ELECTROCOAGULATION AND ADVANCED ELECTROCHEMICAL OXIDATION

ELECTROCOAGULATION OVERVIEW

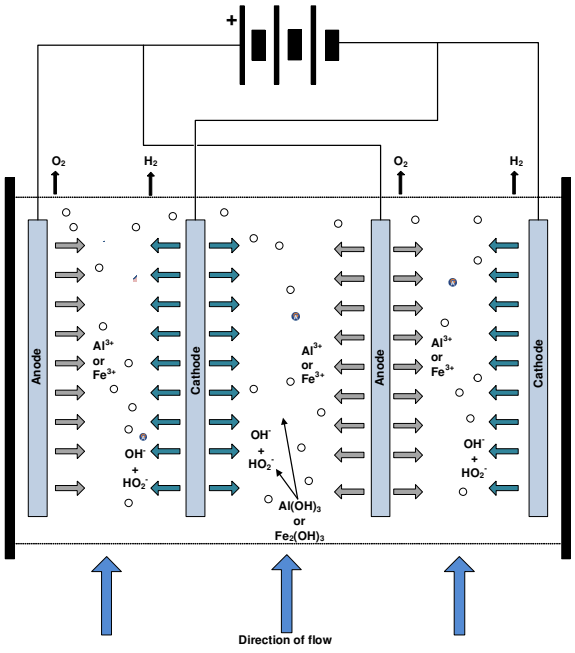
Electrocoagulation is a proven and cost effective technology to treat and remove most contaminants/pollutants from water. It removes suspended solids, emulsified hydrocarbons and many dissolved organic compounds, heavy metals, (including chromium, cadmium, gold, platinum, radionuclides) and arsenic, bacteria, algae, larvae, etc., from water for re-use/discharge. The process may also be used to protect reverse osmosis elements, membrane filters, ion exchange columns, etc., from fouling. The process is continuous flow and is low in energy consumption.

ELECTROCOAGULATION PROCESS

Electrocoagulation cells consist of pairs of parallel metal plate electrodes separated by a few millimetres with a low voltage applied at high current densities.

The current flowing between the electrodes destabilises electrical charges, which maintain suspensions of particulates, e.g. clays, and emulsions/micro-emulsions of hydrocarbons and insoluble organic compounds. The particulates coagulate together into flocs. The hydrocarbons and insoluble organic compounds coalesce into larger droplets and rise in the cells.

Electrochemical reactions at the electrodes produce very fine H_2 and O_2 gas bubbles and highly chemically reactive hydroxyl OH^- and superoxide HO_2^- radicals. The gas bubbles promote the flotation of coagulated solids and coalesced hydrocarbons, etc. The hydroxyl and superoxide radicals cause precipitation of hydroxides of heavy metals and breakdown of many soluble organic molecules.



REMOVAL OF CONTAMINANTS

Electrocoagulation processes are able to remove (and recover) many contaminants from waste and polluted water streams including:

	One pass	Two passes
Suspended solids	>95%	>99%
Emulsified/dissolved hydrocarbons	>95%	>99%
Bacteria/algae/larvae	>95%	>99%
Heavy metals	>95%	>99%
Calcium, magnesium	>90%	>95%
Arsenic	>90%	>95%
BOD	>90%	>95%
COD	>90%	>95%

