UNIVERSIDAD DE SANTIAGO DE CHILE

8th International Symposium on Wetland Pollutant Dynamics and Control

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AARHUS UNIVERSITY - DENMARK

PERFORMANCE OF HYBRID PEANUT SHELLS BIOFILTERS WITH SCHOENOPLECTUS CALIFORNICUS TO REMOVE ORGANIC MATTER FROM DOMESTIC WASTEWATER

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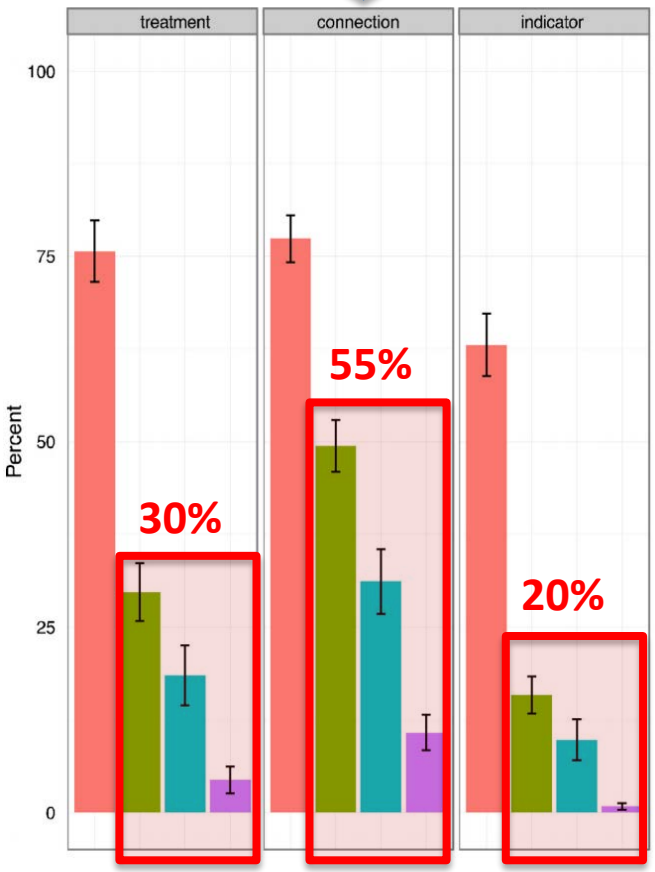
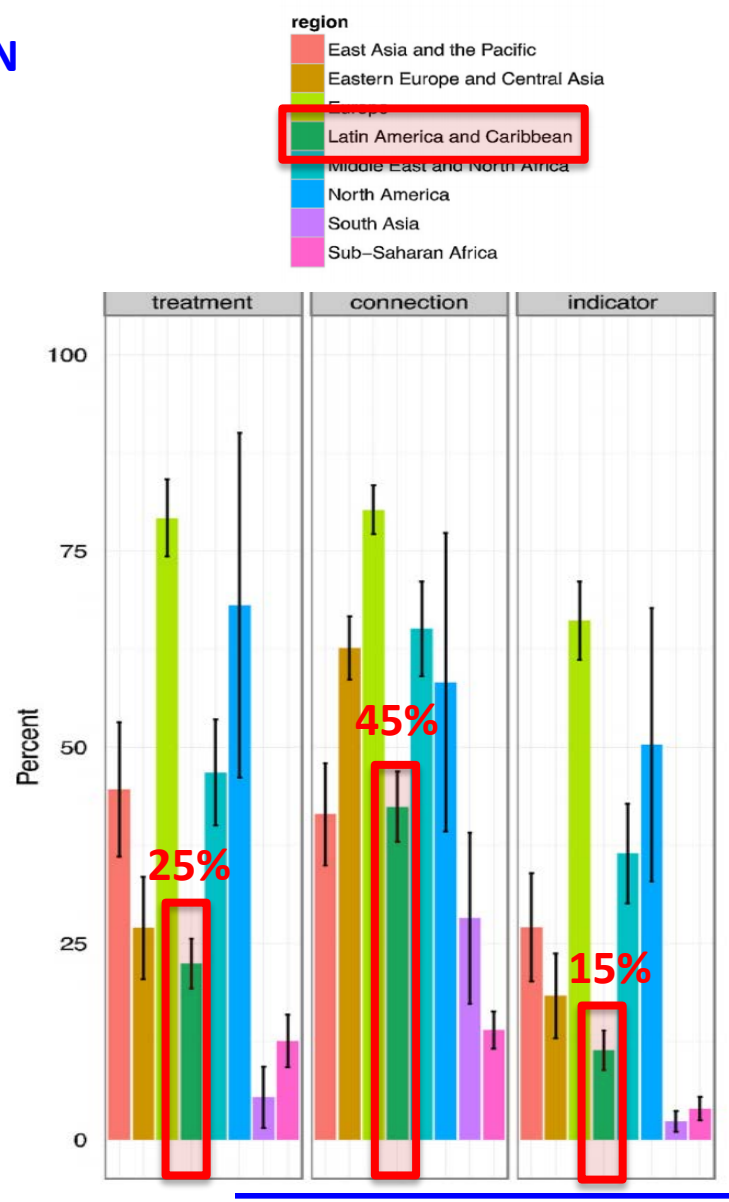
INTRODUCTION

