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IRON AND MANGANESE INFLUENCE OVER THE NITRIFICATION PROCESS

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Introduction

Ammonium, iron and manganese are some of the compounds found widely spread in groundwater. Such waters are usually improper for human consumption without a proper treatment. This is due to the fact that the presence of iron in the water can increase the turbidity, and global studies have shown that excessive assimilation of manganese can have adverse effects on the human body primarily affecting the nervous system.

Thus, the simultaneous presence of Fe, Mn, NH_4^+ has led to the development of new methods for the replacement of the physicochemical removal methods of Fe and Mn by biological processes, already successfully applied in water treatment containing $N\text{-}NH_4^+ > 1$ mg / L.

Materials and methods

The biological nitrification experiment was conducted in a continuous pilot scale biological aerated filter operated in up flow mode (Figure 1).

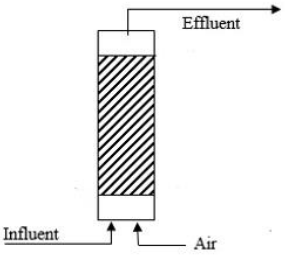

Figure 1. Schematic representation of the upflow biofilter

The influent used consisted of real groundwater enriched with NH_4^+, Fe^{2+}, Mn^{2+} and $H_2PO_4^-$ (table 1).

Table 1. Influent quality parameters

Nr.	Parameter	M.U.	Variation range	L. 458 (r1) /2002, republished in 2011 admited values
1	pH	-	7.03-7.53	6.5 – 9.5
5	**NH_4^+**	**mg/L**	**1.6-6.1**	**0.5**
6	NO_3^-	mg/L	29.8-36	50
7	NO_2^-	mg/L	< 0.1	0.1
8	Fe_t	µg/L	188-818	200
9	Mn_t	µg/L	292-702	50

Results and conclusions

The experiments were conducted over a five months period. SEM investigations revealed the presence of the biofilm on the entire granular surface and inside the granules (figure 2).

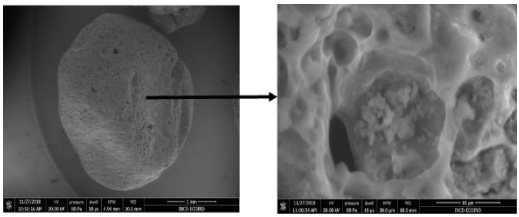

Figure 2. Granule SEM micrograph

The nitrification rates were calculated and the following conclusions were conducted:

- the obtained nitrification rates (NR = 461-622 gN/m^3/day) for influents with significant Fe (Fe_t=188-818 µg/l, Fe^{2+}=114-603 µg/l) and Mn content (Mn_t=292-702 µg/l, Mn^{2+}=268-669 µg/l) at a filtration rate of Wf = approx. 10 m/h, at a temperature range of 11.3-16.5ºC, are higher than those previously obtained on the same groundwater enriched in ammonium but with no significant Fe and Mn content (NR = 387-570 g N/m^3/ day at a temperature range of 11.6-16.9ºC); it can be assumed that the presence of Fe (III) precipitate particles favors the maintenance of the nitrifying biomass in the bioreactor;
- it was also observed that at an empty bed contact time (EBCT) of 4.2-4.5 min, Fe^{2+} oxidation and Fe_t removal were 33 – 71% and 4.9 – 83.3 % respectively; the oxidation increased substantially to 97% by increasing the contact time to 8.8 min;
- on the other hand Mn^{2+} oxidation and Mn_t removal rates were small, ranging between 0.5-17.6% and 1.0-20.9% respectively;
- nitrification and Fe (II) oxidation appears to be possible to achieve in a single nitrification bio filter, with the condition of providing a sufficiently high reaction time, up to 10 minutes.

Acknowledgments

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