Application Cases of BDD Electrochemical Technology in Wastewater Treatment

- Oil & Gas Industry
- Lithium Battery Industry
- Smelting Wastewater
- Emulsion Liquid
- Energy Extraction
- Printing & Dyeing Wastewater
- Pharmaceutical Wastewater
- Coking Wastewater
- Pesticide Wastewater
- Chemical Industry Wastewater
- Landfill Leachate
- Others

Application Case #01

Subsidiary of CNPC
(China National Petroleum Corporation)

The company is located in Shaanxi Province, and its industrial coverage mainly includes oil, natural gas, oil, gas and coal comprehensive chemical industry, coal and power, new energy and new materials and technical development.

Type: Petrochemical Wastewater **Operation:** Dec. 2023

Treatment Goal: Treatment of PT wastewater with high COD value in the production process (complex composition), mainly to control CODcr, B/C ratio and PH and other related indicators.

BDD Anode: 42 m^2 **Floor Area:** 16 m^2 **Water Volume:** 4 m^3/h ; 96 m^3/d

Parameter	pH	CODcr(mg/L)	B/C
Inlet Water	3-5	≤23000	< 0.1
Outlet Water	/	≤16100	≥ 0.25

Remark:
1. When COD of inlet water ≥23000 mg/L, COD removal amount ≥7000 mg/L;
2. The inlet water contains traces of grease.

Application Case #02

Petrochemical Enterprise

The company is located in Hunan Province, specializing in technology development services, results transformation and product production in petroleum and coal chemical industry and other related fields.

Type: Petrochemical Wastewater Treatment

Operation: Dec. 2024

Treatment Goal: To degrade the diverse pollutants produced in the production process:

① Acetone Wastewater ② Special Alcohol Wastewater

③ Special Phenol Wastewater ④ Special Ester Wastewater

⑤ Furfuryl Alcohol Hydrogenation Wastewater and Other Wastewater

To control CODcr, TDS and other pollution emission indicators.

BDD Anode:12 m^2 **Floor Area:** 10 m^2

Parameter	Acetone	Special Alcohol	Special Phenol	Special Ester	Furfuryl Alcohol
COD of Inlet Water	≤6000	≤1000	≤20000	≤200000	≤6000
CODcr of Outlet Water	≤600	≤600	≤600	≤600	≤600

