Electrolytic Purification of Contaminated Waters by using Oxygen Diffusion Cathodes

Inventor: Casado Gimenez, Juan, Barcelona, ES
Brillas Coso, Enrique, Barcelona, ES
Bastida Bonany, Rosa Maria, Barcelona, ES
Vandermeiren, Michel, Brussels, BE
Assignee: Sociedad Espanola de Carburos Metalicos, S.A. (03), ES
Carburos Metalicos S A ES (Code: 19719)
Examiner: Phasge, Arun S. (Art Unit: 171)
Law Firm: Steinberg & Raskin, P.C.

	Publication Number	Kind	Date	Application Number	Filing Date
Main Patent	US 6224744	A	20010501	US 97511860	19971014
CIP	Abandoned			US 535223	
Priority				ES 94299	19940216

Current US Classification (Main): 205756000 (X-ref): 204275100; 204277000; 205758000; 205759000
US Classification on document (Main): 205756 (X-ref): 205758; 205759; 2042751; 204277
International Classification (Edition 1): C02F-001/461
Examiner Field of Search (US): 205756; 205758; 205759; 2042751; 204277

Cited US Patents:

Patent Number	Date YYYYMM	Main US Class	Inventor
US 3793173	197402	204149	Kawahata
US 4300987	198111	204129	Tseung
US 4585710	198604	429027	McEvoy
US 4885217	198912	429027	Hoge
US 4927509	199005	204083	Mathur

Cited non-US Patents:

Patent Number	Date YYYYMM	Main US Class	Main IPC
CN 5119363	197606		
EP 231100	198708		
EP 248433	198712		
ES 2080686	199402		
FR 2270211	197512		
GR 320453	197201		
GR 962212	198209		
GR 966028	198210		
JP 4118091	199204		
JP 4197489	199207		
WO 7900347	197712		

Cited non-Patent References:
Journal of Applied Electrochemistry; An Integrated Electrochemical--Chemical Method for the Extraction of O.sub.2 from Air; Tseung, A.C.C., Jasem, S.M. (1981) 209-215 (No month).
Pryolysis of Sewage Sludge and Plastics in a Fluidized Bed Reactor, Stammbach, Marc R. et al. (No date).

J. Chem Soc., Faraday Trans. L.; Oxidation of 2,4-Dibromo-6-nitroaniline in Aqueous Sulphuric Acid Solutions on a Platinum Electrode; Arias, Santiago et al. 1987, 83 (8), 2619-2633 (No month).
Pedido Unginal, P. Cabot (2 pages) (No date).
Journal of Applied Electrochemistry; Thin-film Catalyst Layers of Polymer Electrolyte Fuel Cell Electrodes; Wilson, M.S., Gottesfeld, S. 22(1992) 1-7 (No month).
Process Technologie for Water Treatment; Treatment Techniques for Wast Water from Chemical Industries; Plattner, E., Comninellis, Ch. 1988 205-217 (No month).
Electrochemical Oxidation of 2,4-Dibromoaniline in Aqueous Sulphuric Acid Solutions, Arias, S. Brillas, E. 1985; vol. 30, No. 11, pp 1441-1448, No month.
J. Electroanal. Chem., Effect of Methyl Groups as o-Substituents on the Anodic Decomposition Pathways of Substitute p-Bromoanilines in Aqueous Sulphuric Acid Solutions at a Platinum Electrode; Arias, S., Costa, J.M. 283 (1990) 231-250 No month.
J. Electrochem. Soc., The Anodic Decomposition Pathways of Ortho- and Meta-substituted Anilines; Hand, Rodney L., Nelson, Robert F. 125 (1978) 1059-1069 No month.
J. Electroanal. Chem., Electrochemical Behavior of Mesidine in Aqueous Solutions; Desideri, P.G., et al. 63 (1975) 187-196 No month.
J. Electrochem. Soc., Bi-Functional Oxygen Electrode Using Large Surface Area La.sub.1-x Ca.sub.x CoO.sub.3 for Rechargeable Metal-Air Battery; Shimizu, Youichi, et al., vol. 137, No. 11 (1990) 3430-3433 No month.
The Canadian Journal of Chemical Engineering; Anodic Oxidation of Phenol for Waste Water Treatment; De Sucre, V.S., Watkinson, A.P., vol. 59 (1981) 52-59 No month.
Journal of Applied Electrochemistry; Anodic Oxidation of Phenol for Waste Water Treatment; Comninellis, Ch., Pulgarin, C. 21 (1991) 703-708 No month.
J. Electroanal. Chem.; Mechanistic Aspects of Cathodic Oxygen Reduction, Fischer P., Heitbaum, J., (1980) 233-238 No month.
Journal of Applied Electrochemistry; Electrochemical Waste Water Treatment Using High Overvoltage Anodes. Part I: Physical and Electrochemical Properties of SnO.sub.2 Anodes; Kotz, R, et al. 21 (1991) 14-20 No month.
Journal of Applied Electrochemistry; Anodic Oxidation of Aniline for Waste Water Treatment; Kirk, D.W. et al., 15 (1985) 285-292 No month.

