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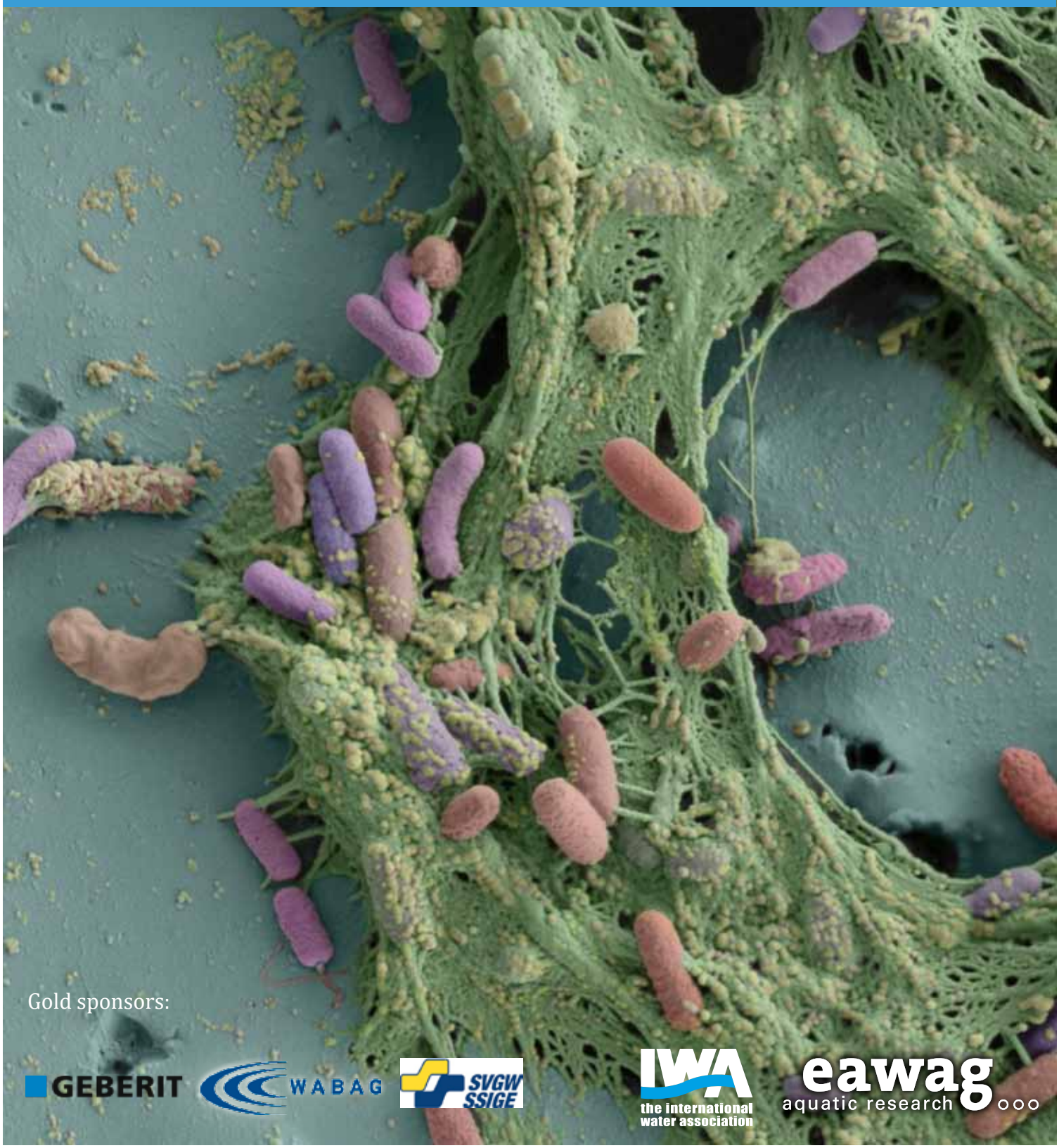

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Removal of pesticides with filter sand from biological rapid sand filters

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Introduction

Groundwater is a widespread drinking water source in Europe where 70% of the population is supplied by treated groundwater (Navarrete et al., 2008), but unfortunately, large parts of this groundwater are contaminated by pesticides. In Denmark approx. 100% of the drinking water is treated groundwater, and in the period from 2010-2012 pesticides were detected in 20-25% of the active waterworks wells (GEUS, 2013). Pesticides can be removed from the water phase by advanced treatment methods such as granular activated carbon (GAC) (e.g. Heijman et al., 2002). In Denmark, waterworks are not designed to remove pesticides and treatment consists of aeration followed by filtration in primary and secondary rapid sand filters. Therefore common practice is to substitute contaminated wells. However, investigations have shown potential for removal of the pesticide MCPP in full-scale rapid sand filters at a groundwater-based waterworks (Hedegaard et al., 2014) and others have found that biological filters used to treat surface water are able to remove pesticides after a six-month adaption period (Zearley and Summers, 2012).

