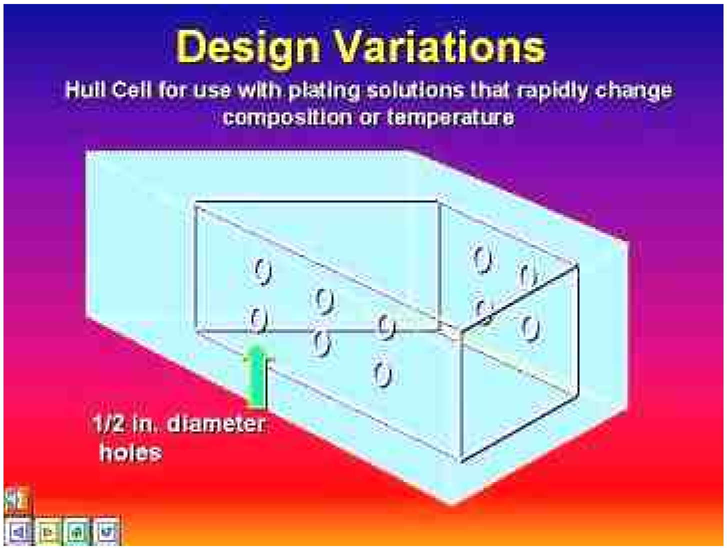
Mechanical? Via glass rod manual or automatic with a specific, adjustable-agitator.

Air?

Solution pumping?

Heat? From a hot plate, hot water bath, or immersion heater.

Cell with holes (for large-volume work).



Porcelain (for chrome baths).

The Panel.

Shelf roughness.

*Adhesion—B*rass or steel, or nickel, or stainless .

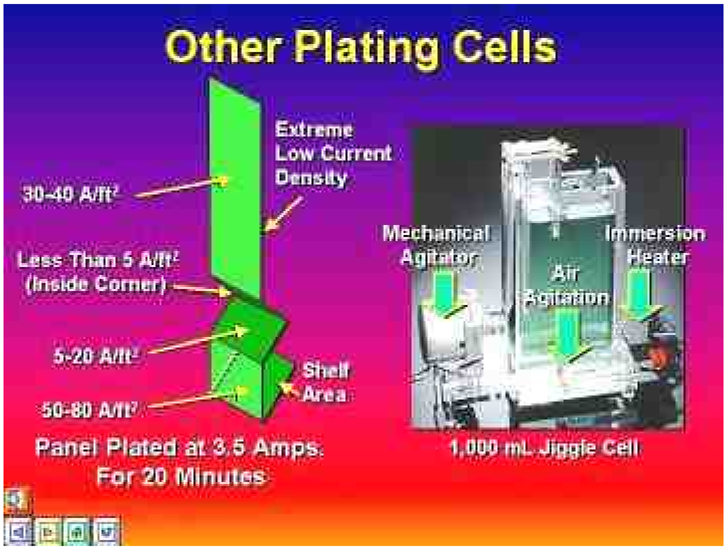
Ductility

Power.

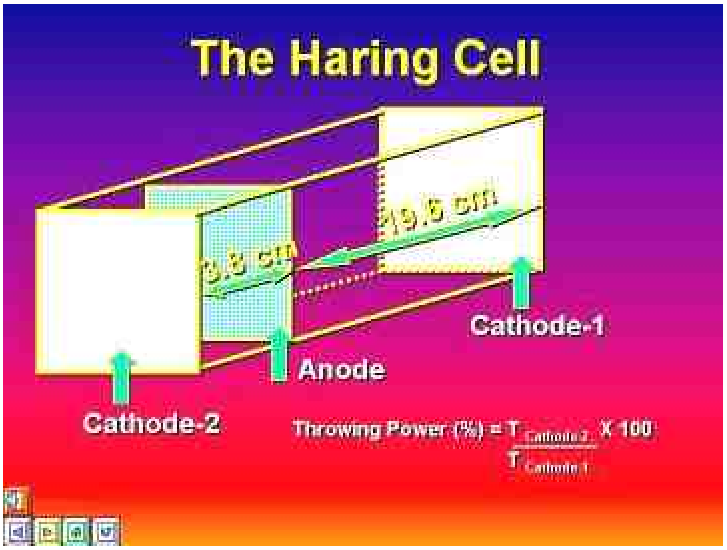
Efficiency 0.2, 1, 2, 3, 5, A for 20, 10 or 5 min.

