



Treatment, at Real Scale, of a Mediterranean Running Water with Acid Mining Drainage (AMD) Characteristics Using Floating Beds



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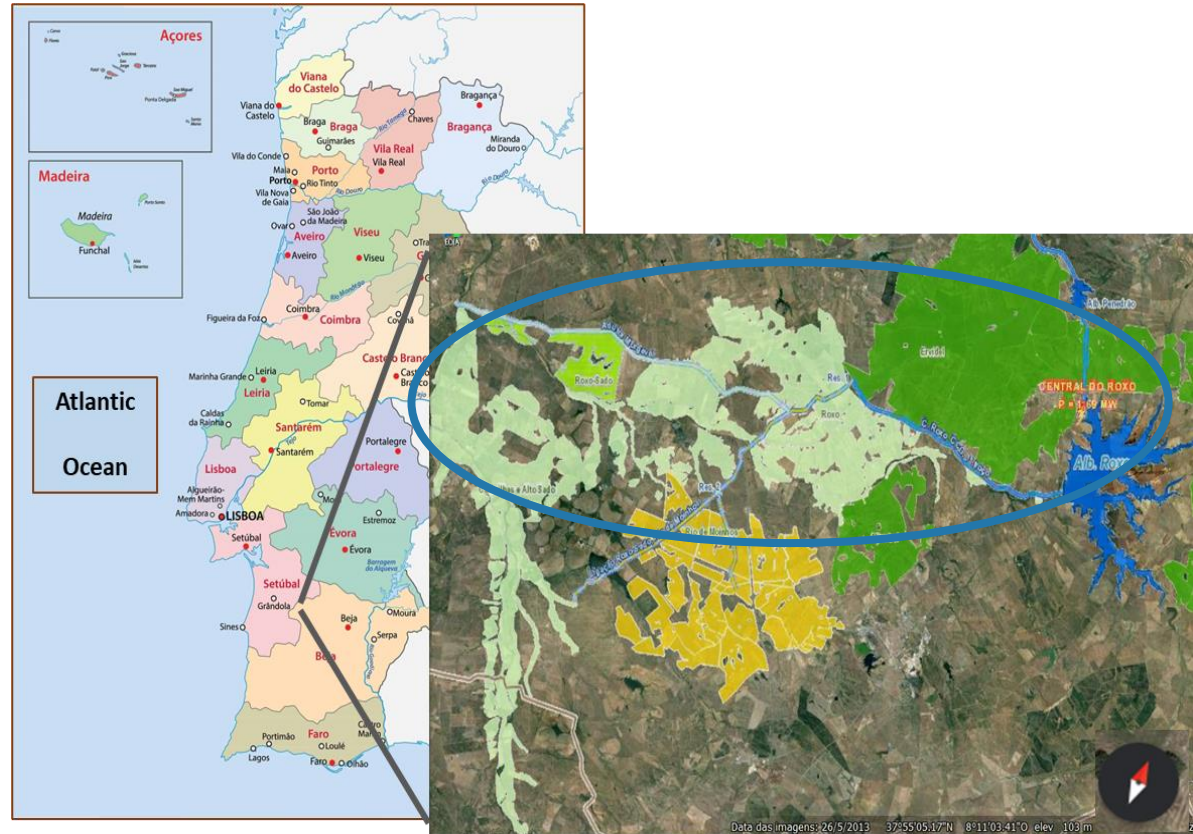
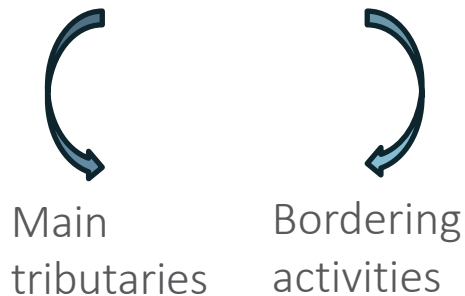
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1. Background

Treatment, at Real Scale, of a Mediterranean Running Water with Acid Mining Drainage (AMD) Characteristics Using Floating Beds

- The Roxo Stream is located in Alentejo (Southern of Portugal)

Poor Water Quality



1. Background

Treatment, at Real Scale, of a Mediterranean Running Water with Acid Mining Drainage (AMD) Characteristics Using Floating Beds

Mining Activity (Iberian Pyrite Belt)

Acid Mine Drainage (AMD)

Água Forte Stream- High acidity, toxic metals and sulphate contents

Impacts on soil, water resources and aquatic communities

Eco-rehabilitation measures

2. Aim of the Work

Treatment, at Real Scale, of a Mediterranean Running Water with Acid Mining Drainage (AMD) Characteristics Using Floating Beds

The aim of this work was to test, at real scale, the possibility of using the technique of Floating Beds in order to treat, the water of Água Forte stream, with the propose to improve their quality. This improvement should minimize the negative impact on agricultural practices around the Roxo stream.



