

Removal of pesticides (metaldehyde and oxadixyl) and other problem organic micro-pollutants from water using the Arvia™ treatment process

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Introduction

- The Arvia™ process is a coupled adsorption and electrochemical regeneration process, which was developed as a spin-off from the University of Manchester in 2007. The process has been shown to be effective for the removal of a variety of organic pollutants in drinking waters and wastewaters alike.
- The effectiveness of the Arvia™ process has been comprehensively demonstrated for a common Molluscicide, Metaldehyde, and a systematic fungicide, Oxadixyl, for which concentrations in water designated for human drinking have frequently breached UK and EU regulatory limits of 0.1 µg/l in recent years [1]. Furthermore, a wide range of pharmaceutical compounds, endocrine disruptors, carcinogens and environmental disruptors found in wastewater can be treated in much the same way - and to below regulatory limits - using the process.
- Arvia's Organics Destruction Cell (ODC) consists of a pair of electrodes, a patented conductive adsorbent Nyex™ and a separator membrane [2].

Case study I: A successful treatment programme for Metaldehyde

Metaldehyde is a selective pesticide used by farmers and gardeners to control slugs and snails in a wide variety of crops [1].

- Between 2008-2012, over 1400 Tonnes of Metaldehyde was used in the UK alone [3].
- It is estimated that over 8% of arable cropland in the UK is treated with this Molluscicide [4].
- Existing traditional treatment technology available on the UK market is not able to treat Metaldehyde safely and efficiently.



- Arvia Technology Ltd. have developed a cost effective solution to the problem that metaldehyde poses.
- A full scale demonstration plant has been deployed for use by a major UK water company for metaldehyde remediation.

Figure 1 shows our flagship treatment tank (ODC22-100) readily integrated and fully containerised ready for deployment to our customer's site. The unit has a hydraulic flow capacity of ca. 11 m³/h.



Figure 1 – Arvia's ODC 22-100.

Successful treatment of Metaldehyde by the Arvia™ process to below the EU/UK regulatory limit is shown below in Figure 2.

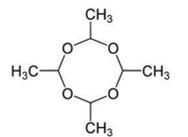
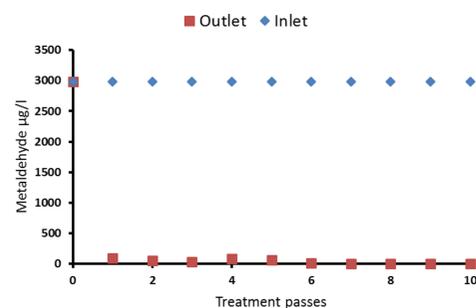


Figure 2 – Metaldehyde removal from tap water. Experimental setup was in pendulum passes, with each treatment pass representing 24h treatment.

Case study II: A successful treatment programme for Oxadixyl

Oxadixyl is a systemic fungicide commonly used for seed treatment.

- Oxadixyl was historically applied for the blight treatment of potatoes but has been banned since 2003.
- Residual concentrations of Oxadixyl have recently been detected in Jersey water.
- The regulatory limit for Oxadixyl is 0.1 µg/L.
- Arvia™ conducted a process trial with successful removal of oxadixyl from 0.123 µg/L to <0.005 µg/L.
- Current discussions are centred on plant sizing.

Determinand	Inlet – µg/l	Outlet – µg/l
Diuron	0.010	<0.003
Clomazone	0.003	<0.002
Oxadixyl	0.123	<0.005
Metalaxyl	0.002	<0.002
Metazachlor	0.021	<0.002
Ethoprophos	0.003	<0.002
Primiphos-ethyl	0.001	<0.001
2,4-D	0.015	<0.007
Atrazine Desethyl	0.003	<0.001
Atrazine Desisopropyl	0.010	<0.001
Boscalid	0.009	<0.005
Carbendazim	0.004	<0.001
Clopyralid	0.008	<0.005
Fluxifop-butyl	0.001	<0.001
Gamma-HCH	0.009	<0.001
MCPP (Mecoprop)	0.005	<0.003
Terbutryn	0.001	<0.001

- Table 1 shows the analytical results obtained from the process trial for treating oxadixyl.
- Process trial successfully removed oxadixyl from raw water supplied by the customer to below the regulatory limit.

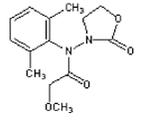


Table 1 – Oxadixyl removal by the Arvia Process in raw water

Case study III: Comprehensive treatment of pharmaceuticals

Improvements in analytical techniques coupled with tightening legislation [5] means that there is need for innovative methods to treat water as traditional technologies are failing to remove organic contaminants to meet discharge consents.

- While individual organic compounds may not present particularly high toxicity alone, mixtures of contaminated waters may pose cumulative effects greater than the sum of risks posed by individual contaminants due to inherent difficulty in Eco-toxicological quantification of mixtures of chemicals [6].

- Arvia's technology has proven to be capable of removing problematic compounds, including those specified in EU and UK regulations – *some of the strictest in the world*.

- Figure 3 shows the graphical representation of the data obtained for the individual compounds. The initial waste was composed of a cocktail of compounds and the waste was treated in a once-through mode.

- The average energy required for treatment was ca. 0.1 kWh/m³.

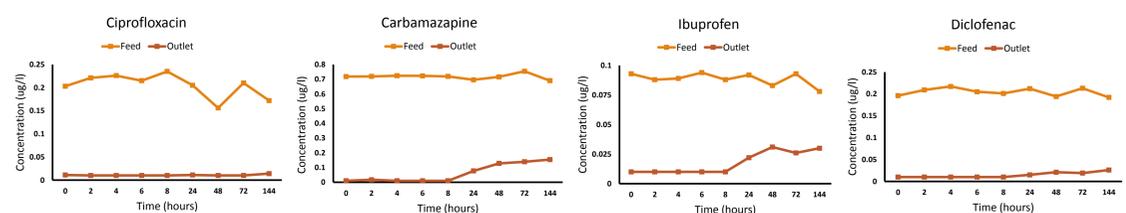


Figure 3 – Feed and outlet (pre and post-treatment) concentrations of commonly found micro-pollutants - Ciprofloxacin, Carbamazepine, Diclofenac [7], and Ibuprofen are shown in µg/l – all plotted against time in hours.

Arvia Technology perfectly suited for treatment of a wide variety of pharmaceuticals and recalcitrant organic contaminants.



Conclusions and further work

- Removal of Metaldehyde has been demonstrated to below EU/UK regulatory limits [8], and the efficacy of our technology has resulted in the deployment of a demonstration plant with a major water company in the UK specifically targeted at the treatment of water contaminated with the recalcitrant Molluscicide.
- Removal of Oxadixyl has been conclusively demonstrated.
- A range of organic compounds which are of concern due to characteristics such as persistence, acute toxicity, reproductive/developmental effects on ecosystems, bio magnification or carcinogenicity – can be successfully eliminated from the water without chemical addition or known generation of toxic by-products.
- Scaled up, the technology is currently being rolled out across the UK and internationally for demonstration stage testing.

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