GLOBAL SANITATION

6 CLEAN WATER AND SANITATION





Malik et al. (2015)

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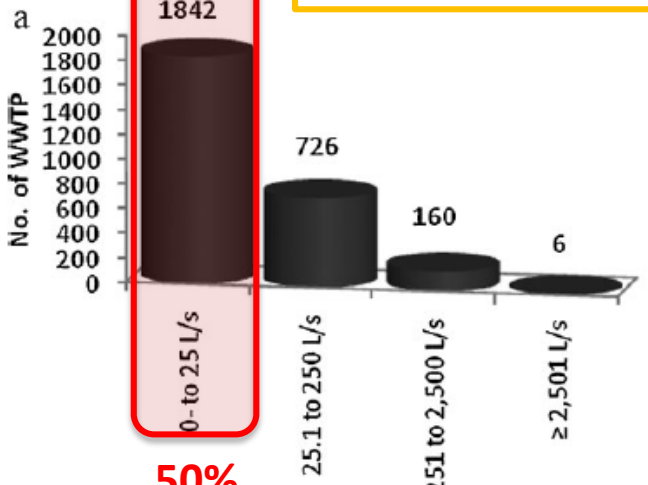
INTRODUCTION

LATIN AMERICA SANITATION

67%

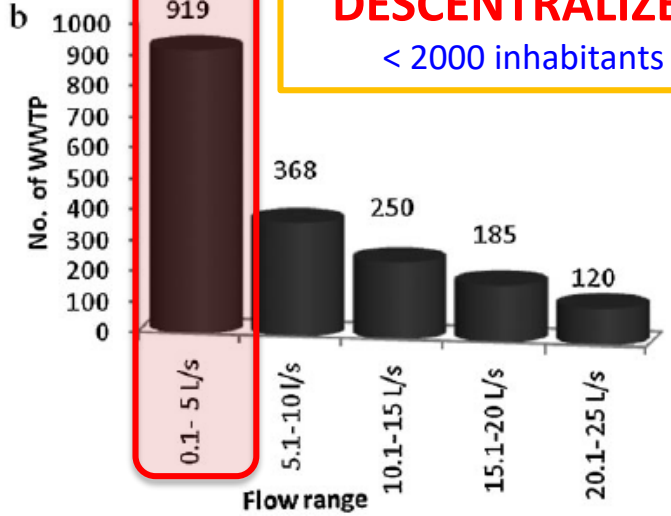
< 10000 inhabitants



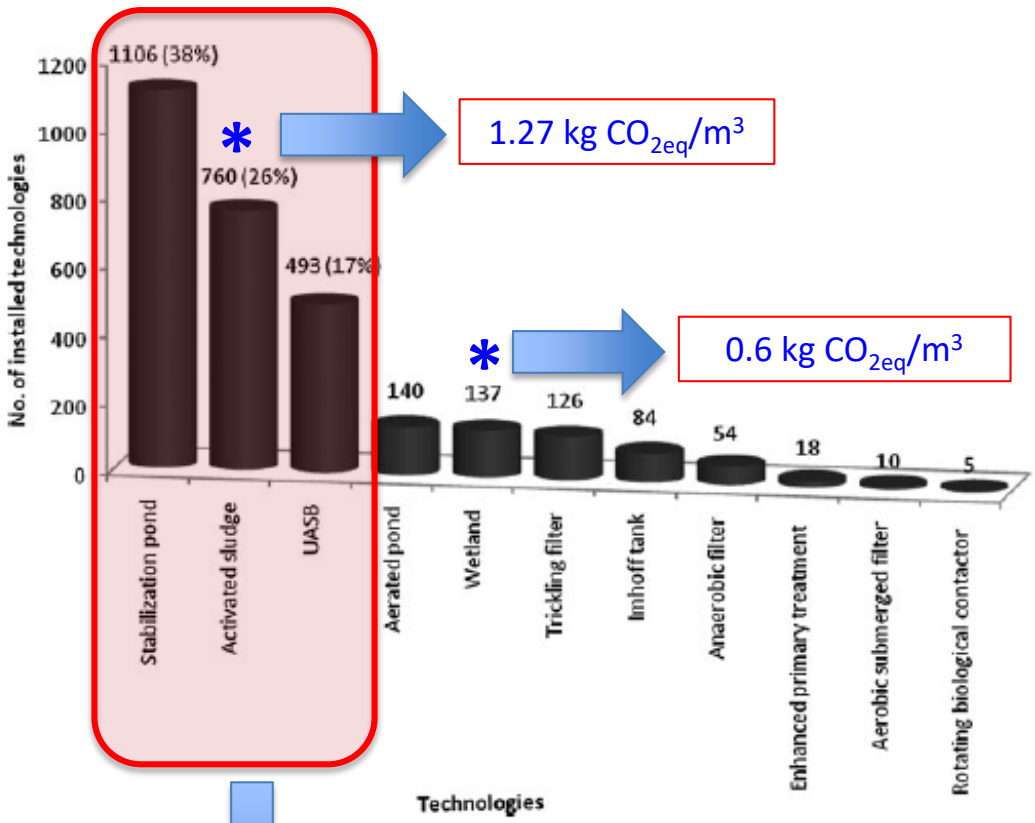
50%

DESCENTRALIZED

< 2000 inhabitants



81%