Application Case #03

Lithium Wastewater

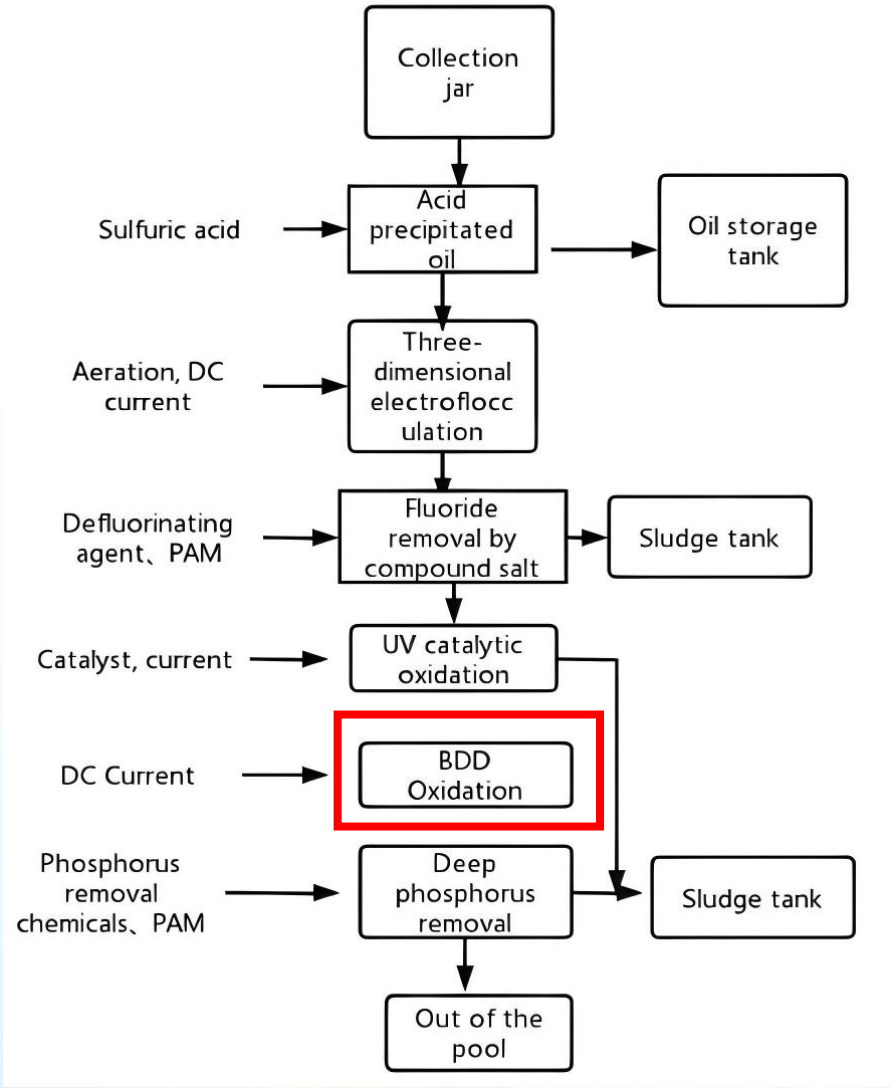
Lithium Phosphating Wastewater

Water treatment volume: Overall planning 4×60 m³/d

Phase I: 2×60 m³/d

Indicators mg/L	CODcr	BOD_5	TP	TF	As	NH_3-N	TN	Na	TDS	PH	Water Temperature
Inlet water quality	≤35000	≤2000	≤2500	≤2000	≤0.3	≤30	≤60	≤4000	≤30000	6~7	60℃~80℃

Indicators mg/L	CODcr	TP	TN	NH3-N	As	F	SS	PH
Output water quality	≤150	≤6.5	≤60	≤30	≤0.3	≤20	≤100	6-9



Process Flow Chart

Lithium Phosphating Wastewater


Raw Water


Acid Precipitation Water

3D Electro-coagulation Water


UV Catalytic Oxidation Water

BDD Water

Reaction Phase	COD mg/L	TP mg/L	F- mg/L	BOD mg/L	Electrical Conductivity
Raw water	34000	2558.9	1520	1680	12.9 ms/cm
After Acid Precipitation	21413	1211.2	1505	1520	14.84 ms/cm
After 3D Electro-Coagulation	18804	742.2	741	1460	16.75 ms/cm
After First-Stage Defluoridation	18110	722.4	25		17.62 ms/cm
After Deep Defluoridation	18029	716.8	15		18.33 ms/cm
After UV Fenton	6790	208.6 (Phosphate26)	12	62	23.35ms /cm
After Biochemical Treatment	3280	202	/	/	/
BDD Electro-Oxidation for 12 min	**146.8**	**22**			**20.75 ms/cm**
Deep Phosphorus Removal		<0.5			

Application Case #04

Lithium Wastewater (1)

Extraction waste liquid precious fine metal recovery

Project Name:
Brunp Recycling

Treated Water Quantity:
50 m^3/d

Treated Quality:
Influent water COD<1000mg/L

Effluent Wastewater:
COD<500mg/L

BDD Anode:
15 m^2

Floor Area:
4 m^2

Current (A)	Voltage (V)	Time (h)	COD mg/L	Removal Ratio
6000	10.7	0h	854.3	
6000	10.7	2h	492.8	42.3%
6000	10.7	4h	**246.9**	**71.1%**
6000	10.7	0h	553.6	
6000	10.7	4h	340.7	38.46%
6000	10.7	6h	203.6	63.22%

Application Case #04

Lithium Wastewater (2)

Lithium recycling wastewater Discharged wastewater

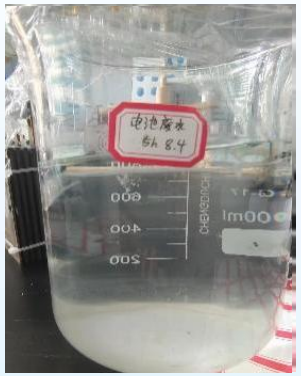
Lithium battery discharge wastewater: front-end treatment of battery disassembly.
Using sodium sulfate solution to conduct electricity, high salt content
Electrolyte leakage, mainly containing fluorine, organic matter, etc.

Reuse of sodium sulfate solution through degradation of organic matter.

