

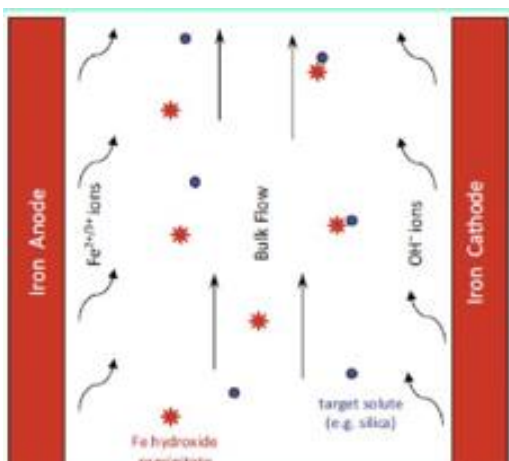
WINWERKS & POWELL ELECTROCOAGULATION

The Technology Process Narrative

www.winwerksipd.com/electrocoagulation-facts

Electrocoagulation (EC) has been in existence for decades with the first patent issued in 1906. However, it has been only during the past 30 years that the process has been fully commercialized as a result of technological advancements by Powell Water to overcome the deficiencies of previous units.

Electrocoagulation] utilizes direct current to cause sacrificial electrode ions. to remove undesirable contaminants either by chemical reaction and precipitation or by causing colloidal materials to coalesce and then removed by electrolytic flotation. Powell's patented and proven electrochemical system copes with a variety of wastewaters. These waters can originate from oil and gas wells, coal utility plants, paper pulp mill waste, metal plating, tanneries, canning factories, steel mill effluent, slaughterhouses, or PWWTP. Chromate, boron, arsenic, lead and mercury laden effluents, as well as domestic sewage are treated. These wastewaters will be reduced to clear, clean, odorless and reusable water. In most cases, especially domestic sewage, the treated water effluent will be better than the raw water from which it had originated."¹



In the Electrocoagulation process, the electrical current is introduced into water via parallel plates constructed of various metals that are selected to optimize the removal process. The two most common plate materials are iron and aluminum. In accordance with Faraday's Law, metal ions will be split off or sacrificed into the liquid medium. 'these metal ions tend to form metal oxides that electromechanically attract to the contaminants that have been destabilized. The unit also contains an air purge system to fluidize precipitates, polarity reversing to extend blade life and prevent contaminants from coating the blades, and an automated clean-in-place system. The acid solution used in the automated cleaning cycle is recycled and, when exhausted, it is routed through the EC system for final disposal. Frequency, every 4-6 hours, 20-minute cycle or less.

No chemicals are required for the treatment process. Solids are removed by filters or clarifiers with water available for reuse or discharge.

Scalable to handle small and large flows of multi-million gallons per day
Mobile Systems

(1) Eckenfelder, W.W. and Cecil, L.K. "Applications of New Concepts of Physical-Chemical Wastewater Treatment." Vanderbilt University; Nashville, TN: Pergamon Press, Inc.

EC Mobile System Footprint

EC Train Options:
10 GPM - 24' long x 8' wide x 8' high trailer with clarifier
Custom Trailers and Trains, up to 40' long



WINWERKS & POWELL ELECTROCOAGULATION

"30 Years of EFFECTIVE, RELIABLE, SAFE Wastewater Treatment and Recovery Applications"

Frac flowback and produced waters, sewage, heavy metal streams, silicas, salts, & bacteria with Electrocoagulation (electrocuting wastewater clean) are treated and recovered, safely, economically and environmentally qualified. This water treatment meets reuse or discharge standards and compliance requirements. Recover water, capital and operating costs by eliminating discharge fees and fines, harvesting water resources for beneficial reuse, and significantly reducing water replacement costs. Design Build & P3 Delivery

Contaminants Removed	Percentage of Removal
Radioactive Substances	99%+
BOD	90%+
TSS (Clay, coal, silt, silica, etc.)	99%+
Fats, Oils, Grease	93-99%+
Water From Sludge	50-80%+
Heavy Metals	95-99%+
Phosphates	93%+
Total Coliform	99.99%+



1.5 GPM to 60 M+ GPD



System Capabilities for Hydrocarbons & Other Wastewater

- Removes heavy metals to pass TCLP and MCL
- Filters out frac sand and colloidal clays
- Breaks and separates oil emulsions and water
- Removes fats, oil, and grease
- Removes complex organics
- Destroys & removes bacteria, viruses, and cysts
- Processes multiple contaminants, simultaneously
- Flexible to meet changing effluent
- Designed to meet discharge standards
- Reduces energy consumption/ damage to RO membranes

