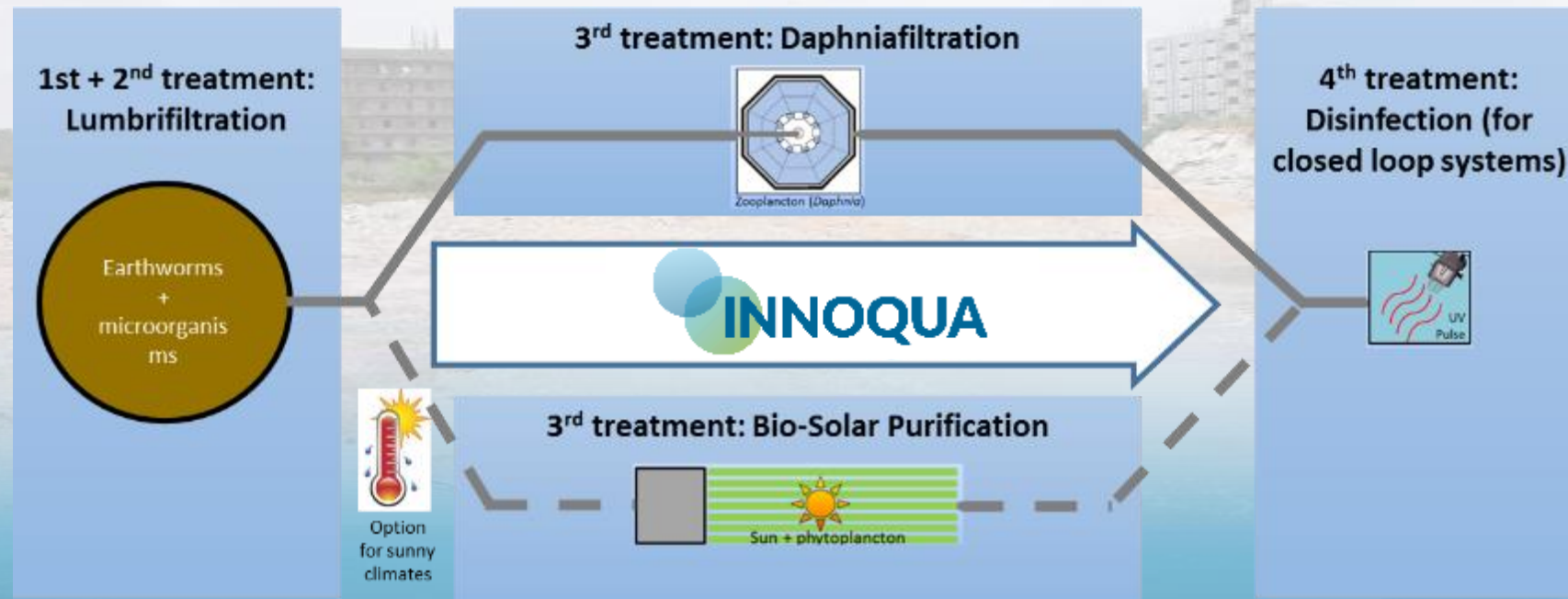


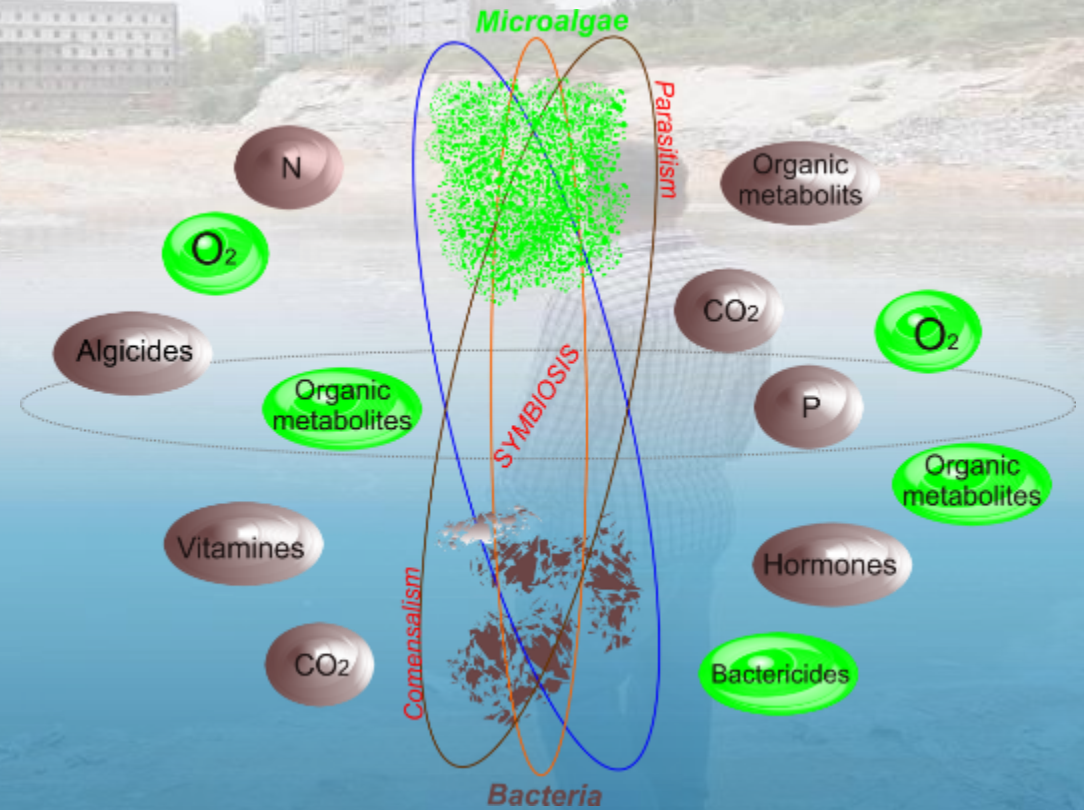
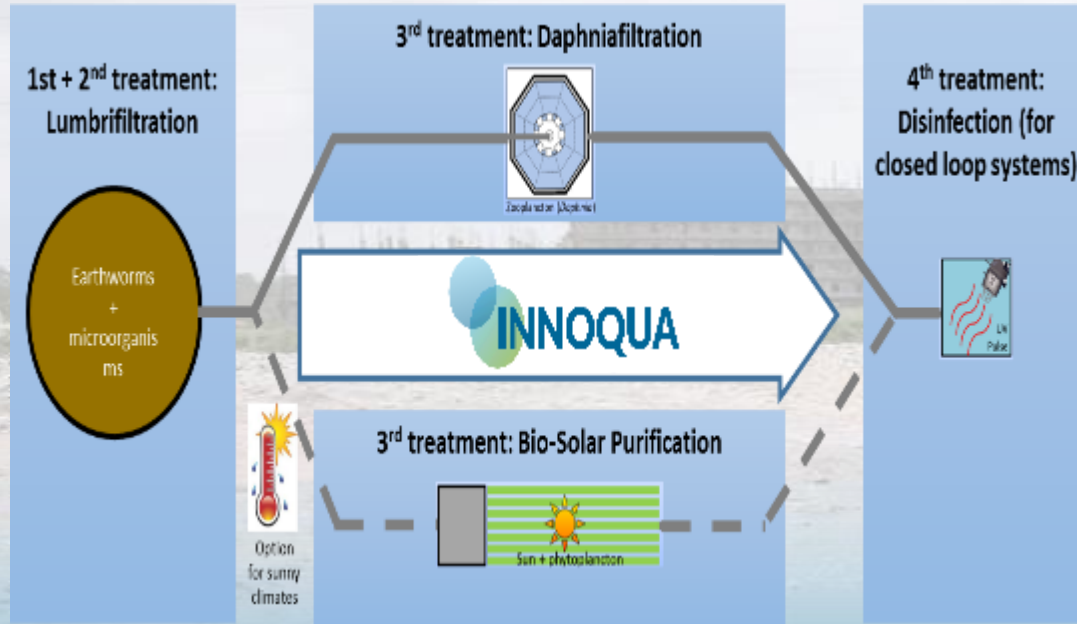
Microalgae based wastewater treatment system: lab and pilot results'

**Costel Bumbac, Elena Manea, Olga Tiron, Laurentiu Dinu (ECOIND)
Alex Schaal, Jean-Baptiste Dussaussois (NOBATEK/INEF4)**