Fulltext Word Count: 5943
Number of Claims: 19
Exemplary Claim Number: 1
Number of Drawing Sheets: 1
Number of Figures: 1
Number of US cited patent references: 5
Number of non-US cited patent references: 11
Number of non-patent cited references: 16
Calculated Expiration Date: 20171014

Abstract:
The process comprises the oxidation, in an electrolytic cell provided with at least one anodes of pollutants which contaminate wastewaters, and is characterized in that oxygen is diffused in the electrolytic cell cathode or cathodes subjected to a voltage lower than 100 V in order to reduce said gas to a dissolution oxidizing species selected among hydrogen peroxide or hydroxyl and/or peroxydril

(HO[sub]2[sup][multiplication dot]) radicals. The equipment for implementing said process comprises an elecrolytic cell continuously supplied and provided with an anode (1) and two oxygen diffusion cathodes (2) and is sealed on either side with a frame (3), said frames and cathodes delimiting the compartments (4) which are supplied with oxygen gas and/or gas mixtures containing oxygen through inlets (6); similarly, the cathode and the anode delimit the compartments (5) through which circulates the contaminated water entering through the inlet (5) and coming out through outlets (8). The electrolytic cell of the invention provides for the treatment of contaminating waters which contain toxic, non biodegradable substances or substances which cannot be oxidized by conventional processes.

What is claimed is:

1. An electrolytic cell apparatus for treatment of wastewater comprising pollutants, said electrolytic cell comprising:
   at least two frames;
   at least one anode;
   at least one oxygen diffusion cathode which is impermeable to water;
   at least one first compartment delimited between at least one of said frames and said at least one cathode, said at least one first compartment, having a first inlet;
   a source of oxygen which causes oxygen or a mixture of gases containing oxygen to be added to said electrolytic cell through said first inlet;
   at least one second compartment delimited between said at least one anode and said at least one cathode, said at least one second compartment having a second inlet; and
   a source of wastewater which causes said wastewater to be added to said electrolytic cell through said second inlet. (Main Claim)
2. The apparatus of claim 1, wherein said at least one second compartment further comprises an outlet, and said wastewater added to the electrolytic cell flows from said second inlet to said outlet.
3. The apparatus of claim 1, wherein said at least one cathode comprises carbon and a water-repellant polymer or polymeric agglomerant.
4. The apparatus of claim 3, wherein said water-repellant polymer is polytetraflouroethylene.
5. The apparatus of claim 3, wherein said oxygen diffusion cathode further comprises a metallic mesh structure.
6. The apparatus of claim 5, wherein said metallic mesh structure comprises a metal selected from the group consisting of nickel, silver, or stainless steel.
7. The apparatus of claim 1, wherein said at least one anode comprises a metal or metal oxide.
8. The apparatus of claim 7, wherein said metal or metal oxide is selected from the group consisting of lead dioxide, tin dioxide, platinum, titanium or mixtures thereof.
9. The apparatus of claim 7, wherein said anode further comprises doping or catalyzing species.
10. The apparatus of claim 9, wherein said doping species are selected from the group consisting of antimony and bismuth.
11. The apparatus of claim 1, wherein the cathodes and anodes are disposed in a vertical position and parallel to each other.
12. The apparatus claim 1, wherein oxidation of said pollutants occurs at said at least one anode and near said at least one cathode.
13. The apparatus of claim 1, wherein said at least one anode is a chemically inert, high oxygen overvoltage anode.

14. A process for the treatment of wastewater comprising pollutants in an electrolytic cell comprising at least one anode and at least one cathode, said process comprising:
contacting said wastewater comprising pollutants with said at least one anode and said at least one cathode, said at least one cathode being an oxygen diffusion cathode which is impermeable to water;
supplying oxygen gas or a gaseous mixture containing oxygen to said at least one cathode;
forming oxidizing species at said at least one anode and near said at least one cathode, said oxidizing species being selected from the group consisting of hydrogen peroxide, peroxhydril and hydroxyl radicals and mixtures thereof; and
oxidizing said pollutants at said at least one anode and near said at least one cathode.
15. A process as claimed in claim 14, said process further comprising circulating said wastewater through said electrolytic cell under turbulent conditions.
16. A process as claimed in claim 14, said process further comprising contacting said wastewater with an electrolyte selected from the group consisting of an acid, alkali, salt or hydroxide.
17. A process as claimed in claim 14, said process further comprising irradiating said wastewater with ultraviolet or visible light.
18. A process as claimed in claim 14, said process further comprising contacting said wastewater with a redox catalyst selected from the group consisting of iron, silver, or cobalt ions.
19. A process as claimed in claim 14, wherein no oxygen bubbles are formed at said at least one cathode.