CROWLEY ENVIRONMENTAL

Electro Coagulation
Waste Water Treatment

Electro Coagulation (EC) is a well established technology for the treatment of waste water without the need for expensive, conventional process chemicals such as Ferric, PAC and other polymers.

A wide range of pollutants can be efficiently removed up to 98% including heavy metals, COD, BOD, suspended and colloidal solids, FOGs, bacteria, viruses, hydrocarbons, pesticides and herbicides.

EC will not remove dissolved solids such as chlorides, salt etc. EC is a good pre treatment to membrane technologies where high quality water re-use is required.

Applicable Industries

- ★ Pharmaceuticals
- ★ Metal Plating
- ★ Oil & Gas
- ★ Anaerobic Digestion
- ★ Mining
- ★ Concrete Crushing
- ★ Food Manufacturing
- ★ Meat and Fish Processing
- ★ Vegetable Washing
- ★ Sludge Dewatering
- ★ Algae (Red Tide) Treatment
- ★ Textile & dye
- ★ Water Treatment
- ★ RO Pre-Treatment
- ★ Ground Remediation
- ★ Surface Water
- ★ Sewage Treatment
- ★ Car & Truck Wash
- ★ Coal Washing
- ★ Produced Water
- ★ Fracking

Typical Application for EC

Drill platform wash down containing oils, drilling mud and other contaminants.

The drilling mud is a very complex product but can be successfully treated using EC to produce a clean treated water for discharge.

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The Electro Coagulation Process

Electro Coagulation is the process of applying a direct current voltage to the waste water to be treated using submerged electrodes which act as the anode and cathode. Typically, these electrodes are made from mild steel and aluminium. The current passes between the electrodes due to the conductivity of the water.

The electrical current acts on the suspended particles in the water, neutralising their charges and allowing the very fine solids to precipitate and settle.

The electrical current also makes the electrodes sacrificial and in doing so, they give up their metal ions into solution in water. These ions act as chemical coagulants used in DAF systems.

Suspensions and emulsions are destabilised, solids coagulate and separate out and and hydrocarbons coalesce.

The EC reaction time is typically between 20 and 120 seconds depending upon the contaminants being treated.

The consumables are electricity and the sacrificial electrodes. Both these directly effect the EC operational cost. Energy consumption is typically 1.0 - 2.0 kWhr per cubic meter (1000 litres) treated with a metal electrode consumption of around 24 grammes per cubic meter treated.

Sludge production in chemically treated waste water treatment carries a very significant expense in terms of the volume produced and the cost of further chemicals in its dewatering. This is because chemicals are added, often in large quantities. By comparison, EC produces significantly less sludge with much lower sludge handling costs. Unlike chemically produced sludges, EC produces a broadly neutral pH, easy to dewater and non-leaching, sludge. Handling and disposal costs are much reduced.

Electro Coagulation - Electrical Description

Electro Coagulation (EC) requires a direct current (DC) voltage to be applied to the submerged electrodes in the reaction chamber. The incoming voltage is AC and therefore needs rectifying before it can be applied. The incoming electrical supply is typically 400V three phase but for smaller EC plants 230V single phase can be used.

A 1:1 isolation transformer for safety and then the AC supply is converted to DC via a fully configurable and controllable digital DC drive. This delivers a fully variable DC voltage to the electrodes.

The EC process depends upon the electrical Current Density (CD) applied to the electrodes and the available surface areas of the electrodes. The EC plant provides a very large electrode surface area relative to the flow rate meaning the CD can be minimised for the specified reaction time. The current drawn is dependent on the conductivity of the water which can vary extensively. It is therefore important to be able to vary the voltage and hence the current to ensure the minimum current, and hence energy consumed, is drawn for a complete EC reaction. Any excess voltage or current drawn leads to wasted heat. Because the operator of the EC plant is able to fully tailor the voltage applied, the absolute minimum electrical energy and metal electrodes are consumed.

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Typical Contaminant Removal Performance using EC Technology

The removal rates for the contaminants listed below are typical and are intended to provide a guide. Most waste waters are complex products and it may only a single contaminant that needs removal to meet discharge or re-use standards. The EC technology can remove multiple contaminants from waste water or target specific elements and this is done by selection of electrode material, residence time and current density applied. It every case, it is advisable to run trials to determine the most efficient operation procedure to maximise removal rate to minimise operational costs

Contaminant	Removal %
Aluminium	99.0
Ammonia	60.0
Arsenic	97.0
Barium	93.0
BOD/COD	98.0
Boron	70.0
Cadmium	97.0
Calcium	98.0
Chromium	99.0
Copper	99.00
Dyes Textile	99.00
FOGs	98.0
Flouride	63.0
Herbicides Agricultural	98.0
Hydrocarbons	99.0
Iron	99.0
Lead	99.0
Magnesium	99.0
Manganese	98.0
Mercury	98.0
Nickel	99.0
Nitrate	76.0
Nitrite	42.0
Nitrogen TKN	94.0
PFOS Fire Surpressant	96.0
Phosphate	99.0
Platinum	84.0
Pesticides Agricultural	99.0
Potassium	45.0
Turbidity	99.0

Acrylic paint contaminated water showing raw water, EC treated and settled/clarified stages of treated.

