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Frequently Asked Questions
Current Monitor System

1. Why Measure Anode Cell Current?

In e-coat, adequate paint film build occurs only when there is sufficient electrical current flow. In a typical system, 35 coulombs (one coulomb = one amp for one second) are required to deposit one gram of paint. Deviations in the data can point to problems affecting overall system performance, which can then be monitored or corrected.

2. What Amp Measurements Will Tell You?

Amp draw data can help identify a problem with an individual cell. Under normal conditions, all cells in a hoist system pull similar amounts of current. Monorail systems show an expected deviation between the first and last cell's current draw (usually highest and lowest, respectively). By collecting amp draw data for each cell in either of these systems an operator is able to notice any unexpected or significant differences in a single cell's performance over time. Finding a cell that pulls very little or no current, the operator can inspect for any of several conditions: a loose electrical connection, broken wire, low or no anolyte, or a fouled membrane.

Of course, it is necessary to account for other tank chemistry variables that may affect the day-to-day current readings. These include, but not limited to: voltage, conductivity of the anolyte and paint, bath temperature, rack load, and line speed.

3. What is Ohm’s Law?

For a DC (Direct Current) circuit application, the voltage (V) is proportional to the product of current (I) times resistance (R) and is written as follows: V=I x R. In a practical sense this means that if the voltage is constant (i.e. voltage set point on the rectifier does not change), as resistance increases than current will have to decrease. This will result in less ED film thickness.

4. What happens when higher than normal current flows through a ME Cell?

Normal current is defined as something equal to or less than 50 amps/sq meter (~5 amps/ft²). So if a Membrane Electrode Cell has 1 Sq meter (~10/ft²) of Electrode surface area, its normal current is 50 amps or less. At higher than normal current densities, the electrodes will deteriorate more rapidly and the electrical resistance of the membrane will increase at a faster rate.

5. What if I group several ME Cells together and measure the total current to this small group?

If several Cells are measured as a group, then it is likely that if one Cell in the group weakens (i.e. has lower current flow), then the others in the group will pick up the load caused by the weak Cell in the group. As a result there may be little or no change to the readout. At some point, the other Cells will not be able to carry the load thrown off by the increasingly weakened Cell. In this situation you will begin to notice a decline. The benefit to grouping Cells is a reduction in the initial capital cost. The resulting trade off is the lost accuracy and the reduction in fault tolerance provided by a Current Monitor System in the first place.

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6. What is ME Cell Current Density?

Current density is defined as the total current flowing through the Membrane Electrode Cell divided by the total effective surface area of the Electrode.

7. What is a typical "design" ME Cell Current density?

Typically the owner of a high painted through-put ED system will design the ME Cells so the design current density is about 30 amps/Sq meter (~3 amps/ft²). This provides for fault tolerance and if some of the ME Cells fail to function, the remaining Cells would not be forced to operate above normal levels. Sometimes, mostly due to capital spending constraints, the "design" current density is closer to 50 amps/m² (~amps/ft). In this situation, there is little or no fault tolerance and the owner must be prepared to replace non-operating Cells quickly to reduce the load on the remaining Cells.

8. What is the expected life of an ME Cell at normal current densities?

On the low end it can be 2 or 3 years in some cases, the lifetime is as long as 10 years, or longer. An ME Cell's life-end is defined when the Electrode mass is mostly gone (i.e. more than 80% lost) and/or the resistance of the ME Cell is increased so the voltage drop across the Cell is now 80-100 volts.

9. Why is my design current density higher than normal?

In some situations with complicated ware packages, it my not be possible to fit in all the required ME Cells. In these situations, different more inert Electrodes materials are typically specified to extend the operating lifetime. These inert anodes are also called precious metal anodes and tend to have longer lifetimes than 316L stainless steel.

10. Why is the current density of my first ME Cell more than normal?

In most situations the first ME Cell in a monorail type ED system will operate at a very high level. In some cases the current density for this first Cell is as much as 100 amps/m² (~

11. Will Amp Measurements Tell Me Everything?

Amp draw data will not reliably indicate how much electrode material is left. Whether made of 316L Stainless Steel or an inert material, an electrode can sustain 20 amps/SF as easily as 5 amps/SF. Obviously, an electrode will be able to perform longer at the lower current density. Most likely, the cell will show the same, or similar, amp draw measurements right up to the point when the electrode completely dissolves – at which time the current will drop to zero. In some cases, a sudden, significant drop in current flow may provide warning of impending electrode failure.

12. How to Take Amp Measurements?

Generally, the rectifier has voltage and amp meters that measure current flow for the anode cell system as a whole. This unit, however, will not reveal anything about individual cell performance.

There are four methods to measure amp draw in individual cells: direct reading ammeter, hand held clamp-on ammeter, shunt-rated ammeter and data acquisition system.

13. What is a Direct Reading Ammeter?

Thought to be inexpensive, this ammeter has several drawbacks. For example, appropriate cabling is relatively expensive. Because it receives the same voltage and current as the cells, it must be kept behind a protective enclosure. Moreover, it is usually not designed to work in a paint environment.

14. What is a Clamp on Ammeter?

This is a measuring device used by electricians to quickly estimate how much DC current is going through a cable. The device actually measures the AC ripple in the DC cable and makes an estimate of the amplitude of the DC current flowing in the cable. A qualified electrician should only use this device.

15. What is a Shunt rated Ammeter?

Like the direct reading ammeter, it too will show electric current (amps) flowing through a cable. However, this one can be mounted farther away. The ammeter accepts low voltage differential signals that are proportional to the actual current flowing in the cable. The low voltage signal usually comes from a DC shunt. The DC shunt is connected in series with the load. It has a precision resistor (usually something like 0.001 Ohm) that the current must flow through. The low voltage signal is generated across this precision resistor can be scaled into the real current.