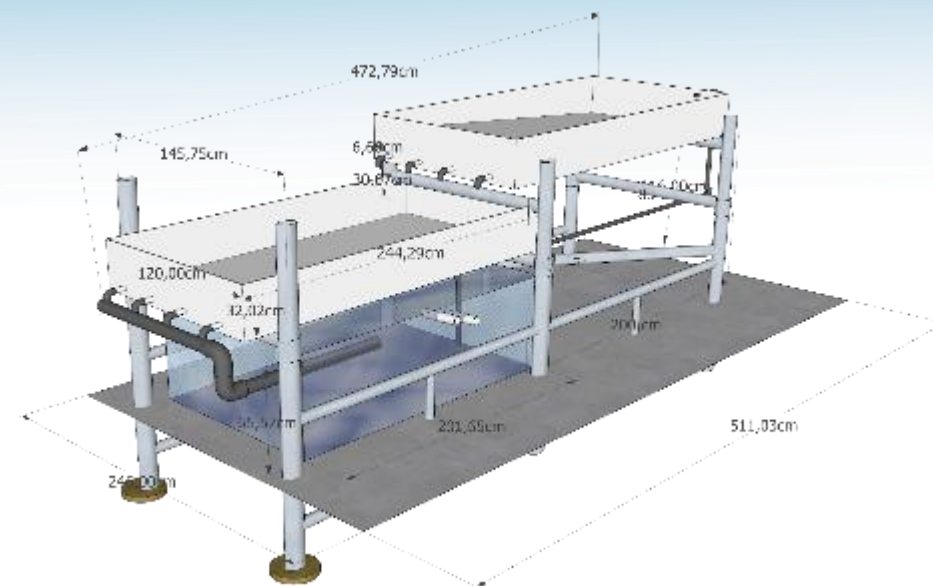
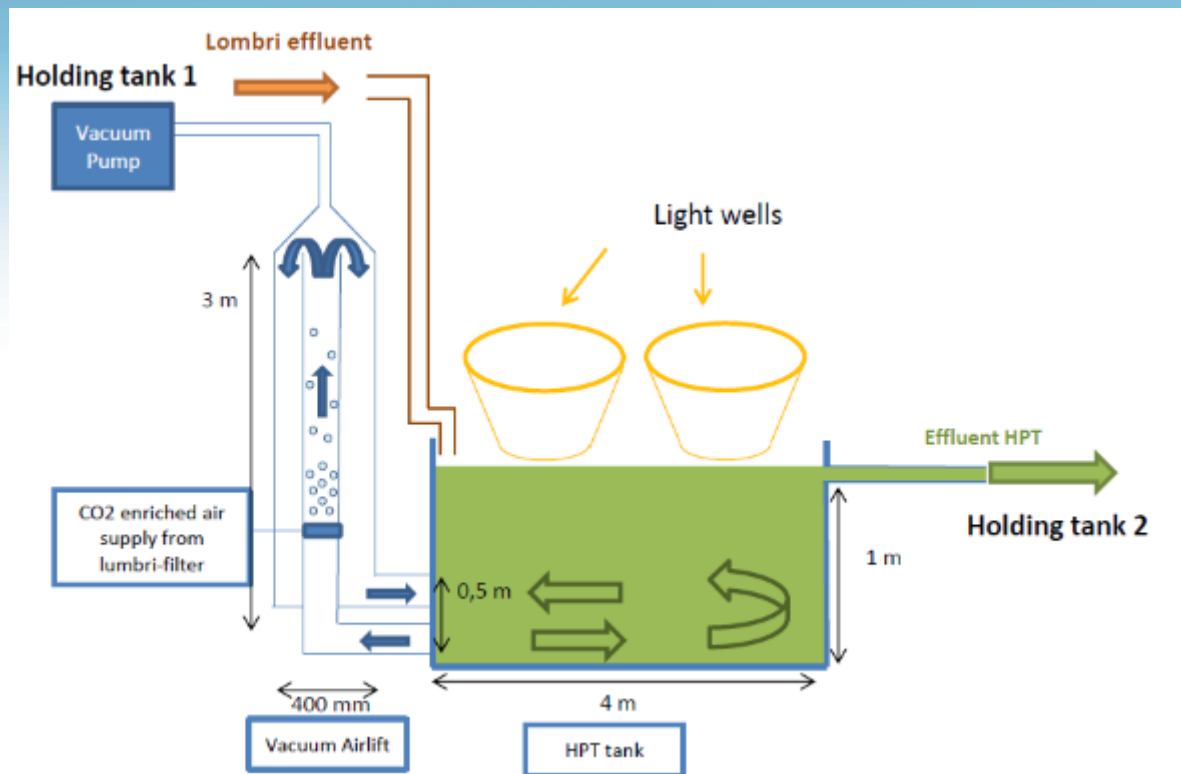
Concept



Concept



Adapting the technology



€€€€€€€€€€

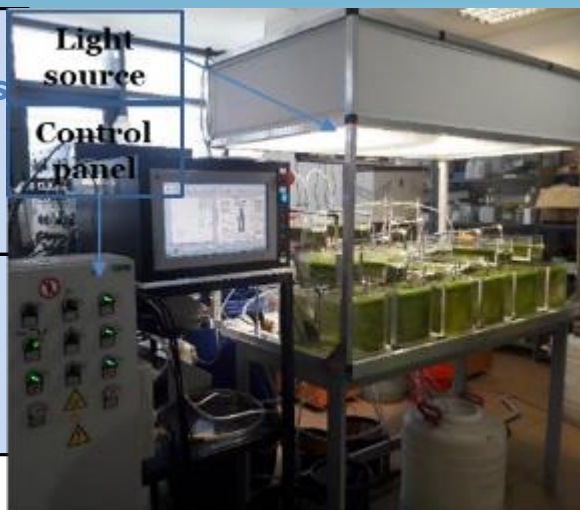


€

BSP lab scale experimental rig (Ecoind)

Pumped inflow to each photobioreactor: 10 litres per day relative daily volume based on full scale unit surface area