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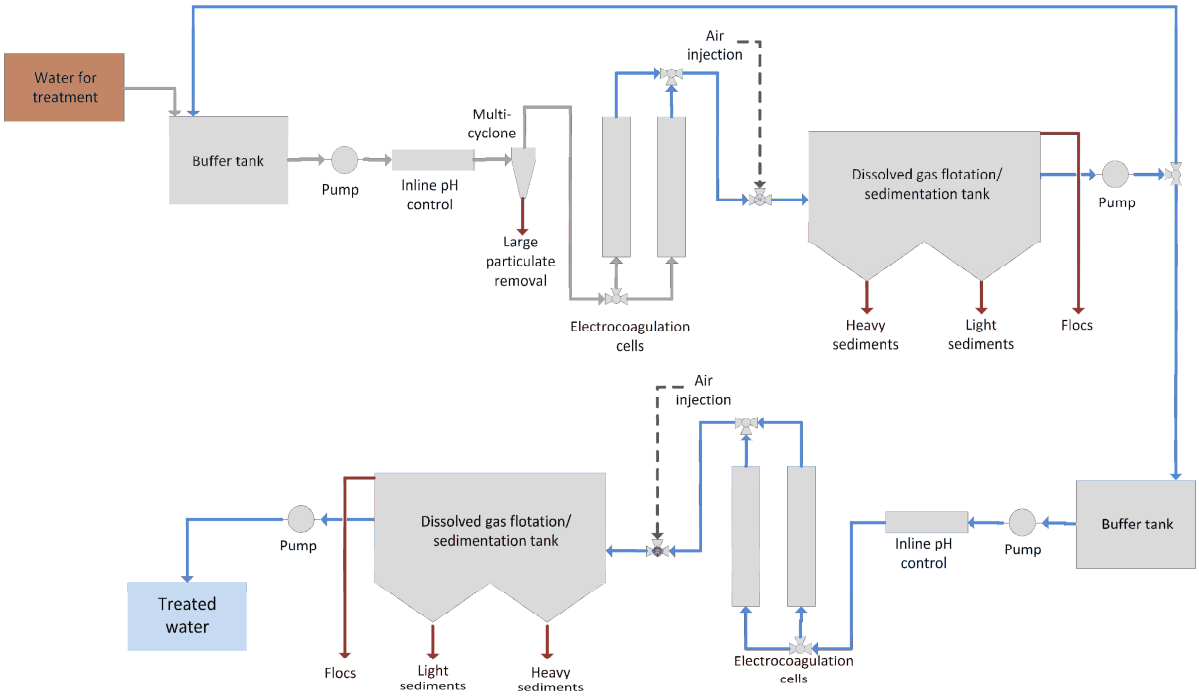

Typical configuration for Oil Pollution Services two-stage electrocoagulation systems

APPLICATIONS FOR ELECTROCOAGULATION

Description	Emulsified/ dissolved hydrocarbons organics	Suspended solids	Heavy metals, arsenic	NORM**	Fats, oils, greases (FOG)	BOD+COD C, NH_3, H_2S	Bacteria, algae, larvae
OIL + GAS							
Drilling platform waste water + slops, etc.	✓	✓	✓	✓		✓	✓
Flowback water	✓	✓	✓	✓		✓	
Produced water	✓	✓	✓	✓		✓	
Refinery process + storage tank + ground water	✓	✓	✓	✓		✓	✓
Distribution depots storage tank + ground water	✓	✓	✓	✓		✓	✓
Platform + structure decommissioning	✓	✓	✓	✓		✓	✓
MARINE + TRANSPORT							
Tanker + ship bilge water	✓	✓	✓			✓	✓
Tanker ballast water	✓	✓	✓	✓		✓	✓
Cruise liner wastewater		✓			✓	✓	✓

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MINING + MINERALS							
Mine discharge water + tailings ponds	✓	✓	✓	✓		✓	✓
Mineral and precious metals recovery (gold, platinum, etc.)		✓	✓	✓		✓	
METALs + MINERAL EXTRACTION + PROCESSING							
Process water	✓	✓	✓	✓		✓	
Cooling water	✓	✓	✓			✓	✓
Precious metals recovery from process discharges		✓	✓	✓			
Mineral recovery (e.g. clays)		✓	✓				
CHEMICAL PRODUCTION							
Process water	✓	✓	✓			✓	
Cooling water	✓	✓	✓			✓	✓
ENGINEERING + POWER GENERATION							
Process water	✓	✓	✓			✓	
Cooling water	✓	✓	✓			✓	
WASTE MANAGEMENT							
Landfill leachate	✓	✓	✓	✓	✓	✓	✓
Intensive animal production		✓	✓		✓	✓	✓
Anaerobic digestate	✓	✓	✓		✓	✓	✓
Municipal waste autoclave discharge	✓	✓	✓		✓	✓	✓
WATER TREATMENT							
Prior to reverse osmosis, membrane filtration	✓	✓	✓		✓	✓	✓
FOOD PROCESSING							
Process water		✓			✓	✓	
Cooling water		✓	✓		✓	✓	✓
Recovery of fats, oils + greases		✓			✓	✓	
DISTILLERIES, BREWERIES, WINERIES							
Process water		✓	✓		✓	✓	
Cooling water		✓	✓		✓	✓	✓

