

TECHNICAL REFERENCE

TOPIC: EROSION OF STAINLESS STEEL ELECTRODES IN E-COAT PAINTING

The 316L stainless steel electrodes used in cathodic electrocoat painting are sacrificial. The electro-chemical processes taking place will eventually cause them to erode because the electrical potential needed to form iron oxides is less than the potential required for water dialysis. As electrical current flows from the electrode, oxygen gas and hydrogen ions are created. The rate of electrophoresis is proportional to the amount of electrical current flowing.



Anode erosion is primarily due to oxygen (and other gases) being created at the surface of the anode. This is supported by field experience showing that erosion rates increase with increasing current density (amp/ft²).



WHAT IS "NORMAL" EROSION AND CURRENT DENSITY?

UFS_C recommends a current density of 55 amps per square meter (5 amps/ft²) or less. (Refer to Bulletin 991004 to calculate the anode area necessary to maintain our recommended current density.) Tests show that at current densities less than 55 amps per square meter (5 amps/ft²), 316 stainless steel anode erosion rates are less than 10 mils per year (MPY), based on 4,000 to 5,000 hours usage per year. At greater than 100 amps per square meter (10 amps/ft²), life expectancy begins to fall rapidly. If end-users find they are drawing 100 amps per square meter (10 amps/ft²), they should increase anode area.



Routine measurements of anode diameter and/or weight will help predict when anodes need to be replaced. Replacement is recommended when 60% of the original anode volume is gone.

CURRENT DENSITY WITH FLOOR OR ROOF ELECTRODES

When using floor or roof anodes in auto body tanks, be sure to monitor their amp draw independently of the side cells. There may be ample side anode area, but the electrical current will follow the path of least resistance (shorter distance) to the roof or floor cells. Therefore, these cells may have higher current densities that will lead to rapid erosion and shorter life.

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EROSION vs. CORROSION

While erosion is gradual, corrosion is a very rapid process that can destroy anodes in a matter of weeks or months. In our experience, corrosion is often accompanied by the presence of undesirable anions (such as chlorine) in the paint or anolyte system. These contaminants can enter the system through the process water, or by direct accidental introduction of a contaminant to the paint or anolyte system. Corrosion is characterized by catastrophic pitting or selective attack of the anode.

If the end-user is operating at less than 110 amps per square meter (5 amps/ft²) and experiences abnormal erosion or corrosion, look for the following:

- Anions that act as accelerators. These can originate in the paint, D.I. water, or pretreatment carry-over.
- A cut or tear in the membrane, or other breakdown, that may allow undesirable anion species to enter the anolyte circuit.
- Blockage in the anolyte supply, preventing proper cooling and flushing of the electrode.
- High anolyte conductivity. Many times destructive anions can be flushed from the tank by lowering the conductivity.

For more information, call UFSc at 219-464-2027 ext. 28.