Influent: synthetic wastewater to replicate the quality of Lumbrifilter effluent



Feeding pumps

Feeding tank

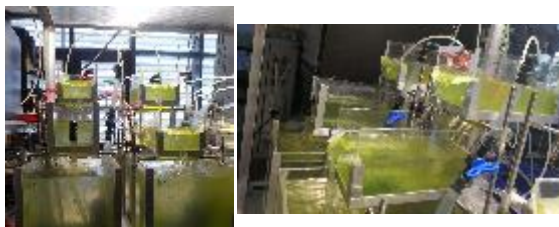
Internal recirculation pumps

Effluent discharge

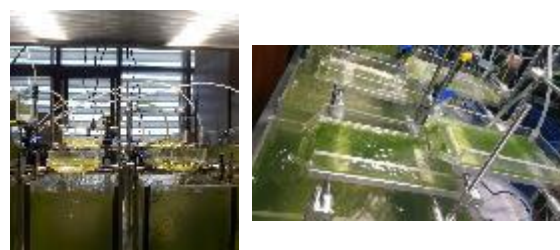
3 platform design tested

- In duplicate each
- Same total platform surface area

Double cascade reactor



Thin layer cascade reactor



Single platform bioreactor



SUMMARY OF LABORATORY WORK

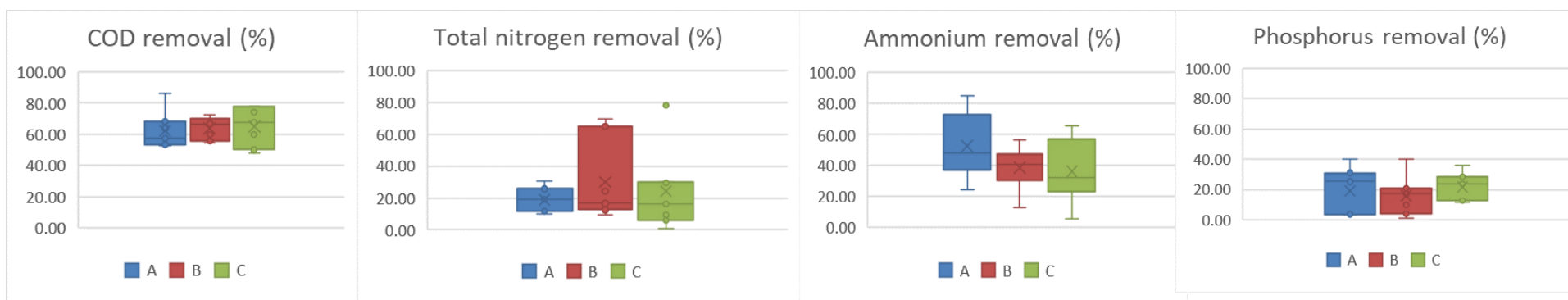
Short-term performance of BSP (lab-scale).

- 0.04 m² surface area
- 10 L/day (250 L/m².day)
- Room temperature
- Photoperiodicity: 12h light+12h darkness

Influent quality

| Expriment phase | COD mg O ₂ /L | N-NH ₄ ⁺ (mg/L) | N-NO ₃ ⁻ (mg/L) | Total N (mg/L) | Total P (mg/L) | Observations |
|-----------------|--------------------------|---------------------------------------|---------------------------------------|----------------|----------------|--|
| I. | 143.2 | 26.99 | - | 56.74 | 12.04 | Light source 8000 lumens/m ² |
| II. | 170.2 | - | 53.5 | 63.78 | 7.3 | Light source 12000 lumens/m ² |

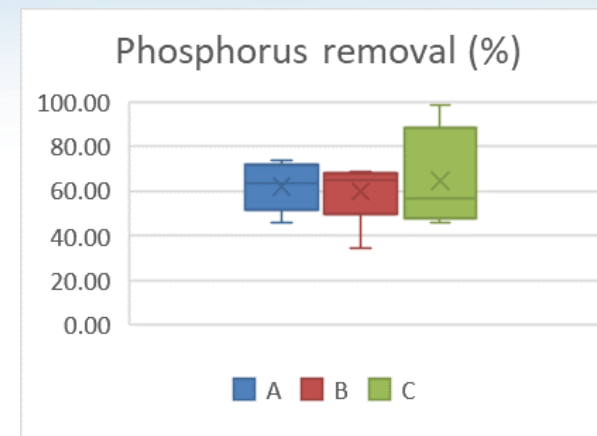
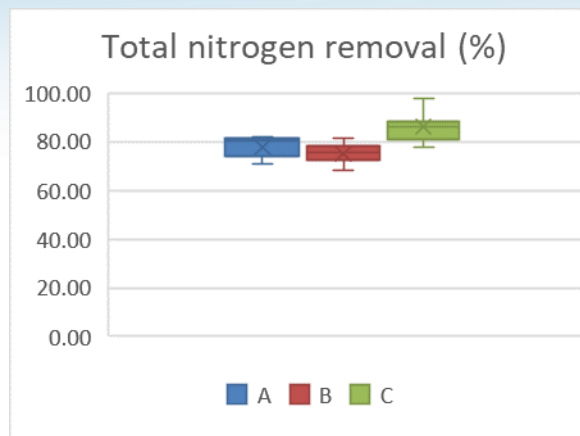
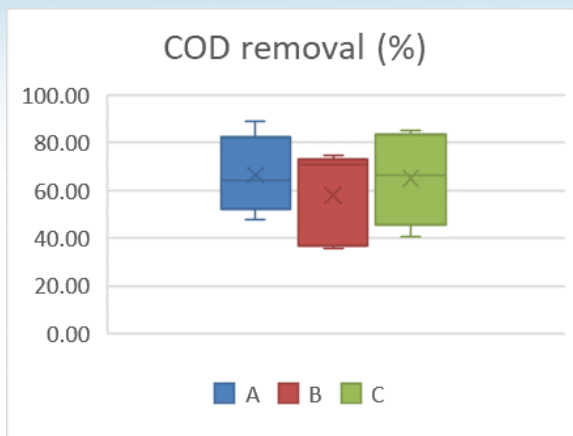
I. Removal efficiencies during start-up for main quality parameters



SUMMARY OF LABORATORY WORK

Short term performance of
BSP (lab-scale).

