

CASE STUDY: WATER RECLAMATION NEEDS FOR A DRIP IRRIGATED FENNEL FIELD IN FLANDERS

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Abstract

In the light of the European Union's regulation on minimum requirements for the reuse of water in the agricultural sector (2020/741), it is relevant to understand and describe practical implementations. A recent mapping demonstrates that most European reclamation initiatives for agricultural irrigation are located in Southern European countries. Few cases are documented reusing treated urban wastewater for irrigation in North-West Europe, and particularly in Flanders (Belgium). Dry summer periods in recent years have increased the interest in this water source. Flanders is particularly vulnerable because of the low water availability in the area. Moreover, local studies predict fewer precipitations in the summer caused by the effects of climate change. The growing interest in reclaimed water as an irrigation source in the region also raises some barriers towards practical implementations. The case study in Sint-Amands aims to give insights into the reclamation treatment needs and possibilities in a Flemish context. The case study investigated to which extent the treated wastewater from the wastewater treatment plant (WWTP) of Sint-Amands complied with the water quality criteria mentioned in the European regulation for a drip-irrigated fennel field. Moreover, the water quality was evaluated with regards to agronomic guidelines and food security regulations in Flanders.

The water quality parameters studied included organic material, microbiological parameters, heavy metals, salts and nutrients. The Flemish Environmental Agency monitors the water quality of the treated wastewater as mandatory to the Urban Waste Water Directive (91/271/EEC). The parameters include biweekly measurements of organic material (COD, BOD, TSS) and nutrients (NH_4 , NO_3 , NO_2 , N_{TOT} , PO_4 , P_{TOT}) and monthly follow-up of some heavy metals (As, Ag, Cr, Cu, Cd, Hg, Ni, Pb, Zn). A complementary monitoring campaign was set up from January 2020 to evaluate the water quality in terms of microbiological parameters (*E. coli*), salts (Na, Cl, Ca, Mg, SAR) and other nutrients (S_{TOT}).

The drip-irrigated fennel field belongs to water quality class C in the European regulation. Based on the water samples of the year 2020, all measured values for BOD and TSS were well below the criteria set for class C. The treated wastewater never complied with the norms for *E. coli* in class C, which should not exceed 10^3 CFU/100ml. The measured average of the samples amounted to $3,26 \cdot 10^4$ CFU/100ml with minimum and maximum values of respectively $2,48 \cdot 10^3$ CFU/100ml and $1,30 \cdot 10^5$ CFU/100ml.

Other water quality parameters were evaluated from an agronomical perspective based on the guidelines divulged by the Department of Agriculture & Fisheries. Heavy metals detected appeared to be some orders of magnitude below the guidelines. Average values measured for salts such as sodium and chloride were 79,4 mg/l and 129 mg/l. These values are relatively

high. In case high irrigation volumes of this water source are applied in combination with limited precipitations during the winter periods, the leaching requirements for salts might not be reached. This implies that in case frequent use of this water source on the long-term, accumulation of salts in the soil should be considered as a point of attention.

The nutrients' contribution by the reclaimed water application in relation to the crops' nutrient needs was quantified over the growing season. This was done based on the nutrient concentrations in the reclaimed water and the volume of irrigation water applied to the fennel field (1000 m³/ha). The percentage of N-P-K applied through the reclaimed water appeared to be non-significant compared to the standard fertilisation rates. Magnesium and sulphur applied with the reclaimed water represented respectively 13% and between 20-40% of the crops' nutrients demand. This share depends on the crops' irrigation needs applied and the weather conditions during the growing season.

Overall, the treated wastewater in Sint-Amands meets irrigation water requirement regarding the organic material, heavy metals, nutrients and salts. For the latter, caution is advised if used in the long term. The microbiological parameter *E. coli* measured in the treated wastewater never fulfilled the legal water requirements of class C. Therefore, a reclamation treatment including a disinfection step aiming at a 2-3log reduction of the CFU *E. coli*/100ml is necessary in order to reuse the water for agricultural irrigation and complies with the future European legislation. From the monitoring campaign, it is clear the water quality of the treated wastewater fluctuates strongly in time.

A reclamation treatment train including sand filtration, activated carbon and hydrogen peroxide disinfection was performed and evaluated on-site. Samples were taken before the treatment and one hour after the hydrogen-peroxide application. Five doses (varying between 10ppm and 75ppm H₂O₂) were applied. The effect of the hydrogen-peroxide doses implied a reduction of *E. coli* between 42,4% and 90,0%, respectively. This disinfection could not ensure the fulfilment of the legal requirements at all moments. Therefore more research is needed to test at higher doses, longer waiting times prior to sampling and other disinfection technologies.

The research took place within the operational group AWAIR 'gezuiverd AfvalWater voor IRrigatie'.

Keywords: reclaimed water, vegetable production, irrigation, agriculture