3. Methodology

Treatment, at Real Scale, of a Mediterranean Running Water with Acid Mining Drainage (AMD) Characteristics Using Floating Beds

pH, SO_4^{2-} , Cl^- , Zn^{2+} , Cu^{2+} , Fe^{2+} and Mn^{2+} exceed the maximum recommended value (MVR)



Is not able for irrigation

Non-compliance for the parameters
pH e NH_4^+



Poor ecological state, when evaluated only for the physicochemical parameters.

Table 1. Water physicochemical quality characterization of "Água Forte" stream (Mean \pm SD, n=30).

Parâmetros	Unidades	Qualidade da Ribeira de Água Forte	Qualidade das águas destinadas à rega Decreto-Lei n.º 236/98 (Anexo XVI)		Estado Ecológico Instituto da Água, 2009
			VMR	VMA	
pH	Escala de Sorensen	3,2 \pm 0,1	6,5-8,4	4,5-9	6-9
T _w	°C	17 \pm 2	-	-	-
Eh	mV	522 \pm 19	-	-	-
B ³⁺	mg/L	0,3 \pm 0,1	0,3	3,75	-
EC	$\mu\text{S}/\text{cm}$ 20°C	1 813 \pm 117	-	-	-
DO	mg/L	7 \pm 1	-	-	≥ 5
COD	mg/L O ₂	30 \pm 3	-	-	-
COD ₅	mg/L O ₂	4 \pm 0,0	-	-	≤ 6
PO ₄ ³⁻	mg/L	0,007 \pm 0,001	-	-	-
P _{total}	mg/L	0,009 \pm 0,001	-	-	$\leq 0,13$
Nkj	mg/L	11 \pm 0,0	-	-	-
NH ₄ ⁺	mg/L	9 \pm 2	-	-	≤ 1
NO ₃ ⁻	mg/L	7 \pm 1	50	-	≤ 25
SO ₄ ²⁻	mg/L	826 \pm 31	575	-	-
F ⁻	mg/L	1,0 \pm 0,0	1,0	15	-
Cl ⁻	mg/L	208 \pm 21	70	-	-
TSS	mg/L	17 \pm 1	60	-	-
TDS	mg/L	1 238 \pm 232	-	-	-
Zn	mg/L	13 \pm 2	2	10	-
Fe	mg/L	8 \pm 0,0	5	-	-
Cu	mg/L	3 \pm 0,0	0,20	5	-
Mn	mg/L	7 \pm 1	0,20	10	-
SAR	mg/L	15 \pm 3	8	-	-

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3.1. Floating Beds (FB) Field Instalation

- Three Floating Beds (FBs) of 3.3 m²/ unit were placed in Água Forte stream and tied to the watercourse banks.
- Macrophyte *Vetiveria Zizanioides* (Density 40.5 plants/m² with the dimensions of 20 cm).

Table 2. Characterization of the watercourses where FB was placed.

	Água Forte Stream
Localization (GPS Coordinates)	37.9393942 -8.14567566
Average depth (m)	1,2± 0,3
Average width (m)	8,9± 0,5
Average flow (m ³ /s)	0,11 ± 0,20



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3.2. Experimental Procedure

- The sampling collection was made in two points, downstream floating beds (**Outlet**) and around 100m upstream of them (**Inlet**) and were carried out during May 2020 to December 2021.
- Physical-chemical parameters were monitored monthly *in lab*, and were determined according to Standard Methods for the Examination of Water and Wastewater.



