


Performance of constructed wetlands for wastewater treatment subject to peak mass loads



Ana Galvão

Joana Mavioso

José Saldanha Matos

* Department of Civil Engineering Architecture and Geossources - Instituto Superior Técnico.
Av. Rovisco Pais, 1049-001 Lisboa, Portugal. (agalvao@civil.ist.utl.pt) (jsm@civil.ist.utl.pt)

Constructed wetlands for wastewater treatment in Portugal

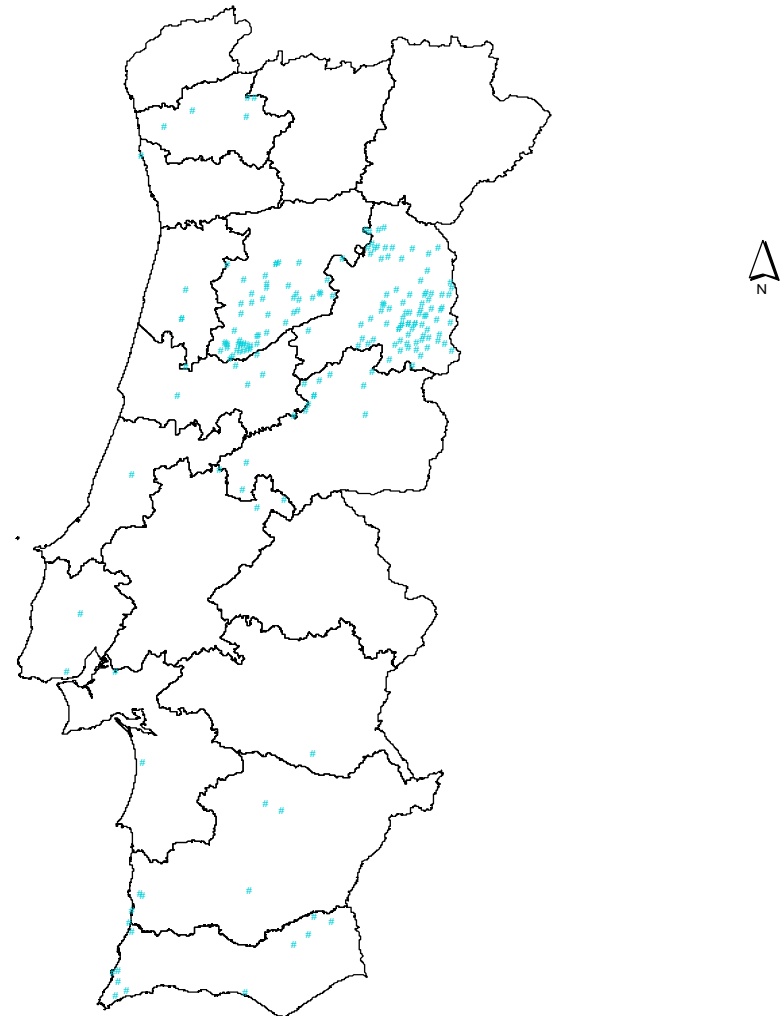
More than 400 CW
mainly sub-surface
horizontal flow.

Mainly in the North-
Central Regions of the
Country.

Typically associated to
septic tanks.

Some of them with
recirculation.

**R3-Robustness,
Resilience and
Reduction of Risks .**





**WWTP Malavado and Fataca (ICREW Project INTERREG
 3B 2003-2006)
 (100-150 e.p)**





Constructed wetlands for wastewater treatment in Portugal

- Performance under regular conditions ensures good BOD₅, COD and TSS removal (similar to conventional secondary treatment).
- Typically applied in Portugal for small agglomerations, and camping sites.
- **Relevant challenges for CW:**
 - Significant flow and concentration variations.
 - Some systems subject to peak conditions

Methods:

Laboratory installation



Site: Hydraulic and Environmental Experimental Laboratory of IST/UTL(Lisbon)

- 9 beds divided into three groups
 - Each group with 1 *Phragmites*, 1 *Scirpus* and 1 without plants (control)

General view of the laboratory

Methods: Laboratory installation



- Bed characteristics
 - Size - 1.2 × 0.8 × 0.76 m
 - Filling media – gravel 4-8 mm
 - Porosity – 30%

- Feeding – 10 l/day with synthetic wastewater

- Monitoring from January 2010 to July 2010

Top view of one bed planted with *Phragmites australis*

Methods:

Monitoring conditions

- Monitoring COD concentrations from January 2010 to July 2010

Phase 1 (3,5 months)

- Group A – 9,3 g COD /(m^2 .day)
- Group B - 4,3 g COD/(m^2 .day)
- Goup C – potable water

Phase 2 (peak conditions during 2 weeks)

- 20% load increase for groups A and B
- Group C fed with 1,4 g (m^2 .day)

Phase 3 (4 weeks)