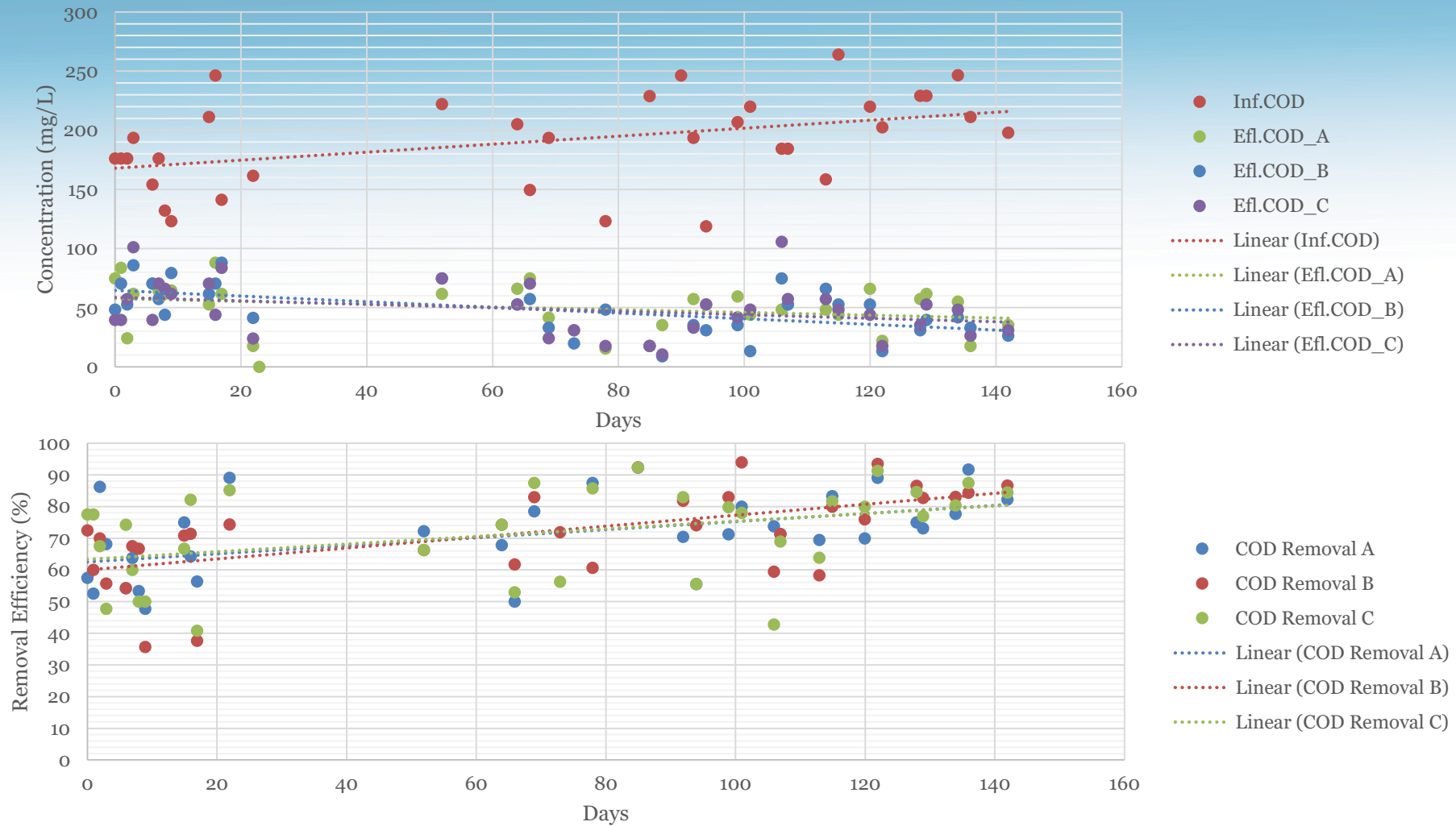
II. Removal efficiencies during start-up for main quality parameters