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3.3. Data treatment

- Calculation of average removal rate/parameter using expression:

$$\%R = \frac{\textit{Inlet} - \textit{Outlet}}{\textit{Inlet}} \times 100 \quad (\textit{Eq. 1})$$

4. Results and Discussion

Treatment, at Real Scale, of a Mediterranean Running Water with Acid Mining Drainage (AMD) Characteristics Using Floating Beds

4.1 Physicochemical monitoring of water quality of Água Forte Stream

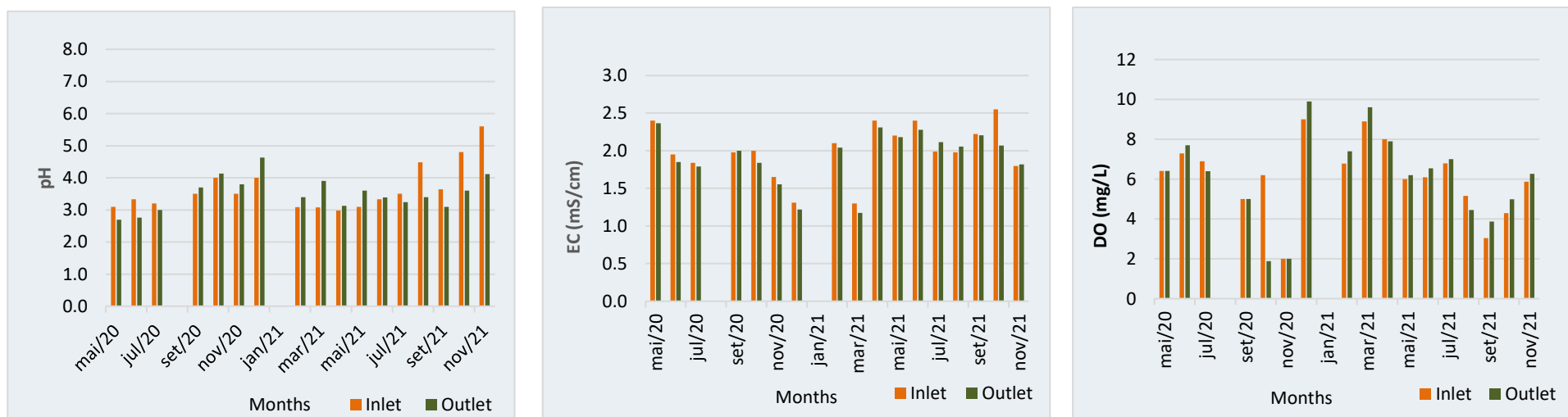


Fig 1. Evolution of the parametric values of pH, Electrical Conductivity (ECw,) and Dissolved Oxygen (DO) along the monitoring period.

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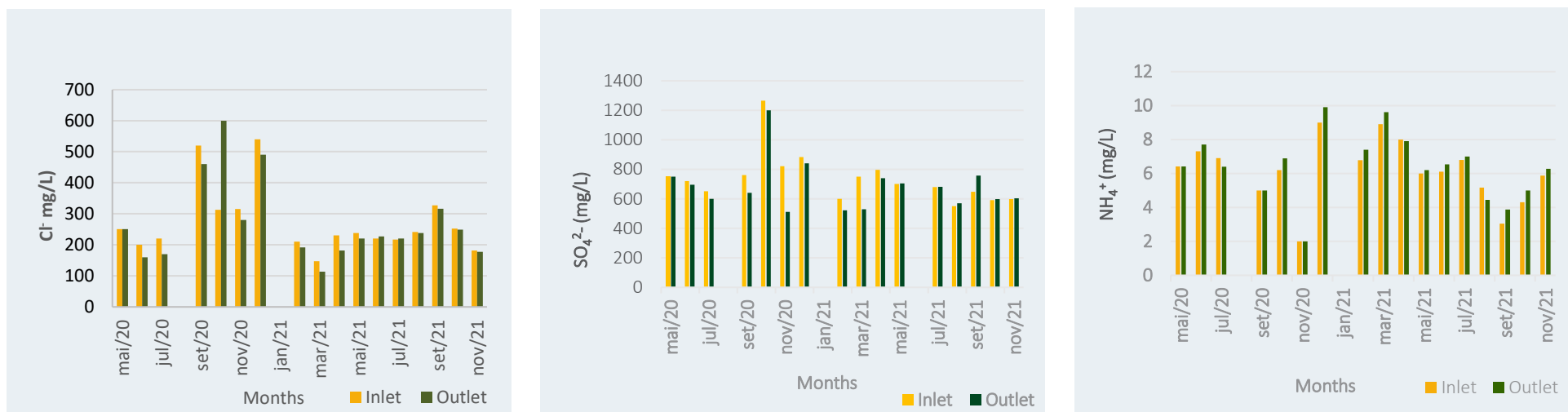


Fig 2. Evolution of the concentration values of Chlorides (Cl⁻), Sulphates (SO₄²⁻) and Ammoniacal Nitrogen (NH₄⁺) along the monitoring period.