Facts & Benefits

- Turnkey delivery, single point of responsibility
- Over 150 site installs; consistent and reliable results
- Proven; University & Case Studies, White Papers
- Low operating and maintenance costs
- Low power requirements & minimal operator attention
- No chemical additions
- Handles a wide variation in the waste streams
- Sustainability; reduce sludge, energy and landfill use
- Treats multiple contaminants & pretreats for salts and RO
- Water reuse- resulting in zero discharge

Kurt A. Tetzlaff
President
O 858-350-1358
C 858-342-2659
ktetzlaff@winwerksipd.com
www.winwerksipd.com



Powell Water Systems Installations

WinWerks IPD Contact Development Services

EC Efficacy: Metals, Ions, Solids, Hardness, Bacteria, Radioisotopes, and Turbidity

Contaminant	Before (mg/l)	After (mg/l)	Removal Rate %	Contaminant	Before (mg/l)	After (mg/l)	Removal Rate %
Aldrin (pesticide)	0.063	ND (0.001)	98	Phosphate	28	ND (0.2)	99+
Aluminium	224	ND (0.7)	99+	Platinum	4.4	0.68	84
Ammonia	49	19.4	60	Potassium	200	110	45
Arsenic	0.076	ND (<0.002)	97	Propetamphos	80.87	0.36	99+
Barium	0.014	ND (<0.001)	93	Selenium	68	38	44
Benzene	90.1	0.36	99+	Silicon	21.07	ND (0.10)	99+
BOD5	1,050	14	98	Sulfate	104	68	34
Boron	4.86	1.41	70	Silver	0.0081	0.0006	92
Cadmium	0.125	ND (<0.004)	96	Tin	0.213	ND (<0.020)	90
Calcium	1,321	21.4	98	Toluene	28,480	0.227	99+
Chlorpyriphos	5.87	ND (0.03)	99+	TSS	1,560	8	99+
Chromium	139	ND (<0.1)	99+	Vanadium	0.262	ND (<0.002)	99+
Cobalt	0.1238	0.0214	82	Zinc	221	0.140	99+
Copper	0.7984	ND (<0.0020)	99+	Bacteria	Before (cfu)	After (cfu)	Removal Rate %
Cyanide (free)	723	ND (<0.02)	99+	Bacteria	110,000,000 cfu	2,700 cfu	99+
Cypermethrin	1.3	0.07	94	Coliform	318,000,000 cfu	ND (<1) cfu	99+
DDT	0.261	0.002	99+	E. coli	>2,419.2 mpn	ND (<0.01) mpn	99+
Diazinon	34	0.21	99+	Enterococcus	83 mpn	ND (<10.) mpn	82
Ethyl Benzene	428	0.372	99+	Total Coliform	>2,419.2 mpn	ND (<0.1) mpn	99+
Fluoride	1.1	0.415	62	Radioisotopes	Before (pCi/L)	After (pCi/L)	Removal Rate %
Gold	5.72	1.38	75	Americium-241	71.99 pCi/L	0.57 pCi/L	99+
Iron	68.34	0.19	99+	Plutonium-239	29.85 pCi/L	0.29 pCi/L	99+
Lead	0.59	0.0032	99+	Radium	1093.pCi/L	0.10 pCi/L	99+
Lindane	0.143	ND (0.001)	99+		Before mg/L	After mg/L	
Magnesium	13.15	0.04	99+	Uranium	0.13 mg/L	0.0002 mg/L	99+
Manganese	1.061	0.018	98	Dyes	Before (NTU)	After (NTU)	Removal Rate %
Mercury	0.72	ND (<0.003)	98	Ref. 006-691	125.1	12.1	90
Molybdenum	0.35	0.029	91	Ref. 006-692	129.4	2.2	98
MP-Xylene	41.6	0.057	99+	Ref. 006-854	68.30	0.68	99+
MTBE	21.58	0.0462	99+	Ref. 006-851	2,340	4.5	99+
Nickel	183	0.07	99+				
Nitrate	11.7	2.6	77				
Nitrite	21	12	42				
Nitrogen TKN	1,118	59	94				
NTU	35.38	0.32	99				
O-Xylene	191	0.416	99+				
PCB	0.0007	ND (<0.0001)	85				
Petro Hydrocarbons	72.5	ND (<0.2)	99+				

Notes: ND = Not Detected at the Reporting Limit mg/l = milligram per liter or part per million pCi/L = picocuries per liter