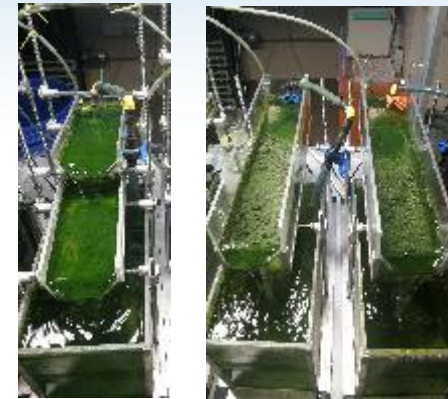
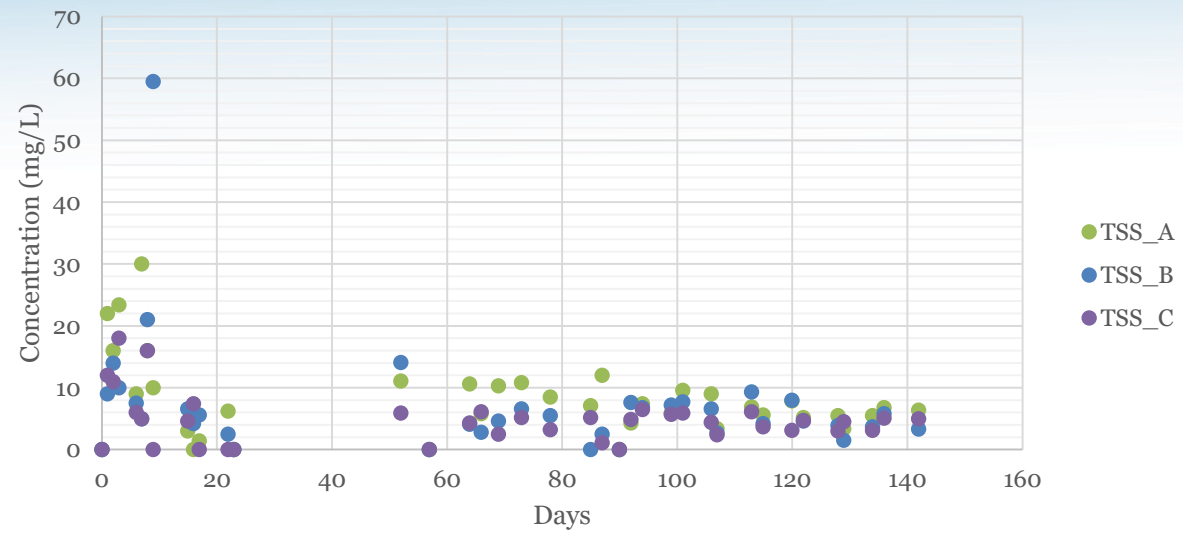


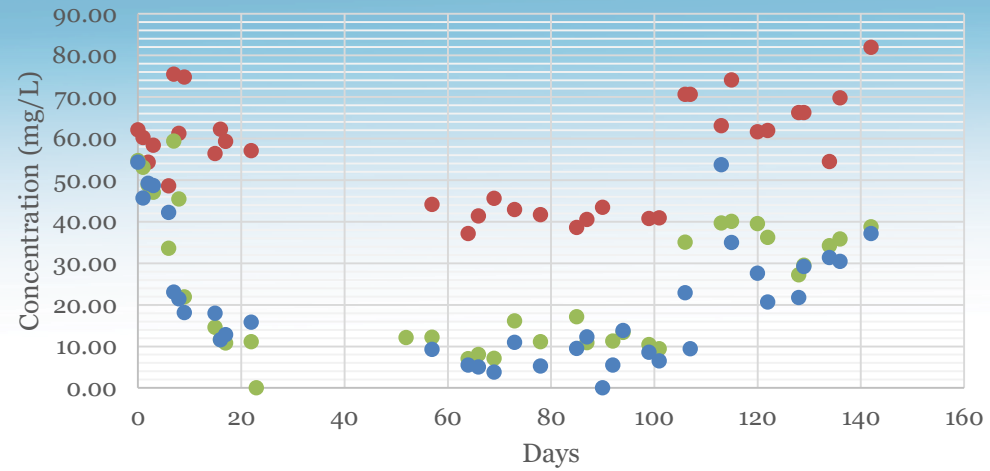
Average mass removal efficiencies (g/m²/day) for each of the tested platform

| Total Nitrogen removal | | | Total Phosphorus removal | | | COD removal | | |
|------------------------|-------|-------|--------------------------|------|------|-------------|-------|-------|
| A | B | C | A | B | C | A | B | C |
| 11.99 | 12.47 | 13.38 | 1.14 | 1.23 | 1.32 | 29.96 | 29.22 | 31.20 |