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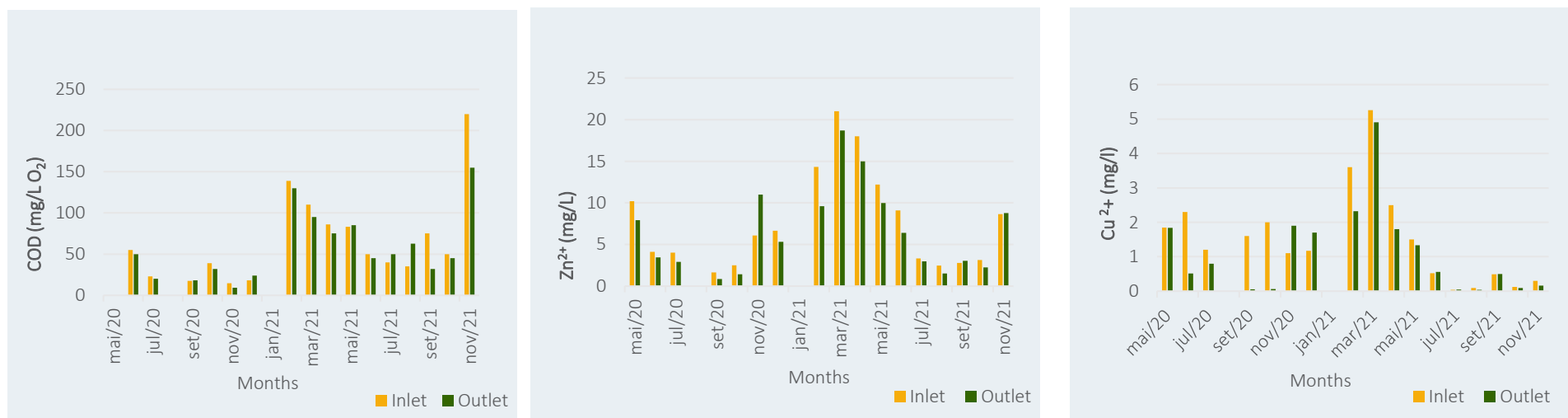


Fig 3. Evolution of the concentration values of Chemical Oxygen Demand (COD), Zinc (Zn^{2+}) and Copper (Cu^{2+}) along the monitoring period.

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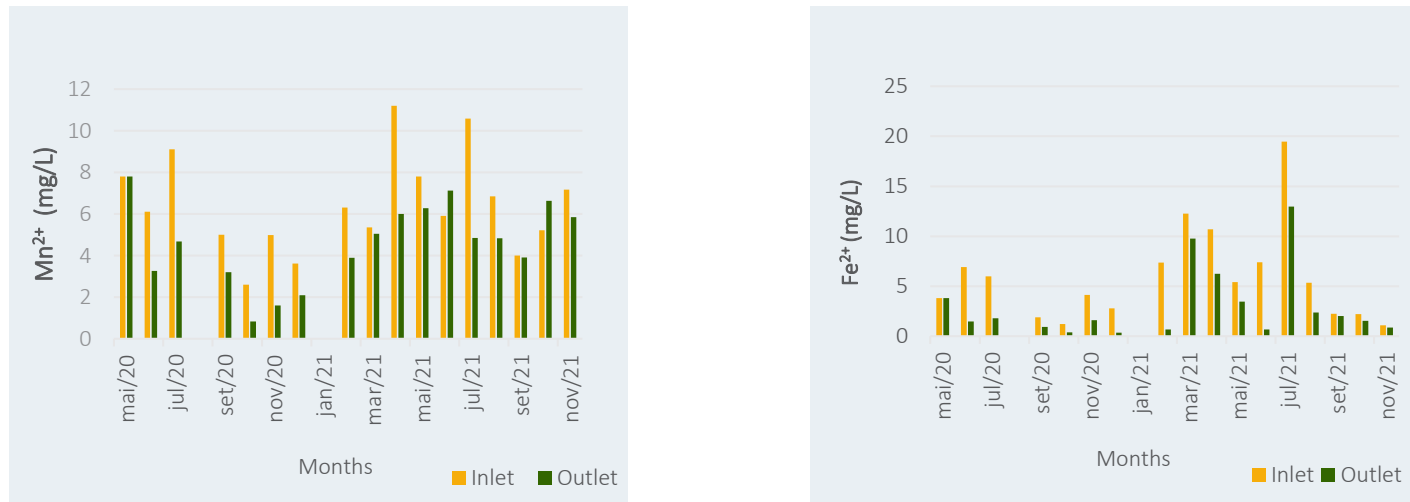


Fig 4. Evolution of the concentration values of Manganese (Mn^{2+}) and Iron (Fe^{2+}) along the monitoring period.

