WINWERKS COAL FINES' CASE STUDY SUMMARY

ELECTROCOAGULATION TREATS POWER PLANT COAL FINES

Treated Sub-bituminous and Lignite Fines Migrate from Wastewater to Combustible Material & Reclaimed Water - No Landfill Costs - reduces costs and environmental risks

Target: To effectively treat 100-500 GPM coal fine' waste streams with WinWerks' turnkey patented Powell Water Electrocoagulation (EC) system. Change coal fines into combustible fuel product and industrial grade water. Eliminate offsite waste sludge disposal and chemical use. This proven water treatment process makes toxic elements like Chromium, Selenium, Arsenic and Boron inert through oxidation. Materials never leave the site. Large life cycle savings, meets utility plant financial metrics; and delivered as a turnkey EC system.

Rationale: Coal fines and free/ bound water create runoff problems during storage and pulverization. DAF and other systems or chemicals have not worked effectively.

How does EC make this happen for a 500 GPM stream from Lignite Coal pulverization?

- Electrocoagulated Coal Fines' Water Treatment: Plan
  Reclaim 48,000 tons of combustible coal &, 447 MGY of industrial grade water
  Eliminate chemicals and nearly 100,000 tons of toxic sludge.
  No offsite water discharge
- WinWerks Turnkey Delivery provides a complete design build solution with operations and financing options. We team with Public Private Ventures or contractors meeting bonding, insurance & performance guarantees.
- Electrocoagulation technology has been around for over 100 years, cleans water by coagulating pollutants and oxidizes toxic elements to acceptable limits for water discharge or industrial reuse.
- WinWerk's EC technology partner operates on 125 sites across the world, from 1.5 to 1200 gpm systems, with Samsung, El Paso Electric, Chevron, Boeing, US Army, Intel and Tyson representing its client list.
- EC protects against future EPA or environmental rule changes dealing with offsite water discharge or sludge storage. Example, Arsenic, Selenium, Mercury, Boron, Cobalt and Vanadium reduced to acceptable limits.
- WinWerks' EC Coal solutions cover multiple coal generation waste water sources
  Pulverized Coal fines, coal stockpiles, Leachate streams, CCP pond dewatering, cooling tower blow down water treatment, FGD & other plant water waste streams.

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Turnkey CapEx	$13,100,000
O & M/ First Year	$378,000
Coal Fines' Reuse	$1,921,616
Landfill disposal offset	$3,362,827
Reclaimed Water	$989,892
20 year Discounted Cash Flow	$46,149,674
Payback	2.76
Savings To Investment Ratio 20 Years	3.52
Cost/ Treated Gallon	$0.0062

Financial Projections; 500 GPM coal fines treatment plant, ROM (Rough Order of Magnitude) EBITA contribution

Assumptions: 500 GPM stream, 23 hours/ day operation, 5% solid to 95% liquid, electric power at industrial rate; $. 09/kWh, Treated fines, dried and available to move to boilers, industrial water replaces potable, Eliminates landfill trucking and disposal costs.
Projections include 3% inflation factor & 10% discount factor

Coal @ $40/short ton
Industrial Water @ $3.00/ 100 CF
Sludge Disposal @ $35/ ton
Offset Chemical Coagulation TBD

Current Status: CALM has tested and vetted the Powell Electrocoagulation Patented process for efficacy.

Action: WinWerks addresses technology and site questions. CALM bench scale tests utility supplied water samples. EPIC reviews after. Finalize cost and operation numbers. Initiate design- build upon conclusions. Commission- & treat existing water in 6-8 months after project approvals.

WINWERKS

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WINWERKS & POWELL ELECTROCOAGULATION

"30 Years of EFFECTIVE, RELIABLE, SAFE Waste Water Applications"

Treating sewerage, heavy metal streams, storm water and leachate with Electrocoagulation (electrocuting wastewater streams) is a very safe, economical and environmentally qualified water treatment for meeting 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

Removes heavy metals and pass TCLP
Removes suspended and colloidal solids
Breaks oil emulsions in water
Removes fats, oil, and grease
Removes complex organics, endocrine-disruptors (EDCs),
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

Wastewaters can be treated for as low as
1-4 kWh per 1,000 gallons

Facts & Benefits

- Turnkey delivery, single point of responsibility
- Over 125 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

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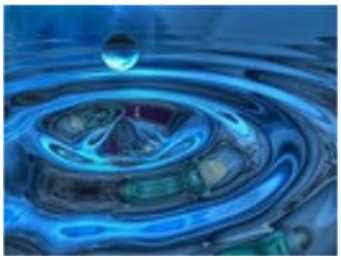
WINWERKS & POWELL ELECTROCOAGULATION