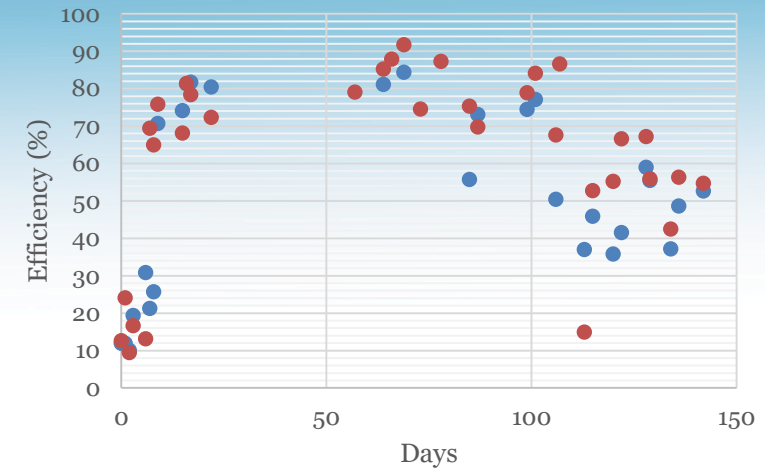
SUMMARY OF LABORATORY WORK



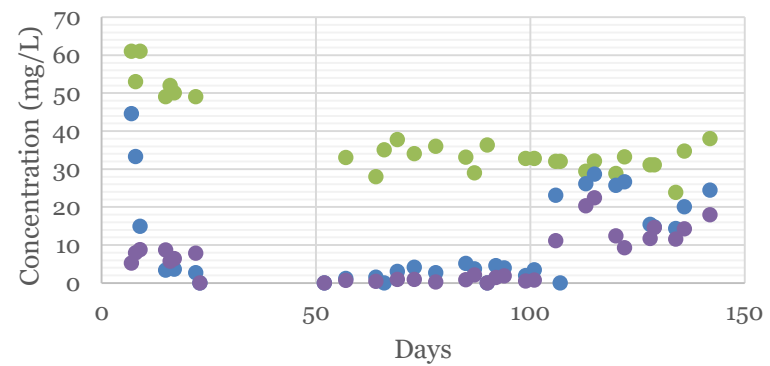




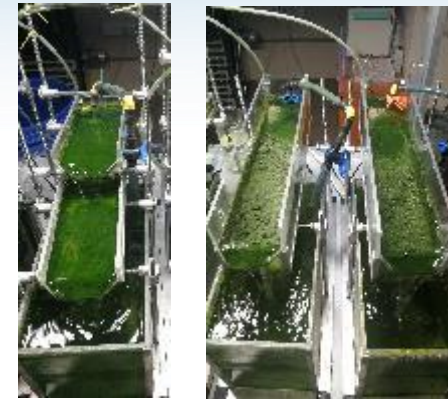
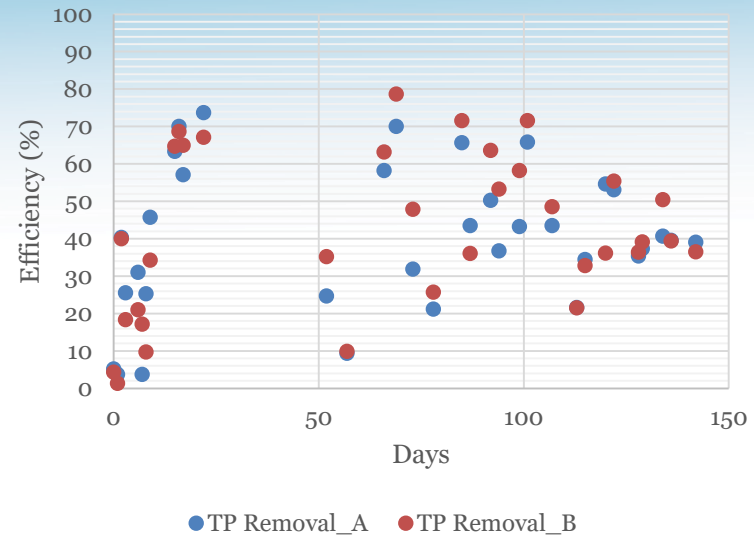
● Inf. TN ● Efl. TN_A ● Efl. TN_B



● TN Removal_A ● TN Removal_B



● Nitrate_Inf ● Nitrate_A ● Nitrate_B



Lumbrifilter +DF +UV system } (Spain, India &Peru)

Lumbrifilter +BSP



Demo-site Spain (Girona)



| LF+DF+UV Removal rate (%) | | | | | | LF+DF+UV Log removal | | LF+BS Removal Rate (%) | | | |
|---------------------------|-------|------------------|--------|--------------------|-----------|----------------------|------------------|------------------------|-------|--------------------|-----------|
| | TSS | BOD ₅ | COD | NH ₄ -N | Turbidity | E Coli | Faecal Coliforms | TSS | COD | NH ₄ -N | Turbidity |
| Average (□) | 94.2 | 87.63 | 87.54 | 94.02 | 96.94 | 2.84 | 2.60 | 92.32 | 86.22 | 78.04 | 88.66 |
| Standard deviation (σ) | ±5.04 | ±7.86 | ±11.71 | ±8.31 | ±3.18 | ±0.96 | ±0.75 | ±10.38 | ±9.05 | ±33.7 | ±15.98 |
| Median | 95.02 | 88.85 | 90.7 | 98.43 | 98.57 | 2.95 | 2.45 | 95.65 | 89.23 | 98.75 | 94.62 |

Lumbrifilter +DF +UV system Lumbrifilter +BSP

(India & Peru)