Battery

Battery Discharge

Battery Discharge Raw Water



After BDD EO Treatment

Time (H)	Voltage (V)	Current (A)	BDD Anode Area cm²	Comsumption kWh/m³	COD (mg/L)
0	6.77	7.5	150	0	5148
1	6.04			51	2253
2	6.67			102	362
COD Removal Efficiency					92.97%

Time (H)	Voltage (V)	Current (A)	BDD Anode Area cm²	Comsumption kWh/m³	COD (mg/L)
0	6.61	7.5	150	0	12303
1	6.01			51	8854
3	6.58			156	1670
COD Removal Efficiency					86.43%

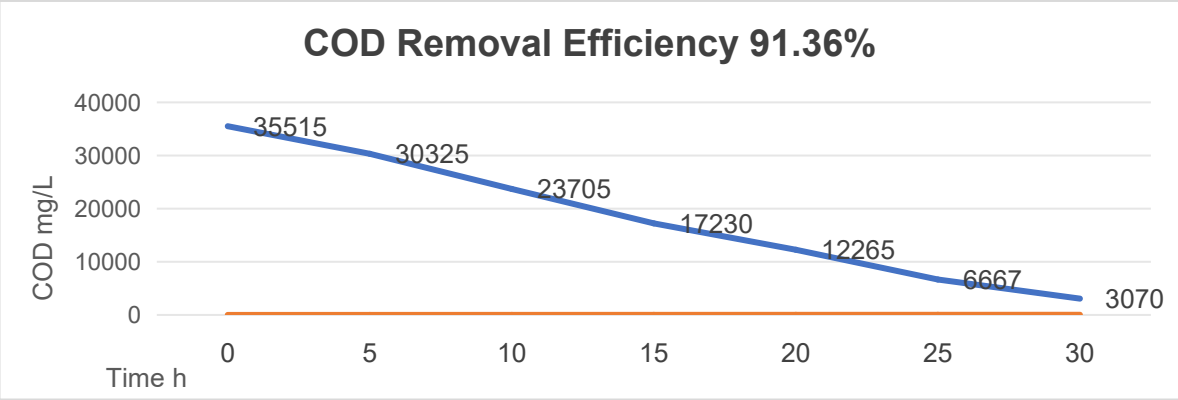
Time (H)	Voltage (V)	Current (A)	BDD Anode Area cm²	Comsumption kWh/m³	COD (mg/L)
0	8	7.5	150	0	43263
2	8			120	34483
4	8			240	25862
COD Removal Efficiency					40.22%

Lithium Wastewater

Resin adsorption solution kettle residue

The organic matter in the nickel sulfate solution is adsorbed by resin, desorbed by organic solvent after saturation, and the desorbed solution is recovered by distillation. The organic solvent is recovered by distillation, and the kettle residue is disposed of as hazardous waste.

Project	Content
C6-C9	9.7-11.8%
C10-C16	12.3-40.5%
Boiling point	165-193℃
COD	35000-40000 mg/L



MC350

Advantage of BDD treatment for Lithium Wastewater

1. The high salt content of wastewater makes it impossible for microorganisms to adapt to survive.

2. The wastewater contains organic phosphorus,kerosene, and is difficult to oxidize and degrade.

3. The evaporated salt output is large, so as to achieve resourcefulness as much as possible and avoid the input of chemicals and impurities.

4. The wastewater contains certain valuable metals, and after evaporation and concentration, the resources can be recovered as much as possible.

5. High electrical conductivity, suitable for electrochemical reactions

6. BDD has high oxygen precipitation point and strong oxidation ability, which can remove difficult to degrade organic matter with high efficiency.

7. The reactants are electrons and no additional chemicals are required.

8. BDD is effective for metal inorganic substances and does not affect the recovery of valuable metals.

Application Case #05

Pharmaceutical wastewater (1)

Main Contaminant: Pyridine, Morpholine and other organic contaminants
Wastewater Volume: 30 tons /day
Original Process: graphite electrode electrolysis, iron carbon micro-electrolysis, air flotation, biochemistry, etc. The degradation of wastewater is difficult to reach the discharge standard.
Water Treatment Mode: Recirculation by Batch Process
BDD Anode: 20.16 m^2
Floor Area: 50 m^2

Time (h)	Voltage (V)	Current (A)	Energy consumption (kW·h/m³)	COD mg/L	NH3- N mg/L	pH
0	6.12	800	0	2275	80.4	9
1	5.56		22.1	1445.25	27.6	6
2.5	5.25		55.3	574.5	2.14	6-7
3	5.18		66.3	339.25	1.2	6-7