* 1.27 kg CO_{2eq}/m^3

* 0.6 kg CO_{2eq}/m^3

CONVENTIONAL

INV. COST (66 – 10000 USD/inhab)

Noyola et al. (2012), Vera et al. (2017), Garfí et al. (2017), Villamar et al. (2018)

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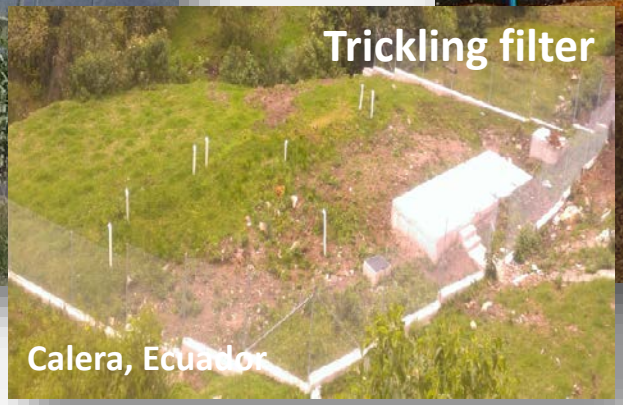
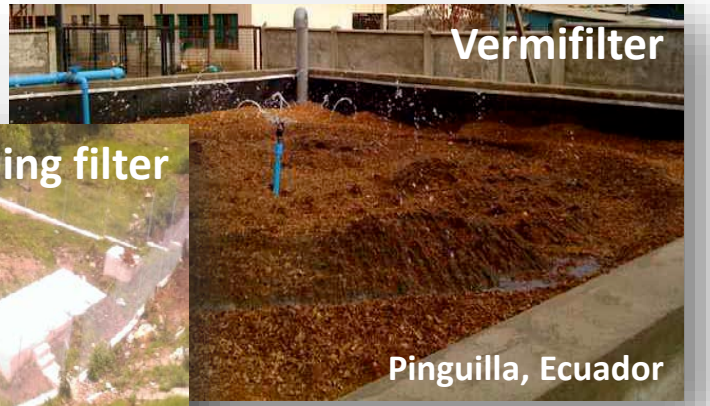
DESCENTRALIZED BIOFILTRATION TECHNOLOGIES