Demo-site India

Wastewater characteristics

TSS: 940-4030mg/L, aver. 2190mg/L

BOD: 600-2000mg/L, aver. 1165mg/L

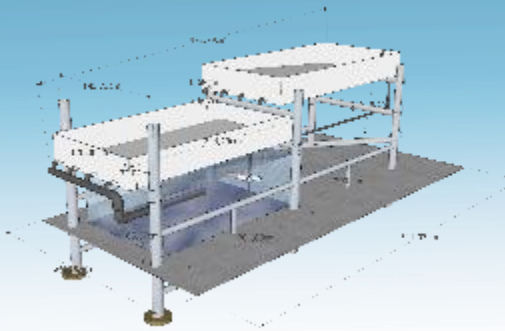
COD: 1104-4190mg/L, aver. 2241mg/L

NH₄-N: 60-144mg/L, aver. 104mg/L

wastewater **temp.:** 20.8 up to 38.8°C



WP5 – INDIA DEMO-SITE



Lumbrifilter +DF +UV system } (India & Peru) Lumbrifilter +BSP



Demo-site India

Wastewater characteristics

TSS: 940-4030mg/L, aver. 2190mg/L

BOD: 600-2000mg/L, aver. 1165mg/L

COD: 1104-4190mg/L, aver. 2241mg/L

NH₄-N: 60-144mg/L, aver. 104mg/L

wastewater **temp.:** 20.8 up to 38.8°C

| | | TSS | BOD | COD | NH ₄ - N |
|---------------------|----------------|--------------|--------------|--------------|---------------------|
| | | mg/L | mg/L | mg/L | mg N/L |
| LFin | average; STD N | 2190 +/- 951 | 1165 +/- 369 | 2242 +/- 851 | 104 +/- 23.7 |
| | max | 4030 | 2000 | 4190 | 144,0 |
| | min | 940 | 600 | 1104 | 60,1 |
| LEff | average; STD N | 271 +/- 186 | 90 +/- 76 | 371 +/- 217 | 15.2 +/- 8.5 |
| | max | 615 | 300 | 803 | 37,0 |
| | min | 36 | 14 | 86 | 2,7 |
| efficiency [%] | average; STD N | 88 +/- 8 | 93 +/- 6 | 83 +/- 10 | 85 +/- 10 |
| | max | 98 | 98 | 94 | 98 |
| | min | 62 | 75 | 60 | 54 |
| Overall Performance | | | | | |
| DF+UV | average | 98 | 99 | 96 | 94 |
| BSP | average | 87 | 97 | 90 | 97 |

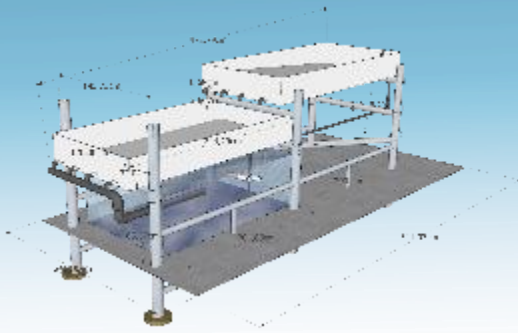
Lumbrifilter +DF +UV system } (India & Peru) Lumbrifilter +BSP



Demo-site Peru



WP5_PERU DEMO-SITE



Lumbrifilter +DF +UV system Lumbrifilter +BSP

(India & Peru)

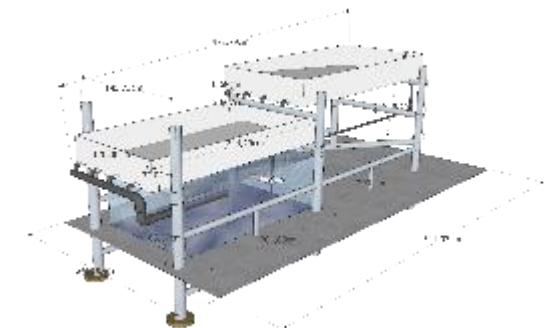
Demo-site Peru



| | LF+DF+UV Removal rate (%) | | | | | | | | LF+BSP Removal Rate (%) | | | | | | | |
|-------------|---------------------------|------------------|-------|-----------------------------------|-------|--------------------|---------------|-------|-------------------------|------------------|-------|-----------------------------------|-------|--------------------|---------------|-------|
| | TSS | BOD ₅ | COD | NH ₄ ⁻ N | TP | PO ₄ -P | Turbi dity | TN | TSS | BOD ₅ | COD | NH ₄ ⁻ N | TP | PO ₄ -P | Turbi dity | TN |
| Average (□) | 78 | 87.02 | 47.88 | 82.39 | 21.99 | 24.09 | 80.21 | 53.8 | 80.43 | 72.9 | 52.33 | 83.0 | 25.75 | 26.59 | 82.14 | 46.77 |
| Std (σ) | ±33 | ±10 | ±18 | ±11 | ±26 | ±20 | ±22 | ±22 | ±23 | ±22 | ±13 | ±15 | ±22 | ±22 | ±19 | ±28 |
| Median | 98 | 88.95 | 53.87 | 82.65 | 27.19 | 14.72 | 89.72 | 52.75 | 89.09 | 82.83 | 54.77 | 86.49 | 20.95 | 21.4 | 90.37 | 35.78 |

Thankyou for taking part!

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