Degradation Requirement:

COD < 500mg/L, NH3-N < 50mg/L

Discharge into industrial park's wastewater system after degradation

Application Case #05

【BDD Anode】20.16 m²　　【Floor Area】： 50 m²

Application Case #06

Pharmaceutical Wastewater (2) THF/DMF Wastewater

Project Name: Xi'an Kaixiang Biology **Source:** Pharmaceutical Manufacturer

Volume of Water Treated: 200t/a; 0.6 m^3/d

Beginning Time: Aug, 2022. 24h uninterrupted operation

Requirements: After treatment, go to the biochemical system

BDD Anode: 1.75m^2 **Floor Area:** 1.82m^2

Contaminants	pH	CODCr
Water Inlet	7-8	≤20000mg/L
Water Out	6-7	≤2000 mg/L

MC175

Application Case #07

Pharmaceutical Facility

Located in Henan Province, the company is committed to the research and development, production and sales of biomedicine, and provides related technical consulting, technology transfer and technical services.

Type: Pharmaceutical Wastewater Treatment

Operation: Nov. 2023

Treatment Goal:

To deal with refractory pollutants produced in the production process:

① Triazole ② Benzene ring sulfonamide

To Control CODcr, ammonia nitrogen and other pollution emission indicators. No need to add chemical reagent, no secondary pollution, Operating costs reduced.

BDD Anode: 19.5 m^2 **Floor Area:** 15 m^2

Water Volume: 24 m^3/d

Parameter	pH	CODcr(mg/L)	Ammonia Nitrogen (mg/L)	Power Consumption (kwh/ton)
Inlet Water	4-5	≤7000	≤60	55
Outlet Water	6-9	≤1000	≤25	

Application Case #08

Chemical Industry Wastewater

Water Streams	Extra Water	ZIP Filtrate	Ti-si Wastewater	Electrodialysis Effluent	Mixed Water
Daily Volume	5	10	17	20	10
Inlet COD (mg/L)	<44000	<18000	<4000	<3000	<15000
Outlet COD (mg/L)	<800				

Project Name: ChangLing Petroleum Project
Resource of Wastewater: Production of Petrochemical Catalyst
Beginning Time: Nov, 2022, 24h Non-Stop Operation
COD Discharge Limit: <800 mg/L
BDD Anode: 56 m^2
Floor Area: 20 m^2

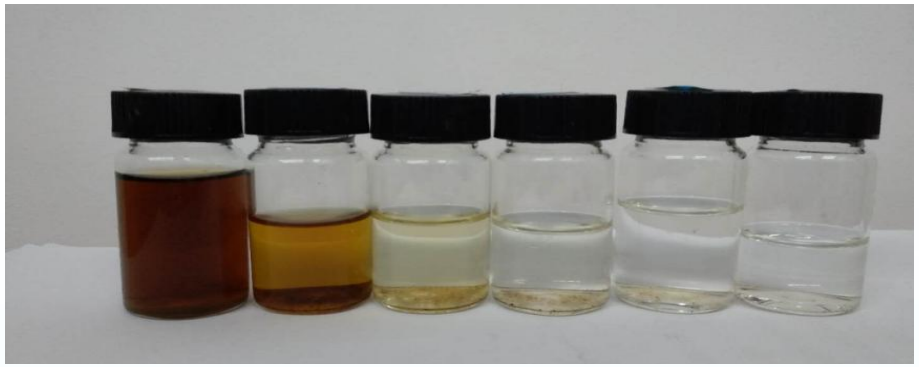
Application Case #09

Pesticide Wastewater

Raw water is light yellow, with a slight irritating odor, contains sodium sulfonate, nitrate, ammonia nitrogen, trace tin, iron; The salt content is 34% and cannot be crystallized by evaporation.

The BDD reaction produces almost no foam during degradation, a very small amount of precipitation, and all the total nitrogen is converted into sodium nitrate salt.