This was achieved using a 60 second reaction time in the EC plant using 100% aluminium blades.

This is a useful test demonstrating the stability of the raw water which has a high colloidal suspended solids content and how the EC treatment destabilises the raw water for easy separation of the contaminant from the clean water.

Cement contaminated water showing raw water, EC treated and settled/clarified stages of treated.

This was achieved using a 60 second reaction time in the EC plant using 100% aluminium blades.

The cement mimics waste waters generated where fine silts are present such as concrete products manufacturing, aggregate washing, concrete crushing & aggregate recovery, mining, vegetable washing, car and truck wash etc.

Paper pulp contaminated water showing raw water, EC treated and settled/clarified stages of treated.

This was achieved using a 60 second reaction time in the EC plant using 100% mild steel blades.

High levels of stable and suspended cellulose solids were quickly coagulated and settled using EC treatment without chemical dosing.

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Waste Water Treatment

Waste water from tannery

After EC treatment & settlement. Sludge settles in 15 mins leaving treated clear water above.

Sample of the clarified water

Tannery Waste Water from processing natural gut strings. This is very similar to tannery waste water with an analysis showing high Total Dissolved Solids in the form of Chlorides, Chromium at 0.6 mg/l and COD at 112,200 mg/l. After EC treatment and settlement in the clarifier, the clear water was analysed. The EC treatment reduced the Chromium by 91.7% to <0.05 mg/l and COD by 90.9% to 10,220 mg/l. The suspended solids were also reduced by 98%.

The chlorides from the salt addition to the tannery processing liquid is not removed by EC. If needed, this can be removed using Reverse Osmosis membranes.
In this trial, the energy consumption was 1.5 kWhr per m3 treated.

Clay Mine Surface Water Treatment

Open cast clay mines fill up with rain water and require pumping out. The resultant water is contaminated with clay particles. In this trial the clay particles were as small as 0.2 micron and would remain in suspension for weeks.

60 seconds EC treatment of this clay suspension of around 400 mg/l and using aluminium electrodes quickly allowed the clay to settle. Complete clarification took 2 - 4 hours due to the very low energy used of 0.7 kWhr per m3 treated. A higher energy usage would have allowed a fasted settlement time.

A 99% reduction in clay was achieved in the

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EC Treatment Plant Capacities

The standard, skid mounted EC plants start at 1 m3/hr flow rate and increase to 50 m3/hr.

Treatment performance will vary depending on the chemistry of the water to be treated and the suspended solids loading.

EC Typical Operational Costs

The two principle costs are energy and the sacrificial electrodes of either aluminium or mild steel. Energy is consumed from the gris as kWhr units and the typical energy consumption for the EC reaction is 1 kWhr - 2 kWhr per 1000 litres treated.

The electrodes will decay at around 24 grammes metal per 1000 litres treated.

The third operation cost is the disposal of the sludge produced by the EC reaction. EC technology has a huge advantage over chemical treatments such as DAF plants in that the EC sludge is an oxide type and easily dewaters without additional chemicals such as polymers. Also, the quality of sludge produced by EC is significantly less than by chemical treatments. Sludge handling costs from an EC plant is cheaper than a DAF unit employing liquid chemical dosing.

Trial and Testing

To test you water using EC technology, send a request to steven@dynameau.co.uk

Generally, a 1000 litre IBC of the water to be treated dis required to undertake a representative trial.

Bench scale trials can be done to prove the concept. A 5 litre sample is needed.

Demonstration EC Plant for On-Site Trials

Trial EC Plant,1 m3/hr c/w settlement clarifier all within a shipping container for on-site trials

Electro Coagulation
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Products
Crowley Environmental

ElectroCoagulation Waste Water Treatment

Oil Water Separation

Gasifiers, 6MW total using 52% moisture feedstock

Gasifier to steam to turbine electrical generation sets

On-farm biogas plants

Biogas Development and Investment

Digestate Concentrators and Ammonium Sulphate Production

In Vessel compost systems

Biological water treatment

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