Parameter	T. Filter	Wetland	Vermifilter
Area (m^2/inhab)	< 0.1	0.8 - 6	0.2 - 0.5
Height (m)	5 – 12	0.2 – 1.5	0.5 – 1.5
Hydraulic loading rate (m^3/m^2- day)	0.2 - > 1	0.2 - 1	0.1 – 2.5
Organic matter removal (%)	57 – 90	75 – 90*	45 – 95

* BOD

Support material

50 % INV. COST

Vymazal (2010), Vigueras et al. (2013), Kumar et al. (2014, 2015), Chicaiza (2017), García (2017), Vera et al. (2017)

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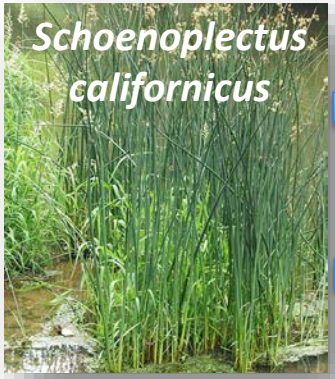
BIOFILTRATION TECHNOLOGY PROPOSAL



AVAILIBILITY → Cosmopolitan

CHARACTERISTICS → Tolerant

BIOTIC

PEANUT SHELLS

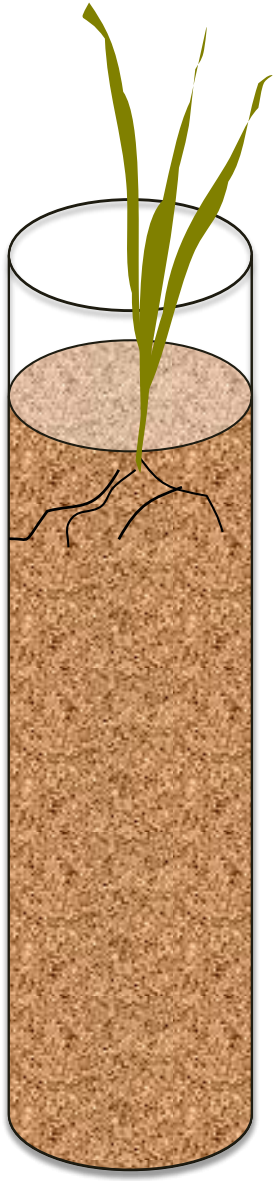
AVAILIBILITY → 44 M t/year

Ecuador

CHARACTERISTICS

↑**Superficial area** (268 m^3/m^2)→**Biofilm support**
↑**Lignin** (up to 31% - functional groups) → **Adsorption**
pH neutral → **Optimun biological environment**

SUPPORT



HYBRID BIOFILTER

Ramírez et al. (2003), López et al. (2015), Brix et al. (1994, 1997)

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OBJECTIVE

Evaluate the performance of hybrid peanut shells biofilters with Schoenoplectus californicus to remove organic matter from domestic wastewater.