Time (h)	Voltage (V)	Current (A)	Electrode area(cm^2)	Consumption ($kW\cdot h/m^3$)	COD mg/L	pH
0	4.81	4.5	150	0	97746	6
24	4.85			577.2	37608	6-7
28	4.87			673.4	14410.5	8-9
32	4.77			769.6	5294.3	8-9
36	4.77			865.8	2301.7	8-9



Application Case #10

Pesticide Wastewater

Project name: LiaoNing Xianda

Resource: Pesticide production

Volume of water treated: 200t/a, 0.6m3/d

Beginning time: Oct,2022,24h uninterrupted operation

Requirement: After treatment, go to the biochemical system MC088

BDD Anode: 0.84m^2

Floor Area: 1.4 m^2

Electrolysis Time (h)	Voltage (V)	Current (A)	Cumulative Electricity Consumption (kWh/ton of water)	COD mg/L
0	8.0	9.0	0	90518
2	6.95	9.0	125.1	60345
4	7.07	9.0	252.3	47414
6	7.13	9.0	380.7	42026

Application Case #11

Pesticide Chemical Enterprise

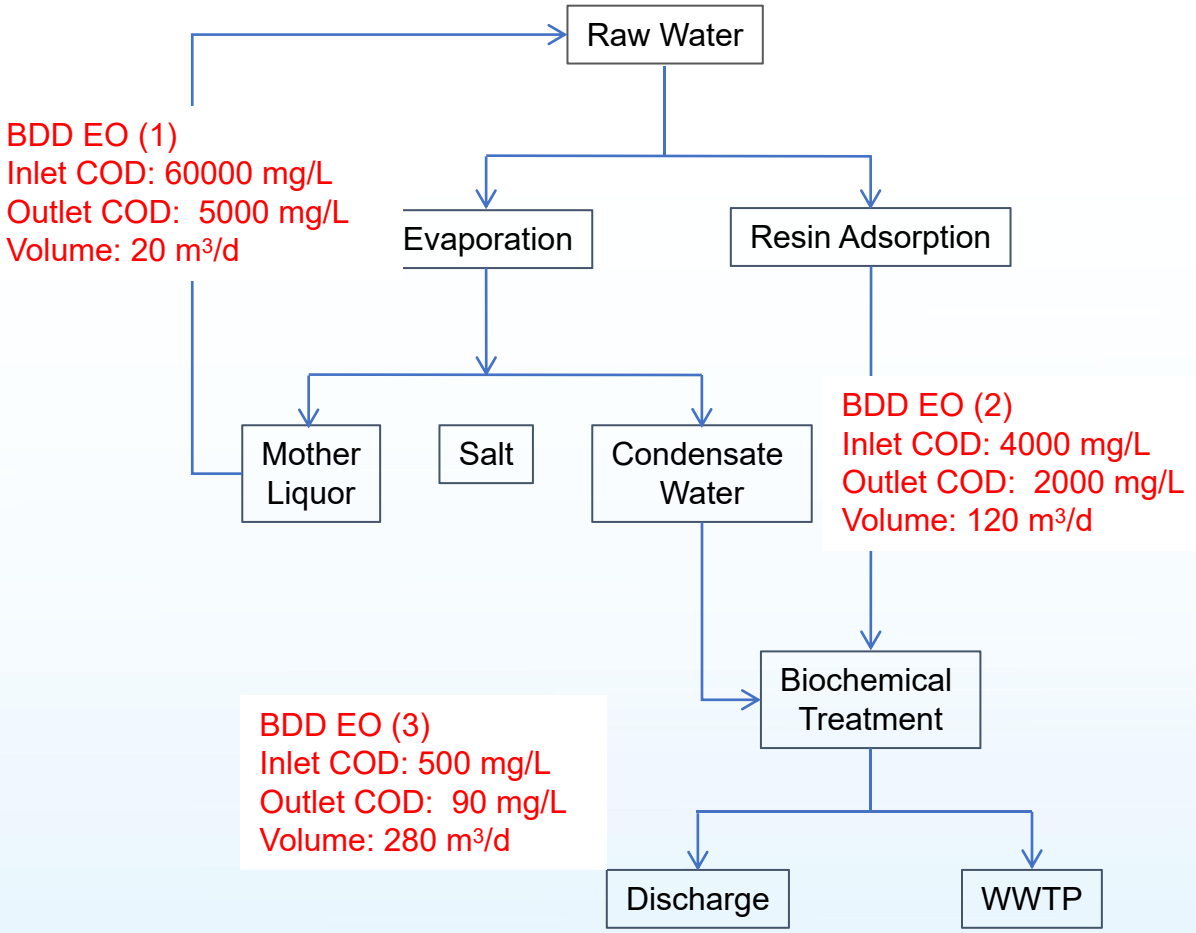
The company is located in Guangdong Province, mainly engaged in biopesticide technology research and development, pesticide production and wholesale and retail, special chemical product manufacturing and sales, chemical product production and sales.