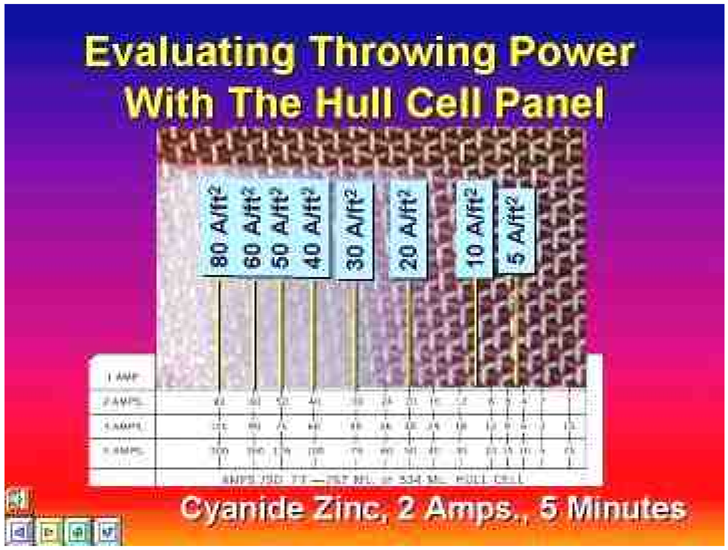
Leveling

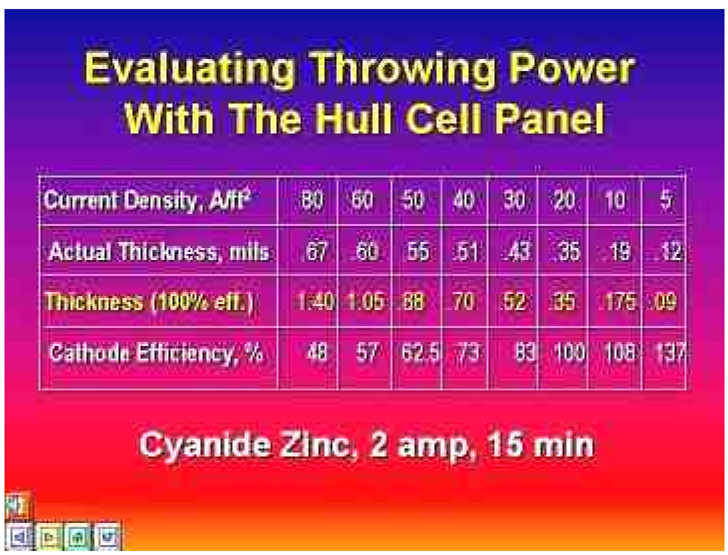
Covering power.



Throwing power. The Haring Cell.



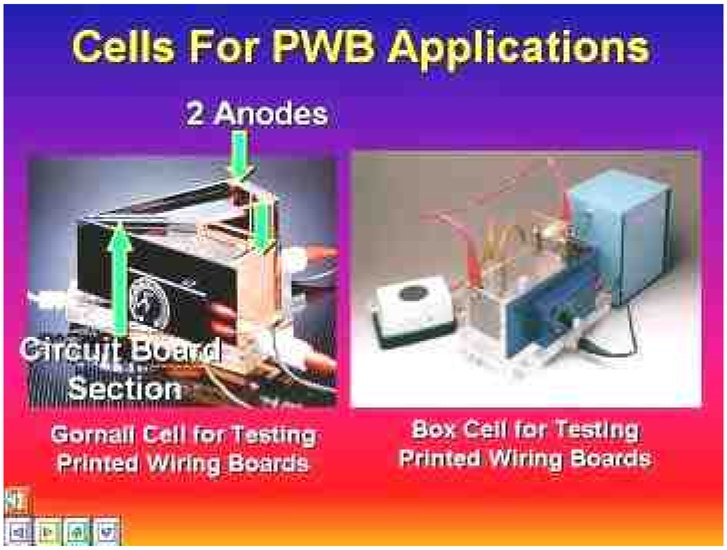




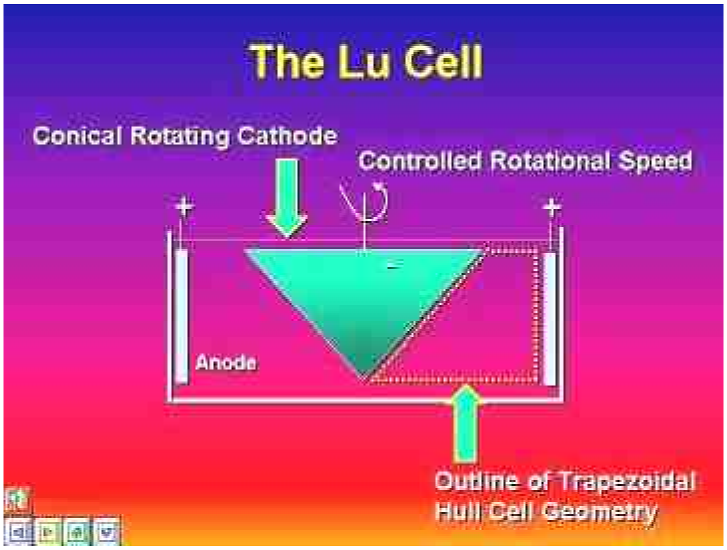
Adhesion test Bic

Special Applications.