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METHODOLOGY

SUPPORT MATERIAL

CONDITIONING

COMPATIBILITY ASSAY

Allometric measurements
Chlorophyll a/b

Non Observed Effects Concentration
NOEC

25% v/v
Peanut Shell/sand-grave

Tejedor (2019); Cóndor (2019)

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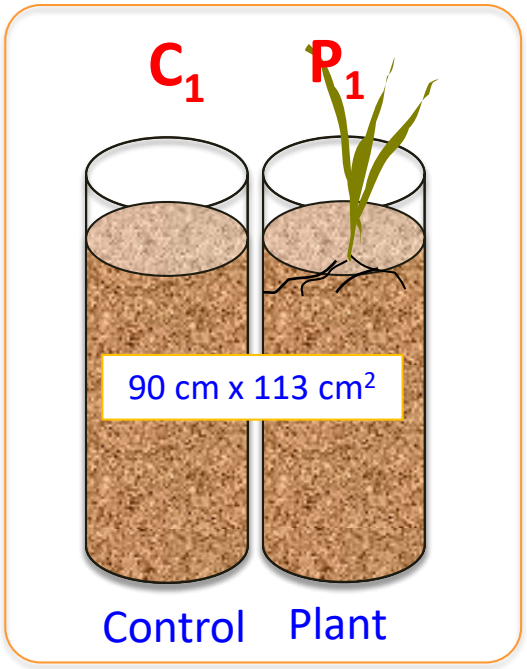
METHODOLOGY

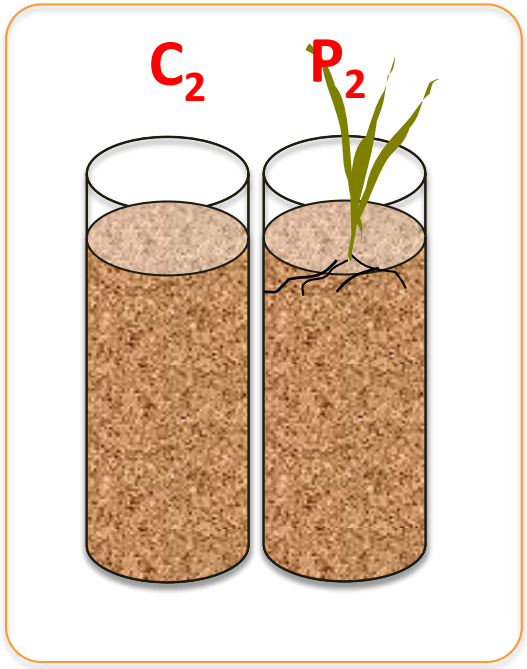
EXPERIMENTAL MODEL

SUPPORT MATERIAL: peanut (up to 20 mm)→**25%v/v**, sand/grave (up to 25 mm)→**75%**

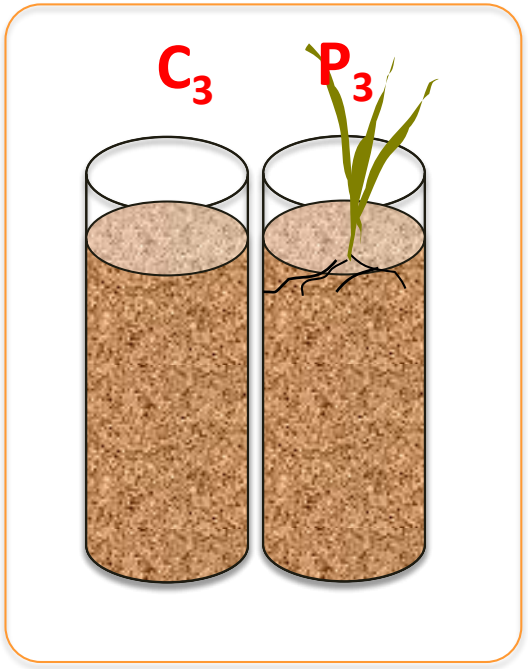
HLR = 0.5 m^3/m^2-day



HLR = 1.0 m^3/m^2-day



HLR = 1.5 m^3/m^2-day



OPERATIONAL: pH, temperature, lignin and derivatives, head loading
REMOVAL: COD, VS

Tejedor (2019), Cóndor (2019); Standard Methods (2005), Cecen (2004)

