

## Direct versus indirect electrochemical oxidation of pesticide polluted drainage water containing sodium chloride

Muff, Jens; Erichsen, Rasmus; Damgaard, Christian; Søgaard, Erik Gydesen

*Published in:*  
Book of Abstracts - Electrochemistry for a Healthy Planet

*Publication date:*  
2008

*Document Version*  
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*  
Muff, J., Erichsen, R., Damgaard, C., & Søgaard, E. G. (2008). Direct versus indirect electrochemical oxidation of pesticide polluted drainage water containing sodium chloride. In *Book of Abstracts - Electrochemistry for a Healthy Planet: 6th Spring Meeting of the International Society of Electrochemistry* (pp. 267). International Society of Electrochemistry.

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

### Take down policy

If you believe that this document breaches copyright please contact us at [vbn@aub.aau.dk](mailto:vbn@aub.aau.dk) providing details, and we will remove access to the work immediately and investigate your claim.



## **Direct versus indirect electrochemical oxidation of pesticide polluted drainage water containing sodium chloride**

Jens Muff, Rasmus Eriksen, Christian Damgaard, Erik G. Søgaaard  
*Esbjerg Institute of Technology, Aalborg University*  
*Niels Bohrs Vej 8, DK-6700 Esbjerg, Denmark*  
*jm@aaue.dk*

Drainage water from a depot of chemical waste, polluted with a mixture of organophosphates and degradation products was treated by a direct as well as an indirect electrochemical method using a Ti/Pt-Ir anode and Stainless Steel 304 cathode. With a concentration of 0.7%, sodium chloride was the main electrolyte. The direct electrochemical treatment showed a first order degradation of COD with an optimal energy consumption of 110 kWh/kg COD<sub>r</sub>. At constant current, addition of sodium chloride resulted in increased degradation up to 2%, whereas no further degradation was obtained at higher concentrations. Analyses of the actual pollutants, Me-Parathion, parathion, malathion and degradation products, confirmed that the concentrations of all initial pollutants were eliminated during the treatment. The only exception was O,O,O-triethyl-phosphoric acid, a degradation product which was formed during the treatment. Indirect electrochemical treatment, where a highly oxidized brine solution was added to the drainage water, revealed immediately reduction in COD, and similar to the direct treatment, degradation of all of the pesticide pollutants was obtained except for the O,O,O-triethyl-phosphoric acid.

The experiments proved that the obtained degradation of pesticide solely was caused by indirect electrochemical oxidation, mainly due to the electrolytic formation of hypochlorite during the treatment, and that direct electron transfer from the pesticide substances at the anode surface didn't significantly contribute to the degradation. Experiments with addition of aqueous sodium hypochlorite solution to the drainage water revealed that hypochlorite was the main oxidizing agent responsible for the indirect oxidation.

The experimentally obtained results for the pesticide degradation were compared to theoretic calculations of degradation rate of parathion using the actual experimental conditions and reactor design. These calculations showed that applying expressions for fractional conversion in a PFR reactor, assuming mass transfer as the limiting step, direct oxidation of the non-ionic pesticide substances due to convection and diffusion was negligible compared to electrolytic oxidation of chloride with subsequent indirect oxidation by hypochlorite due to the high impact of the electric field on the chloride ion. In this way, the theoretical calculations supported the experimental results.