Avivid
Water Technology, LLC

Avivid's Vision:
Abundant clean water for communities, businesses, and the natural world.

ELECTROCOAGULATION UNLOCKED

Problems

Electrocoagulation (EC) has been demonstrated to be an effective way to remove many contaminants from water. While it does not desalinate, it is most effective for cleaning water that has a high salinity content. Despite its demonstrated effectiveness, developing a reliable, low maintenance reactor with sufficient water processing volume has proven to be a significant engineering challenge.

Avivid's TurboCoag™ reactor has overcome the fundamental limitations of EC to allow the operation of a reliable high-volume reactor.

1. Electrocoagulation uses a high current through the anode to dissolve the anode metal directly into the water. It is this dissolved metal that **replaces standard coagulating chemicals**. As the current flows through the anode, oxidation of the anode occurs. This oxidation (passivation) becomes an insulating layer in only a few hours which prevents further dissolution of the anode. In addition to limiting the operating time, this oxide layer is very difficult and expensive to remove. **TurboCoag™ solves the anode passivation problem** by rotating the flat plate anodes, which technically makes the reactor a Tesla pump. Although the water flow through the reactor may only be tens of gallons per minute, the water moves internally at several hundreds of gallons per minute. Due to the cathode spacing arrangement, this water is recirculated internally multiple times. This circulates the water fast enough to carry a very light load of a proprietary abrasive. This abrasive removes the passivation before it can form. This action does not appear to contribute to the dissolution of the anode as this still appears to dissolve at the rate predicted by the amount of current into the anodes. The abrasive also appears to keep the cathodes clean without eroding them.

2. The second major problem is leaving the water in the reactor long enough that the correct amount of metal is dissolved into the water. In a typical flat plate reactor this requirement frequently results in dramatic buildup of waste contaminants within the reactor itself, which also creates significant operational and cleaning problems. With TurboCoag™ internal flow rate and exposure times are controlled independently. The internal **high rate of water flow prevents sludge buildup** within the reactor. Consequently, this reactor can handle much higher levels of suspended solids.

   Note: fundamentally the TurboCoag™ reactor is a very good Tesla pump. While a Tesla pump is not as efficient as some impeller pumps, it is excellent for heavy fluids. The major use for Tesla pumps today is for pumping concrete: flat plates tend to stay clean or are easy to clean.

3. Sludge buildup and passivation are the main reasons EC has had such limited application to date. Hundreds of scientific papers describe the value, but for oil and gas applications the following image

sums it up:

Treating water 'just enough' for reuse

#	Treatment	Reusable?	Cost (Multiples of 1)	Waste (Multiples of 1)
1	Filtration	✓	1.0	1.0
2	Chemical Clarification 1	×	0.5	1.0
3	Chemical Clarification 2	✓	1.3	2.0
4	Chemical Clarification 3	×	0.3	0.6
5	ClO2	×	0.5	0.6
6	ClO2 and filtration	✓	1.5	1.0
7	Electrocoagulation	✓	0.85	0.4

BAKER HUGHES

This slide was captured from a Baker Hughes website which discussed the advantages of EC vs chemicals, outlining potential cost advantages, and large waste disposal advantages. What it does not point out is that EC is also a **biocide** due to OH- radicals produced at the cathode.

Note: Electrocoagulation information is no longer available on the Baker Hughes website. Halliburton only discusses electrocoagulation for offshore applications which is an excellent application since the clean brine can be discharged to the ocean and the reduced volume of sludge can be transported back to land.