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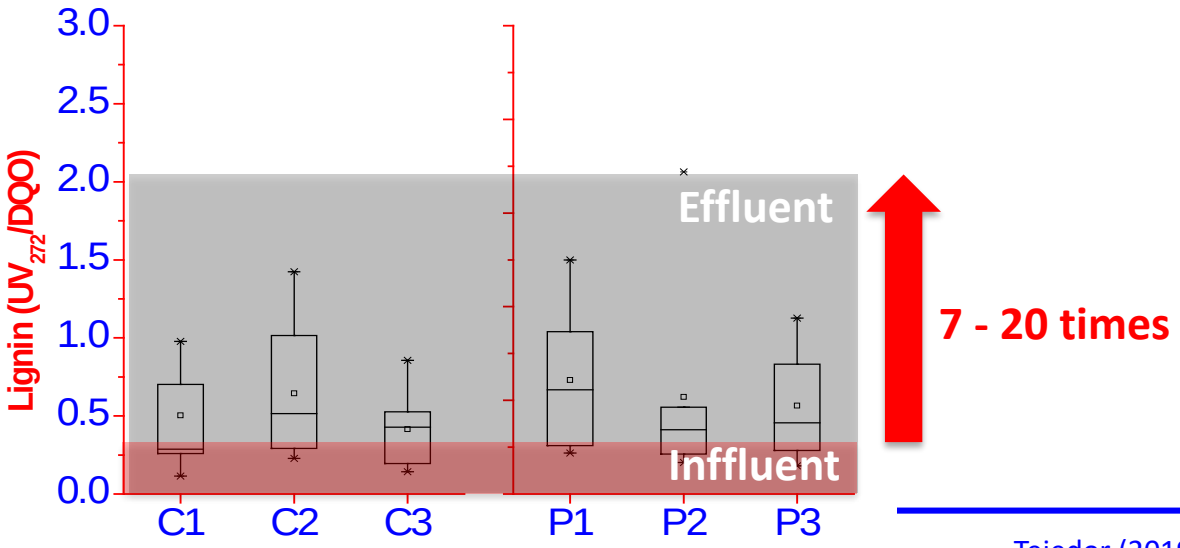
RESULTS

OPERATIONAL CONTROL

BIOFILTER		PARÁMETER			
		HLR (m^3/m^2 day)	pH	Mean daily temperature (°C)	Moisture content (%)
Control	C_1	0.5	7.24	21.3	80.6
	C_2	1.0	7.30	21.1	88.0
	C_3	1.5	7.25	20.9	89.5
Plant	P_1	0.5	7.35	21.1	69.6
	P_2	1.0	7.43	21.2	69.8
	P_3	1.5	7.39	21.0	69.6

- 16%



7 - 20 times

Tejedor (2019); Cóndor (2019)