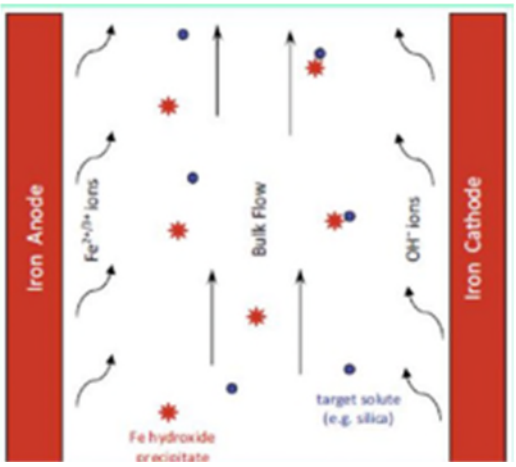
The Technology Process Narrative

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 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]

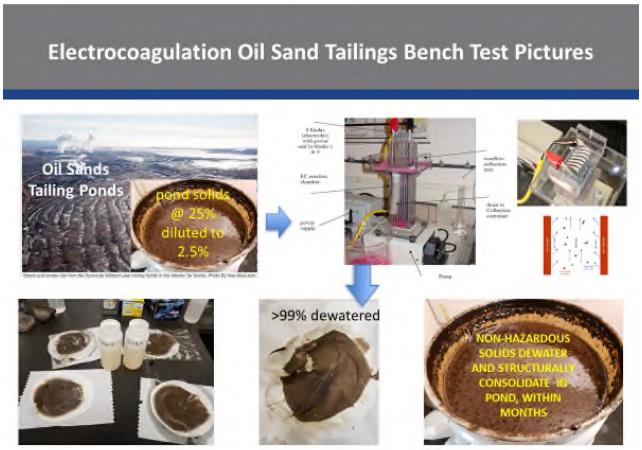




In the Electrocoagulation process, the electrical current is introduced into water via parallel plates constructed of various metals that are selected to optimize the removal process. The two most common plate materials are iron and aluminum. In accordance with Faraday's Law, metal ions will be split 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 large flows of multi-million gallons per day



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

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 %
Aldrin (pesticide)	0.063	ND (0.001)	**98**
Aluminium	224	ND (0.7)	**99+**
Ammonia	49	19.4	**60**
Arsenic	0.076	ND (<0.002)	**97**
Barium	0.014	ND (<0.001)	**93**
Benzene	90.1	0.36	**99+**
BOD5	1,050	14	**98**
Boron	4.86	1.41	**70**
Cadmium	0.125	ND (<0.004)	**96**
Calcium	1,321	21.4	**98**
Chlorpyriphos	5.87	ND (0.03)	**99+**
Chromium	139	ND (<0.1)	**99+**
Cobalt	0.1238	0.0214	**82**
Copper	0.7984	ND (<0.0020)	**99+**
Cyanide (free)	723	ND (<0.02)	**99+**
Cypermethrin	1.3	0.07	**94**
DDT	0.261	0.002	**99+**
Diazinon	34	0.21	**99+**
Ethyl Benzene	428	0.372	**99+**
Fluoride	1.1	0.415	**62**
Gold	5.72	1.38	**75**
Iron	68.34	0.19	**99+**
Lead	0.59	0.0032	**99+**
Lindane	0.143	ND (0.001)	**99+**
Magnesium	13.15	0.04	**99+**
Manganese	1.061	0.018	**98**
Mercury	0.72	ND (<0.003)	**98**
Molybdenum	0.35	0.029	**91**
MP-Xylene	41.6	0.057	**99+**
MTBE	21.58	0.0462	**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+**

Contaminant	Before (mg/l)	After (mg/l)	Removal Rate %
Phosphate	28	ND (0.2)	**99+**
Platinum	4.4	0.68	**84**
Potassium	200	110	**45**
Propetamphos	80.87	0.36	**99+**
Selenium	68	38	**44**
Silicon	21.07	ND (0.10)	**99+**
Sulfate	104	68	**34**
Silver	0.0081	0.0006	**92**
Tin	0.213	ND (<0.020)	**90**
Toluene	28,480	0.227	**99+**
TSS	1,560	8	**99+**
Vanadium	0.262	ND (<0.002)	**99+**
Zinc	221	0.140	**99+**

Bacteria	Before (cfu)	After (cfu)	Removal Rate %
Bacteria	110,000,000 cfu	2,700 cfu	**99+**
Coliform	318,000,000 cfu	ND (<1) cfu	**99+**
E. coli	>2,419.2 mpn	ND (<0.01) mpn	**99+**
Enterococcus	83 mpn	ND (<10.) mpn	**82**
Total Coliform	>2,419.2 mpn	ND (<0.1) mpn	**99+**

Radioisotopes	Before (pCi/L)	After (pCi/L)	Removal Rate %
Americium-241	71.99 pCi/L	0.57 pCi/L	**99+**
Plutonium-239	29.85 pCi/L	0.29 pCi/L	**99+**
Radium	1093.pCi/L	0.10 pCi/L	**99+**
	Before mg/L	**After mg/L**	
Uranium	0.13 mg/L	0.0002 mg/L	**99+**

Dyes	Before (NTU)	After (NTU)	Removal Rate %
Ref. 006-691	125.1	12.1	**90**
Ref. 006-692	129.4	2.2	**98**
Ref. 006-854	68.30	0.68	**99+**
Ref. 006-851	2,340	4.5	**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 • Indland 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

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