CLAIMS

We claim:

1. An electrocoagulation reactor (ECR) apparatus for treatment of a fluid stream, comprising:

(A) an electrode packing frame, wherein the electrode packing frame comprises:

(i) a pair of opposing inserts, wherein each of the inserts comprises a plurality of insert openings; and

(ii) an electrode stack, wherein the electrode stack comprises a plurality of electrode plates, wherein the plurality of electrode plates comprises:

(A) an upper terminal electrode;

(B) a lower terminal electrodes; and

(C) a plurality of intermediate electrode plates sandwiched between the upper and lower terminal electrodes,

each of the terminal electrodes is configured as an anode or a cathode,

each of the terminal electrode plates is configured to be thinner in comparison to the intermediate electrode plates,

each of the intermediate electrode plates is bipolar such that a first surface of each of the intermediate electrode plates is an anode and an opposing surface of the same intermediate electrode plate is a cathode, and

wherein each of the electrode plates is horizontally stacked within a pair of opposing insert openings formed on the pair of opposing inserts; and

(B) a cell comprising cylindrical sidewalls, wherein the electrode packing frame is inserted within the cylindrical cell,

wherein a conducting bar extends across a length of each of the horizontally stacked upper and lower terminal electrodes.

2. The ECR apparatus according to Claim 1, wherein an outer sidewall of each of the inserts is curved, and wherein each of the insert openings is formed on an inner sidewall of the inserts.
3. The ECR apparatus according to Claim 2, wherein each of the electrodes is positioned at a predetermined distance from an adjacent electrode.
4. The ECR apparatus according to Claim 1, wherein each of the inserts is crescent-shaped.
5. The ECR apparatus according to Claim 1, wherein each of the inserts is non-conductive.
6. The ECR apparatus according to Claim 1, wherein each of the inserts is configured to be removable and replaceable.
7. The ECR apparatus according to Claim 1, wherein each of the inserts is configured to divert the fluid stream to one or more active areas on the plurality of electrode plates.
8. The ECR apparatus according to Claim 2, wherein the outer sidewall of the inserts comprises one or more insert apertures.
9. The ECR apparatus according to Claim 8, wherein the cylindrical sidewalls of the cell further comprises one or more openings, and wherein each insert aperture is aligned with a corresponding opening on the cylindrical sidewalls of the cell to form a throughhole when the electrode stack is inserted within the cell.
10. The ECR apparatus according to Claim 9, further comprising a locking device, and wherein the locking device is threaded into the throughhole to securely couple the electrode packing frame to the cell.
11. The ECR apparatus according to Claim 1, wherein the terminal electrodes have a superficially applied external electrocatalytic coating to still carry current while reducing their rate of dissolution and extending their useful life.
12. The ECR apparatus according to Claim 1, wherein each electrode plate is stacked in a horizontal alignment with an adjacent electrode plate, and wherein each of the electrode plates is arranged in a perpendicular plane to a fluid inlet and a fluid outlet.
13. The ECR apparatus according to Claim 11, wherein the conducting bars are attached to an outer surface or or above the upper and lower terminal electrodes.
14. The ECR apparatus according to Claim 1, further comprising a first and a second flange, wherein each of the flanges is configured to seal a first and a second end of the cylindrical cell, and wherein the conducting bars extend through at least the first flange.

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15. The ECR apparatus according to Claim 14, wherein each of the first and the second flanges further comprise a plurality of integral flow diverters.
16. The ECR apparatus according to Claim 15, wherein the plurality of integral flow diverters facilitate a serpentine flow of the wastewater within the cell.
17. A method for treating a fluid stream comprising:

passing the fluid stream through the electrocoagulation reactor (ECR) apparatus of claim 1.
18. The method according to Claim 17, further comprising combining a pressurized saline seawater stream with the fluid stream prior to passing it through the ECR apparatus.
19. The method according to Claim 17, further comprising forming each pair of opposing insert openings at a predetermined and equal distance from an adjacent pair of opposing insert openings to facilitate an even and equal flow of the process stream between each of the electrode plates.
20. The method according to Claim 17, further comprising providing a pair of end flanges for the cylindrical cell, wherein each flange comprises integral flow diverters.
21. The method according to Claim 20, further comprising facilitating a serpentine flow of the process stream, wherein the serpentine flow involves a continuous and sequential flow of the fluid stream from an inlet at the base of the cylindrical cell to an outlet at the top of the cylindrical cell.
22. The method according to Claim 17, further comprising cleaning the electrode stack in-situ, wherein the cleaning comprises:

allowing a pressurized stream of water to flow upward through the electrode stack, wherein the water is passed from an inlet at the base of the cylindrical cell to an outlet at the top of the cylindrical cell; and

passing a pressurized stream of air downward through the electrode stack, wherein the air is passed from the outlet at the top of the cylindrical cell.
23. The method according to Claim 22, further comprising cleaning the electrode stack at about 80 psi to about 120 psi.
24. The method according to Claim 23, wherein the cleaning is carried out at predetermined time intervals.

25. The method according to Claim 17, further involving periodically reversing the electrical polarity of the intermediate electrodes to alternate wear pattern.