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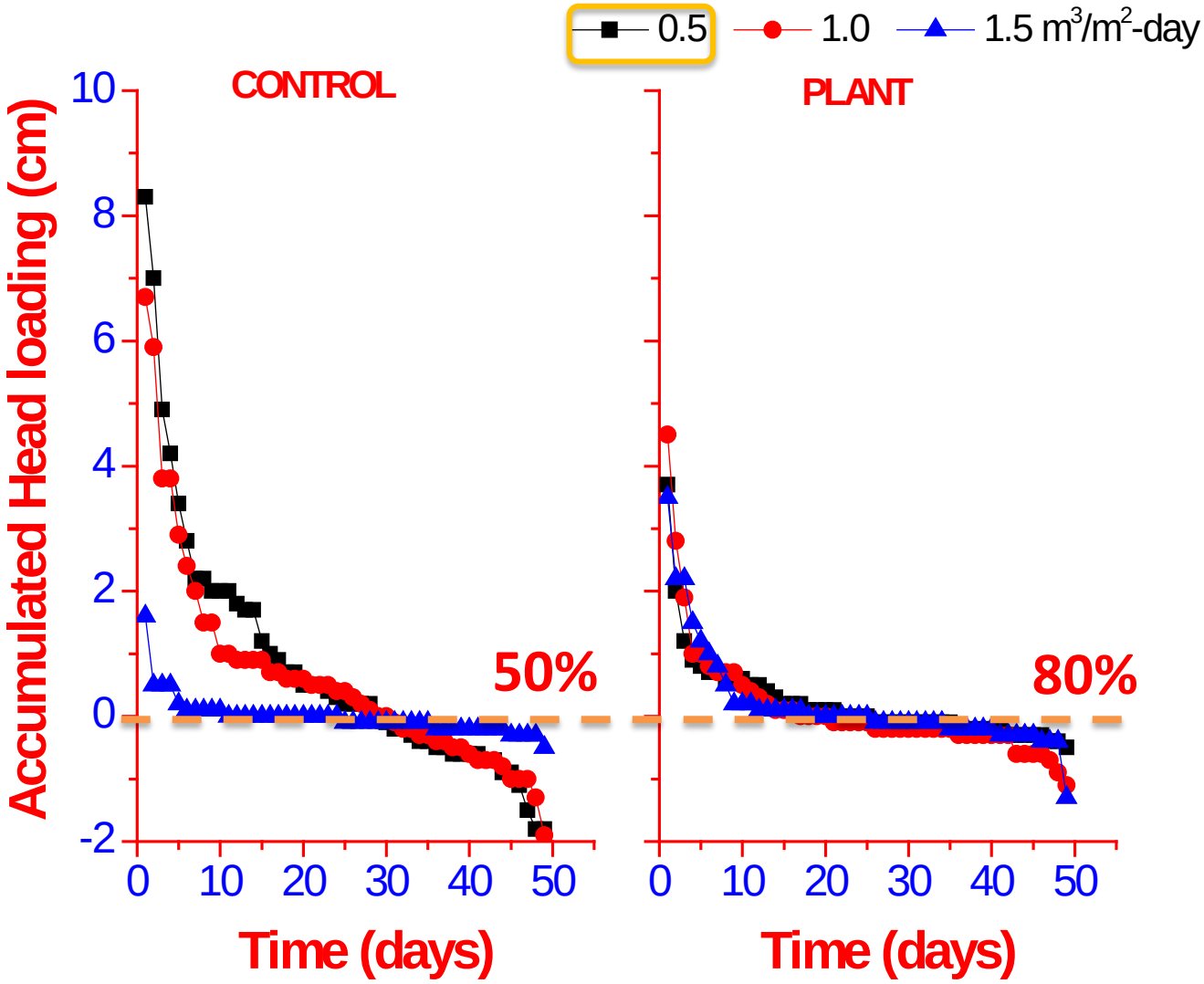
RESULTS

HYDRAULIC OPERATION



Metcalf and Eddy (2003), Ramírez and Vega (2017)