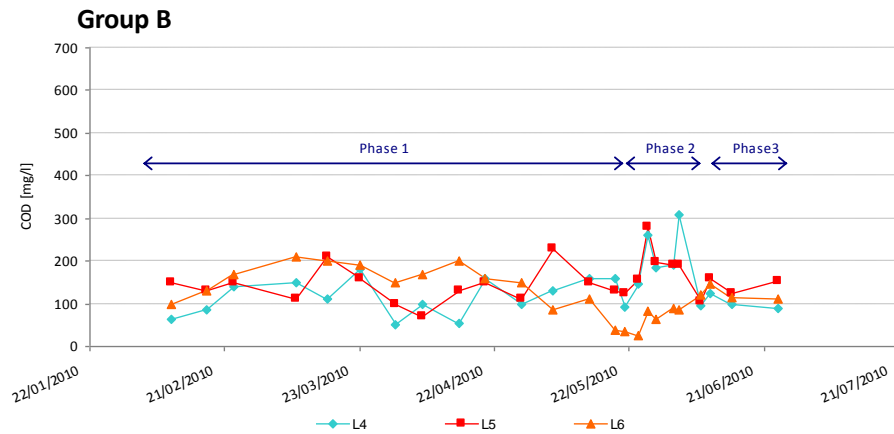
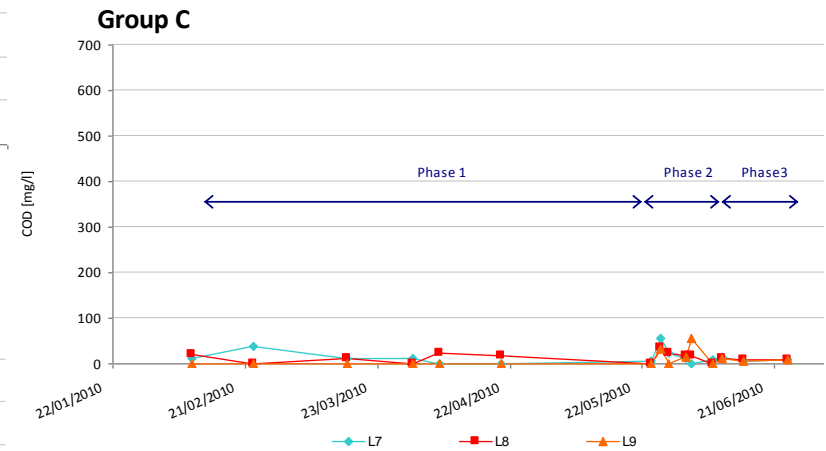
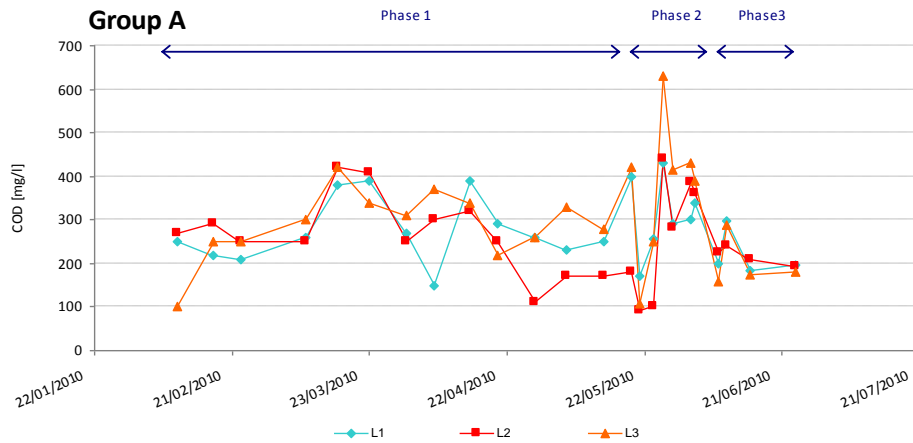
- Phase 1 with conditions restored

Methods: Feeding conditions

Compound	Concentration (mg/l)
Urea	60
Na-acetate.3H ₂ O	130
Peptone	22
Starch	200
Powder milk	200
Soy oil	30
Liquid fertilizer	0.3 ml

- Theoretical COD: 550 mg/l

Results and discussion



Results and discussion

Group	Bed	Mass removal rate (g/ (m ² .day)		
		Phase 1	Phase 2	Phase 3
A	1	6.4	8.0	6.1
	2	6.5	8.5	6.0
	3	6.2	7.3	6.2
B	4	3.1	2.6	3.1
	5	2.8	2.7	2.7
	6	2.7	4.0	2.9
C	7	-0.2	1.1	-0.1
	8	-0.1	1.1	-0.1
	9	-0.1	1.0	-0.1

- Phase 1:
 - COD mass removal rates clear depend on the organic input load
 - Differences within each group are not significant
- Phase 2:
 - Some increase in mass removal rates (Group A)
- Phase 3:
 - mass removal rates similar to Phase 1

Results and discussion

- Influent organic peak loads increase discharge concentrations but also results in mass removal increase.
- Rapid system response may indicate the presence of an established microbial community even during feeding with tap water (Group C results).
- Biofilm established during Phase1 seems to be maintained through the rest of the study (not affected by phase 2 condition)

Conclusions and final remarks

- Differences in CW performance can be attributed to different organic input load, particularly during load peaks
- In this case, vegetation was not relevant for the COD removal for a given organic load mass – start up-system conditions.
- Biofilm formation:
 - Dependent on input load
 - Peak loads of two weeks have a minor influence
- Constructed wetlands fed with tap water during certain periods have also provided organic matter removal.

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