Operation: July 2023

Treatment Goal:

1. Treat CODcr in evaporated mother liquor, resin effluent and resin desorption liquor produced in the production process to reduce hazardous waste;
2. Pretreatment before biochemical treatment to improve BOD/COD ratio;
3. After biochemical treatment, the advanced treatment can further degrade CODcr to reach the in-line standard.

BDD Anode:	Floor Area:	Water Volume:
66 m²	17 m²	280 m³/d



Process Flow Diagram

Application Case #12

Emulsified Wastewater

Electricity Consumption: 120 kWh/m^3

Time(h)	COD (mg/l)	Degradation
0	12880	/
0.5	1430	88.9%
1	169	98.7%
1.5	36	99.7%

Operation Parameter

Current Density: 65 mA/cm^2;

Operation Voltage: 7V

BDD Electrode Area: 8 m^2

1st handling capacity: 9 t/d ; **2nd handling capacity:** 12 t/d

Location: Shenyang release agent wastewater

Application Case #13

Waste Leachate

Project Name: Integration Equipment
Resource of Wastewater: Waste transfer station biochemical effluent
Water Volume: 10 m^3/d
Beginning Time: July, 2022, 24h uninterrupted operation
Processing Requirements: To treat Biochemical Effluent Residual, Non-Degradable COD, Ammonia Nitrogen, Chromaticity
BDD Anode: 0.84 m^2 **Floor Area:** 0.5 m^2

ME21424

Application Case #14

Concentrated Wastewater(NF/RO)

High-salt Reverse Osmosis Wastewater

Water Quality Condition:

1.Contains 2%-3% inorganic salts and organic salts;
2.COD about 590mg/L;
3.Electrical conductivity 20-32ms/cm;
4.Ammonia nitrogen 15.6mg/L.

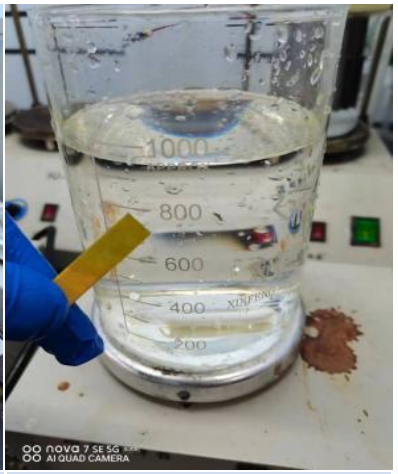
Processing Objectives:

1.Removal of COD down to 50mg/L
2.Removal of ammonia nitrogen to below 5mg/L

Raw water

Turn on the power and reaction starts quickly to yellow

After 1min reaction, the salt color turn light



After 1.0h, No color

Cumulative Electrolysis Hours (h)	Volt (V)	Current (A)	Cumulative Electricity Consumption per Ton of Water	COD (mg/L)	Total Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	PH
0	6.07	9.0	0	590.0	62.7	15.6	7.0
1	5.88	9.0	52.92	10.0	0	0	7.5

COD Removal Efficiency: **98.31%**

Application Case #15

Coking Wastewater

Water quality condition

Complex composition of coking wastewater

Contains a large amount of non-degradable substances and toxic and harmful substances (phenol and aromatic hydrocarbons, etc.) high, organic substances are very stable.

· Poor biochemical properties.

· High concentration of ammonia nitrogen.

· Large variation in water quality.

Processing Objectives:

1.Removal COD, Down to 50mg/L

2.Phenol reduced to below 5mg/L

Time(h)	Voltage(V)	Current(A)	Electrode Area(cm^2)	Consumption(kWh/m^3)	COD (mg/L)	Phenol (μg/L)
0	8.16	10.5	150	0	4757	79200
1	8.10			84	2544	17.9
2	8.05			168	688	2.68
3	8.20			252	235	<1.5
4	8.31			336	73.2	ND
5	8.15			403	45	ND