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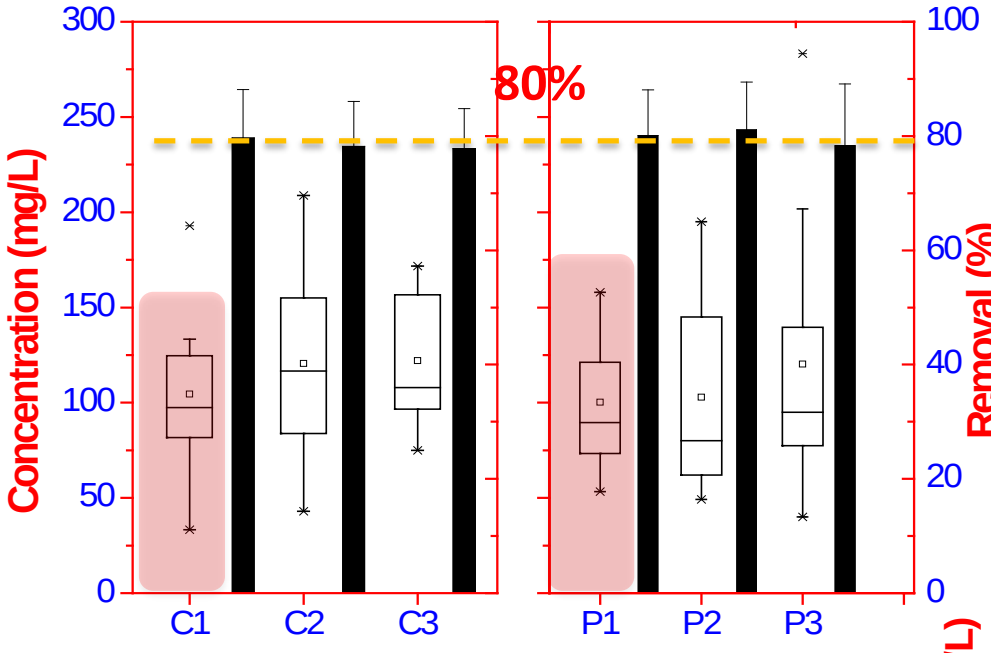
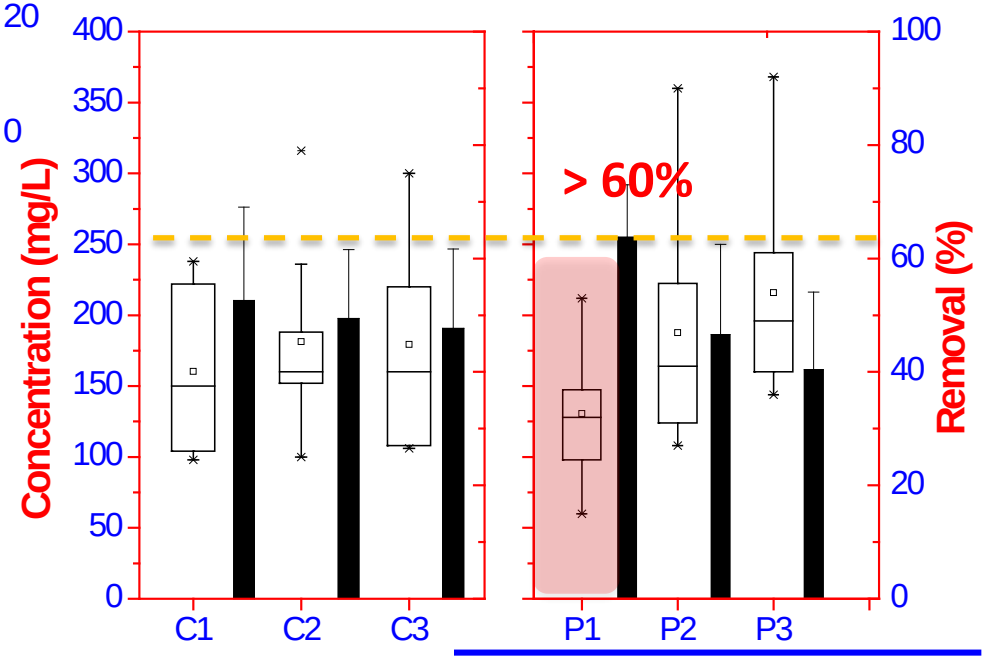
RESULTS

ORGANIC MATTER PERFORMANCE





Metcalf and Eddy (2003), Ramírez and Vega (2017)

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CONCLUSIONS

-Biofilters show **stable operational conditions** (pH: 7.2 – 7.4, mean daily temperature up to 21 C), but **biofilters with plants decreased up to 16% moisture content** by evapotranspiration. Moreover, **effluents from biofilter** generated **between 7 and 20 times more lignin compounds** than influent.

-The **lowest accumulated head loading** was searched by biofilters with hidraulic loading rate was **0.5 m^3/m^2-day**. Moreovoer, **biofilters with plants** give more stability **decreasing clogging**.

-All biofilters remove organic matter searching **efficiencies up to 80% COD**, but only biofilter with plant operating at 0.5 m^3/m^2-day (**P1**) searched **volatile solid removal of up to 60%**. Moreover, P1 archieved effluents with **organic matter** concentrations below **200 mg/L**.

ACKNOWLEDGMENTS

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UNIVERSIDAD DE SANTIAGO DE CHILE

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Thanks guys……

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