Electro coagulation

Lecture-18
Electrocoagulation (EC) is an attractive method for the treatment of various kinds of wastewater, particularly textile wastewater, due to the virtue of various benefits including:

- environmental compatibility,
- versatility,
- energy efficiency,
- safety, selectivity,
- amenability to automation,
- and cost effectiveness.
Simplicity of EC

Electro coagulation is characterized:

- by simple equipment,
- easy operation,
- a shortened reactive retention period,
- a reduction or absence of equipment for adding chemicals and decreased amount of precipitate or sludge which sediments rapidly.
**Electrochemical Process**

1. Single stage operation, two stages at maximum

2. Generates sludge at single point

3. Sludge volume is substantially low

4. No additional chemicals

5. Completely automatic Lower Sludge Volume

6. 70-80% reduction in chemical use

7. Reusable water in high volume application like washing, rinsing etc.

8. Fully automatic

9. Negligible maintenance

10. Ease of capacity expansion
Electrocoagulator

The electrocoagulator is typically made of plexiglas with the dimensions of 120 mm × 110 mm × 110 mm. Al and Fe electrode materials are used as sacrificial electrode in parallel and serial connection modes. Both aluminum or iron cathodes and anodes are made from plates with dimensions of 45 mm × 53 mm × 3 mm. The total effective electrode area was 143 cm² and the spacing between electrodes is ideally 20 mm. The electrodes are connected to a digital dc power supply (Topward 6306D; 30 V, 6 A) operated at galvanostatic mode.
The EC reactor

The EC reactor is operated in batch mode. Characteristics of wastewater used have the following properties: chemical oxygen demand (COD): 2031 mg l$^{-1}$, total suspended solids (TSS): 102 mg l$^{-1}$, Conductivity: 2310 mS cm$^{-1}$, turbidity: 671 NTU, pH: 8.88

Monopolar-parallel (MP-P) connection mode is the most appropriate one for both materials exhibiting similar performance in reducing removal efficiency of COD and turbidity. Fe electrode requires slightly acidic medium (pH 5), while neutral medium (pH 7) is more suitable for Al electrode. From operating cost point of view, Fe electrode is clearly more economic material type than Al electrode.
Typical operating system

When Al and Fe electrodes were used as sacrificial electrodes with parallel and series connection modes. Optimum operating conditions were obtained for both electrodes as pH 7 for Fe, pH 5 for Al electrode, 30 A m$^{-2}$ of current density and 15 min of operating time.

Results showed that Monopolar-parallel (MP-P) mode was the most cost-effective for both electrodes. Similar results were obtained from Al and Fe electrodes for reducing COD and turbidity, but Fe electrode was found to be a low cost material.
Cost effectivity of EC

- Various cost items were considered in the calculation of the total cost for the treatment of wastewater from the textile plant.

- The EC process was faster and more economic

- In the EC it consumes less material and produces less sludge, and pH of the medium was more stabilized as compared to chemical coagulation (CC) for percentage removal efficiency of COD and turbidity from textile wastewater.

- The treatment cost of EC at optimum conditions was 3.2 times cheaper than that of CC.
Other Electrocoagulation Capabilities

- Removes heavy metals as oxides that pass TCLP
- Removes suspended and colloidal solids
- Breaks oil emulsions in water
- Removes fats, oil, and grease
- Removes complex organics
- Destroys & removes bacteria, viruses & cysts
Electrocoagulation Benefits

- Meet Discharge Requirements
- Reduce Sludge Volume
- No Chemicals
- Process Multiple Contaminants
- Process Waste Streams with up to 5% solids.
- Harvest Proteins, Oils, and Metals
Electrochemical System for 100 KL/day Textile house effluent

1. EC needs not more than 3 to 4 sq m of Area (excluding Filtration area)

2. EC needs not more than 8 to 10 HP of total power source

3. Treatment cost varies between Rs 8 to 12/1000 litre only with many benefits

4. Capital cost in range of Rs 10-12 /Litre