The purpose of this study was to investigate the potential of microbial pesticide removal with filter sand from rapid sand filters. In this study removal of the pesticides MCPP, glyphosate, *p*-Nitrophenol and a degradation compound of bentazone were investigated with filter sand from the full-scale rapid sand filters at Islevbro and Sjælsø waterworks plant I and II.

Material and Methods

Filter sand was collected from the top 20 cm of the investigated rapid sand filter at Islevbro waterworks and Sjælsø waterworks Plant I and Plant II, and experiments were started within 24 hours after sampling. Microcosms were set-up with sand, water and initial pesticide concentrations of 0.04-2.4 µg/L. Water samples were collected from the microcosms. The pesticides were ^{14}C-labelled and the analysis was based on a double vial system where produced $^{14}CO_2$ from mineralisation of the pesticide was stripped off the water sample and captured by a base trap (1 mL 2M NaOH). Thus the produced $^{14}CO_2$ and the ^{14}C-activity of the pesticide in the water phase could be quantified.

Results and Conclusions

The pesticides mecoprop (MCPP), bentazone, glyphosate and the degradation compound *p*-nitrophenol are all among the 20 most frequently detected in Danish drinking water well (GEUS, 2013), and including a transformation product of bentazone these were chosen for the investigation due to their different physio-chemical properties. All the investigated pesticides were removed from the water phase in microcosms with filter sand from all three investigated sand filters. The biological removal was largest at Sjælsø waterworks Plant II, where i.e. up to 43% of the initially added glyphosate was mineralised (recovered as $^{14}CO_2$).

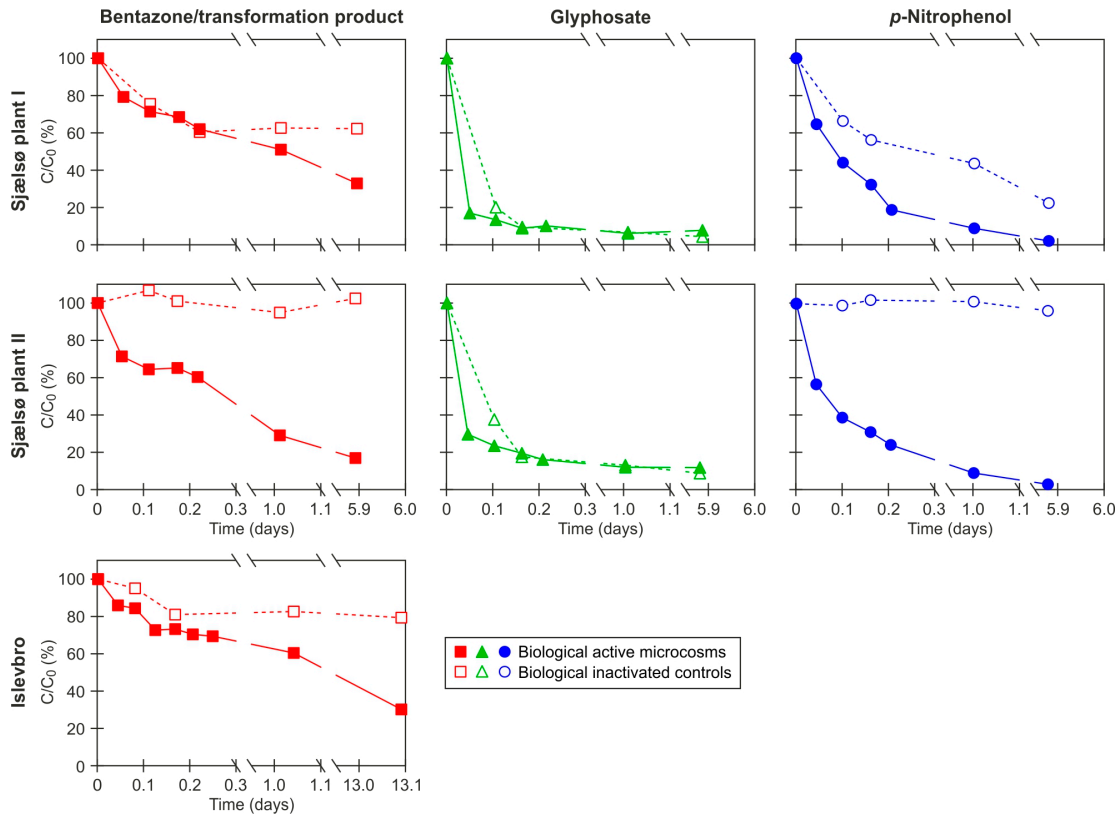

Figure 1.1 The removal potential of bentazone/transformation product, glyphosate and *p*-nitrophenol in filter sand from three different waterworks (modified from Hedegaard and Albrechtsen, 2014).

This investigation shows that there is a potential for using already existing rapid sand filters at Danish waterworks for treatment of pesticide contaminated groundwater.

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