Powell Water Systems Installations

WinWerks IPD Contact Development Services

Alcan-Canada • Alcan International Limited-Canada • Alfa Appliance Service-Colorado • Anadarko Petroleum-Wyoming • Apex Processing Systems-Australia • Aquamanzi-California • Associated Plating-California • AWES-Colorado • BacTee Systems-North Dakota • Barreto Manufacturing-Oregon • BASX Systems-Colorado • Beckley Water Company-West Virginia • Beijing Wall Investment-China • Ben Gerker Company-Missouri • Boeing-Arizona • Brian Collins-United Kingdom • Burlington Engineering-California • Carige Water Technology-Puerto Rico • Chautauqua Hardware-New York • Chevron Energy Technology Company-California • Christ Water USA-Intel-Washington • CleanWaters LTD-Korea • Colorado Energy Management-New Mexico • Compañía Chilena de Tabacos S.A.-Chile • Conoco Phillips-Oklahoma • Consolidated Meats Group-Australia • Dong Lim Industrial-Korea • Doosan Industrial Development-Korea • E.A.R.T.H / I.M.S.E (Division) - Kingdom of Saudi Arabia • Ethan Allen Coachworks-Vermont • EC System (Thailand) Co-Bangkok • EC&P-Korea • Eco Dewell International-Arizona • EcoGeo International-South Korea • El Paso Electric Company-Texas • Electro Chemical Finishing-Michigan • Emerald Performance Materials-Wyoming • Environmental Solutions & Products-Indiana • ES3-Utah • Fontaniva Bonifico -Italy • Flagship Ecosystems Pte Ltd-Singapore • George A. Bull, Jr-Illinois • Gerber Pumps International-Florida • Golden Star Technology-California • Golder Associates Inc - Colorado • Hyannis Car Wash-Massachusetts • I G B Vetsch AG-Switzerland • Ilen Seafoods-Ireland • Inland Empire Oilseeds-Washington • Integralsa SA-Mexico • Intel-Oregon • International Dehydrated Foods-Missouri • J C Engineering Consultant-Taiwan • Joe's Plating-California • Joyner's Die Casting & Plating-Minnesota • Kent Troup-New York • KVF-Quad-Illinois • Lawrence Livermore National Labs-California • LIG-Korea • Metal Preparations Co-New York • Natural Environmental Systems-Missouri • Natural Systems-California • NEAT Environmental Inc-Canada • New Century Water-California • New China Limited-Texas • Newalta Corporation-Canada • Office of Naval Research-Virginia • Peagasus Environmental Group-Washington • Piedras Negras-Mexico • Production Plating-Washington • Quantum Ionics-Florida • RAK Gas Commission-UAE • REW Nukem-South Carolina • Rhapsody Environmental-California • Rich-Aqua Environmental-Taiwan • Sam-Chang Foundry-Korea • Sammis Oil and Gas-Canada • Samsung SDI Cheonan-Korea • Samsung SDI Pusan-Korea • San Antonio Trade Group-Texas • Santa Clara Waste Water-California • Separation Process Technologies-Japan • Shihlin Electric & Engineering Corp-Taiwan • Southern California Water Company-California • Spence Electro Plating-California • SUMCO Oregon Corp-Oregon • Sumco USA Cincinnati Division-Ohio • Sustainable Industrial Development-Pakistan • Tecprosol International C. A. • Ted Bozarth-Texas • Terra-Magic-Oregon • The Art Alliance-Florida • Tom Beckwith International-California • Troop Environmental Alternatives-New York • TSS Filtration Services-Texas • Tyson Fresh Meats-South Dakota • U S Army Research-Pennsylvania • UCO-California • Ultra Wheel Company-California • United States Navy-California • Universal Systems-Oregon • Uxmal-Mexico • Vermont Organics Reclamation-Vermont • Wastech International-New Hampshire • Wastewater Treatment Associates-Colorado • Water & Power Technologies Inc-Utah • Water Solutions-Oregon • Water Systems Integrators-Colorado • Western Finance & Lease-North Dakota • William Long Sales-Michigan • WMC Corp-Ontario • World Water Works-New York

Developer, Turnkey	Technology and Product Engineering
WinWerks IPD	Powell Water Systems Inc
3741 Overpark Rd.	19331 East Tufts Circle
San Diego, CA	Centennial, Colorado
92130 USA	80015-5820 USA
Telephone 858-350-1358	Telephone 303 627 0320
Fax 858-350-1359	Fax 303 627 0116
Cell 858-342-2659	Cell 303 241 2489
ktetzlaff@winwerksipd.com	Skype: powellwater
www.winwerksipd.com	www.powellwater.com