Gornall Cell



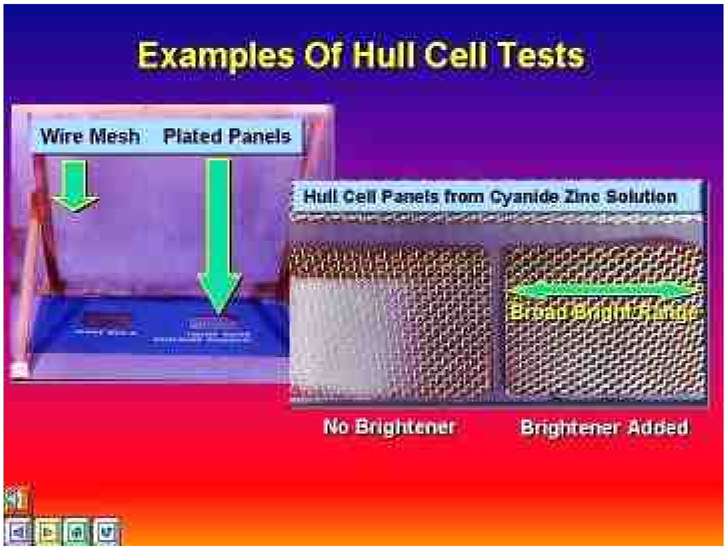
Lu Cell



Hanging Hull Cell

Preventative Maintenance

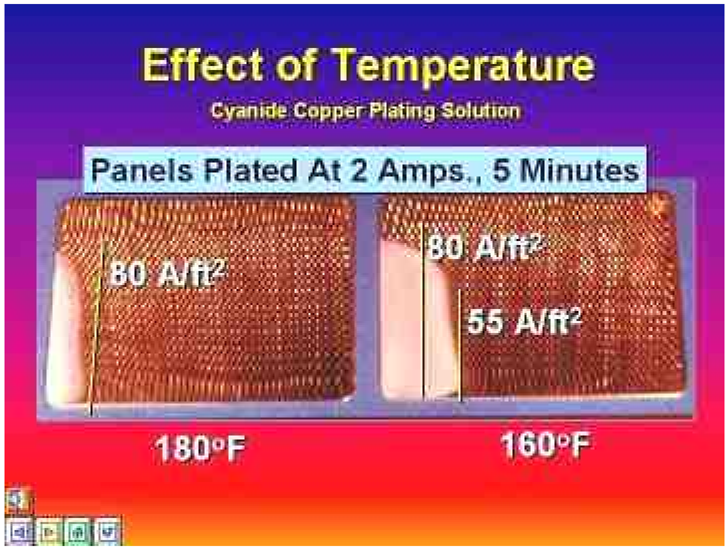
Build a history

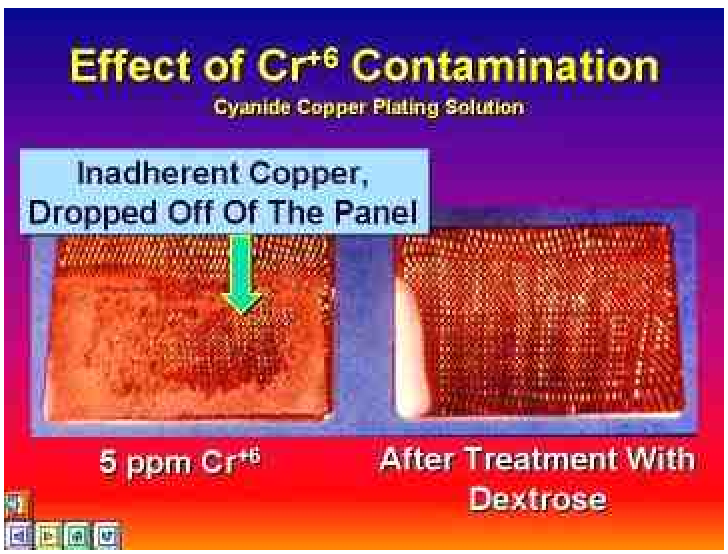



Lead Contamination
(Cyanide Zinc Solution)
Panels Plated At 2 Amps., 5 Minutes
75 ppm Lead Contamination
After Adding 0.75 g/L Na_2S_x


Total Cyanide/Zinc Ratio
(Zinc Plating Solutions)
Panels Plated At 2 Amps., 5 Minutes
Dull Deposit
$NaCN^T/Zn = 2.75$
$CN^T/Zn = 1.3$


Comparing Parts To Hull Cell Tests
Dull Plate
Dull Plate
Cloudy Deposit in LCD Caused by Sulfur Leaching From (new) Hard Rubber Liner in Potassium Chloride Acid Zinc Solution


Effect of Temperature
Cyanide Copper Plating Solution
Panels Plated At 2 Amps., 5 Minutes
80 A/ft²
80 A/ft²
55 A/ft²
180°F
160°F


Effect of Cr+6 Contamination
Cyanide Copper Plating Solution
Inadherent Copper, Dropped Off Of The Panel
5 ppm Cr+6
After Treatment With Dextrose