COD Removal Efficiency: **99.05%**

Application Case #16

PVA Wastewater

Project Name: Hunan HuiTong new material company
Resource: Wastewater from Production of metal fiber
Handle Capacity: 200m³/a , 0.6~1 m³/d
Beginning Time: Jun.2022,24h uninterrupted operation
Requirement: Achieve《Comprehensive sewage treatment discharge standards》3rd discharge degree
BDD Equipment: EQ350S; BDD Anode: 3.5 m³; COD from 20000 mg/L to 100 mg/L

Application Case #17

Fine Chemical Processing Factory

BDD Anode: 36 m^2 **Floor Area:** 10 m^2 **Water Volume:** 5 m^3/d

Application Case #18

Fine Chemical Processing Factory

The company is located in Anhui Province, focusing on the R&D and production of new chemical materials.
This project is mainly to degrade acidizing wastewater in the production process of alicydiol.

Type: Chemical Wastewater Treatment
Operation: Jan. 2023
Treatment Goal:
To deal with pollutants generated in the production process:
① Tert-Butyl Alcohol ② Potassium Permanganate ③ Ene
④ Phosphoric Acid ⑤ Isopropyl Acetate, etc
To control the emission index of CODcr, ammonia nitrogen and so on, improve the purity of potassium dihydrogen phosphate in wastewater.

Parameter	pH	CODcr(mg/L)	Saltness
Inlet Water	3-4	≤34700	5%
Outlet Water	/	≤500	/

Other Cases: Advanced Treatment

#1 Coal Tar Wastewater

Time (min)	Voltage (V)	Current (A)	Electrode Area(cm^2)	Electricity Consumption($kW.h/m^3$)	COD (mg/L)
0	6.85	8	170	0	170
5	6.82			4.53	140
10	6.76			9.1	52
15	6.74			13.6	20
20	6.78			18.1	10

#2 Petrochemical Industrial Park Wastewater

Time (min)	Voltage (V)	Current (A)	Electrode Area (cm^2)	Electricity Consumption (kWh/m^3)	COD (mg/L)	pH
0	7.05	4.5	150	0	112.3	6
10	6.98			5.2	71	6
15	6.85			7.7	56.5	6
20	6.74			10.3	32.2	6

#3 Electronic Material Production Wastewater

Time (min)	Voltage (V)	Current (A)	Electrode Area (cm^2)	Electricity Consumption (kWh/m^3)	COD (mg/L)	Conductivity (Ms/cm)
0	9.68	4.5	150	0	73.3	5800
3	10.08			2.5	46.6	

Application Summary

According to the previous degradation cases and analysis of various types of water quality, BDD electro-oxidation technology can
①pre-treat high salt and high organic wastewater to reduce toxicity and improve biodegradability.
②directly degrade as the main process of COD removal.
③be a deep treatment to reach the standard.

This advanced technology can treat
1. All kinds of wastewater with strong acid and alkali corrosion except fluorine ion.
2. High organic, high salt wastewater, such as lithium extract, leaching waste, post-membrane concentrate, post MVR concentrate.
3. Toxic and harmful wastewater, such as pesticide, pharmaceutical, fine chemical wastewater.
4. Various waste liquids defined as hazardous waste (emulsions).
5. Standard upgrading and end-of-pipe treatment.

As an important step for wastewater treatment, BDD takes advantage of its unique strengths for the oxidation and decomposition of refractory organics in wastewater.

BDD electrode technology can be combined with evaporation, membrane filtration, biochemistry, other electrochemistry, ozone catalytic oxidation, ultraviolet catalytic oxidation and other technology, to achieve the stable standard of waste water treatment and energy saving and consumption reduction.

Advantages of BDD Equipments Installation & Operation

1.Electrons transfer as clean reagent, no need to add other chemicals.

2.Degradation in room temperature and pressure.

3.Small area for the equipment,and it is movable.

4. Ensure stable effluent quality by adjustment of input voltage and current.

5. Low voltage and DC power for easy operation.

6. No Sludge produced. Odor free.

7. No requirement for storage of ozone.(as with other oxidation process)

8. The equipment is suitably designed for all climate zones and achieve maximum efficiency in each process step.

9. The equipment can be easily transported by land or sea due to its modular construction.

10. Option to install in site-built tanks.

11. The equipment is modular, fully automatic plug & play and can be combined with other process technologies to meet strict compliance limits.

12. The modules can be added on to upgrade existing equipment to meet new emission requirement.

13. Rapid installation and setup of the system as the modules are preinstalled.Simply connect the system to the electricity supply, then connect the inlets and outlets.

Thanks

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