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4.2 Floating Beds Treatment Performance (% R)

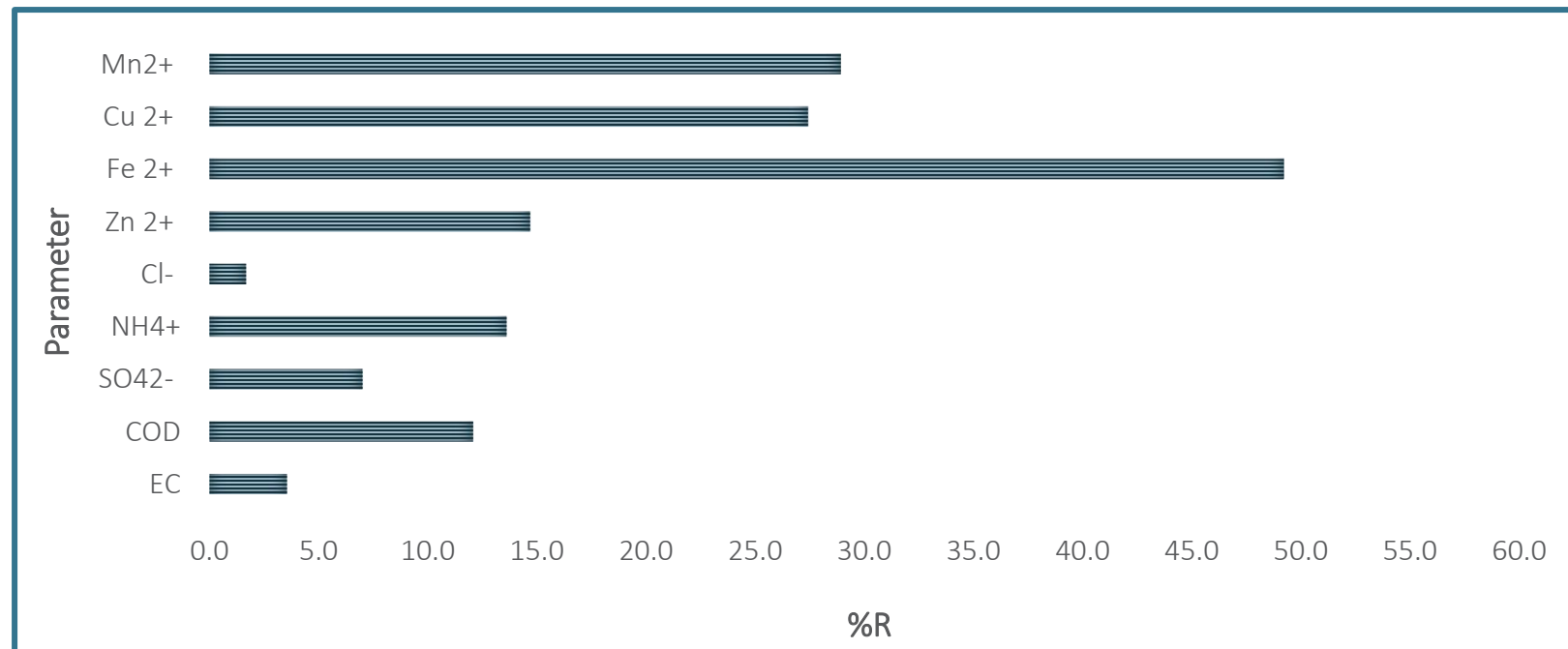


Fig 5. Removal rates obtained for parameters analyzed..

5. Conclusions

- This study, has been restricted to a short period of time, but indicates as role of thumb that:
- Água Forte stream shows ADM characteristics with acid pH, high levels of metals, sulphates and low nutrients levels.
- Using the treatment by FBs we were able to say that improved quality of water for almost all parameters analyzed, but we also concluded that the watercourse are not yet suitable for irrigation and is considered to belong to the bad ecological state.
- The average removal rates obtained ranged from 1.7 % (negligible) to 49.2% (parameters Cl^- and Fe^{2+} , respectively).
- Treatment by FBs seemed to be more effective in removing metals compared to other parameters.
- The results obtained provided evidence that tested FBs can serve as a measurement for other floating bed treatment systems.
- This work contribute to the environmental recovery of surface water masses, assuming as a system of CO_2 sink treatment, effective in long term, ecological, easy maintenance and low cost.



Thank you!



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