**Naturally occurring radioactive materials

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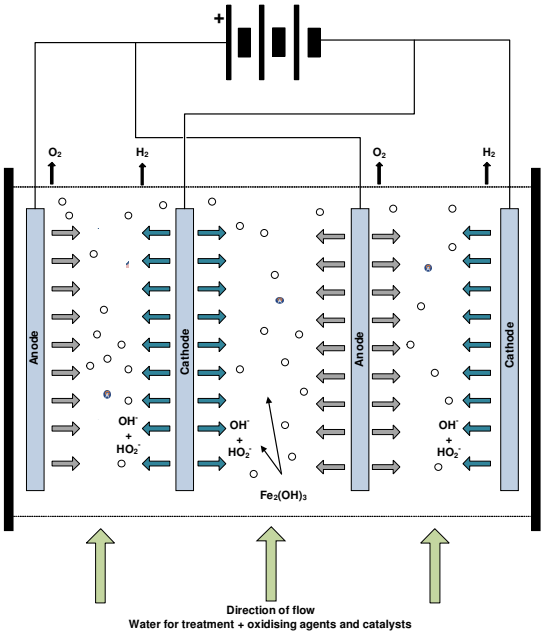
ELECTROCOAGULATION AND ADVANCED ELECTROCHEMICAL OXIDATION

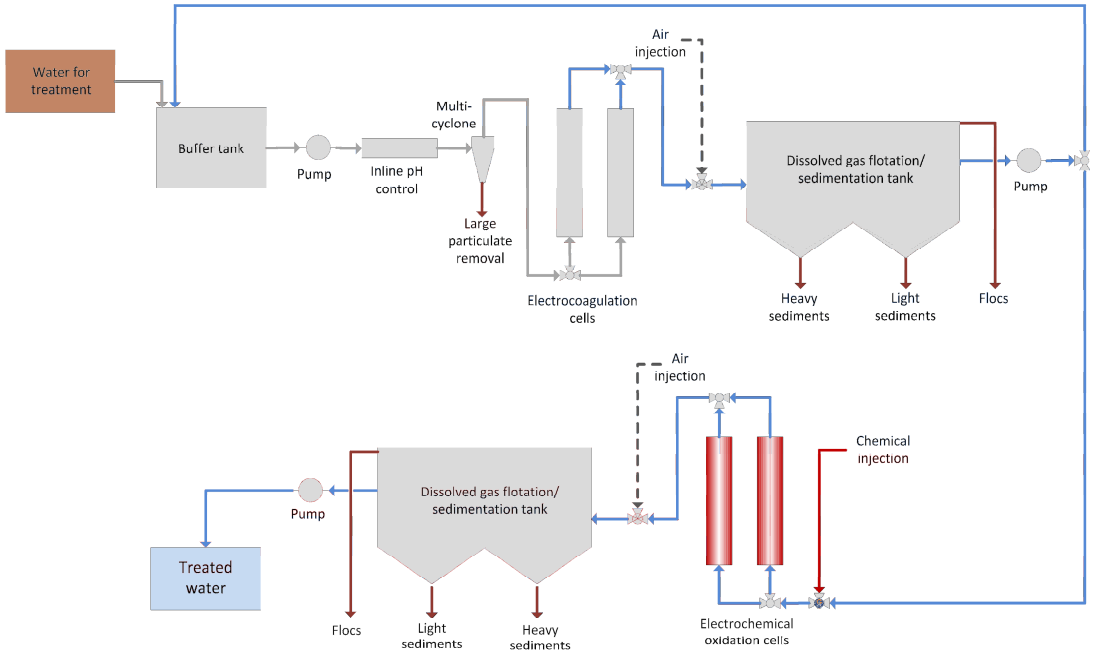
ADVANCED ELECTROCHEMICAL OXIDATION

Advanced electrochemical oxidation is modification to the electrocoagulation process, where oxidising agents and catalysts are introduced into wastewater and effluent before it enters the cells. It oxidises dissolved organic** and ammoniacal compounds, sulphides and mercaptans, etc., to carbon dioxide, water, nitrogen and simple salts, which were not removed by electrocoagulation. Advanced electrochemical oxidation cells are normally installed in wastewater and effluent treatment plant inline after electrocoagulation cells.

Oil Pollution Services advanced electrochemical oxidation cells are built to the same hydrodynamic efficient physical design as the electrocoagulation cells. These cells may be fitted with either iron (for electro-Fenton oxidation) or titanium electrodes depending upon the electrochemistry chosen to oxidise contaminants/pollutants.



**Membrane filtration or aerobic biological treatment is required to remove volatile fatty acids



Typical configuration for Oil Pollution Services advanced electrochemical oxidation systems

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