Supporting of Bio-treatment of Drainage Water From Soilless Tomato Cultivation with Electric Current

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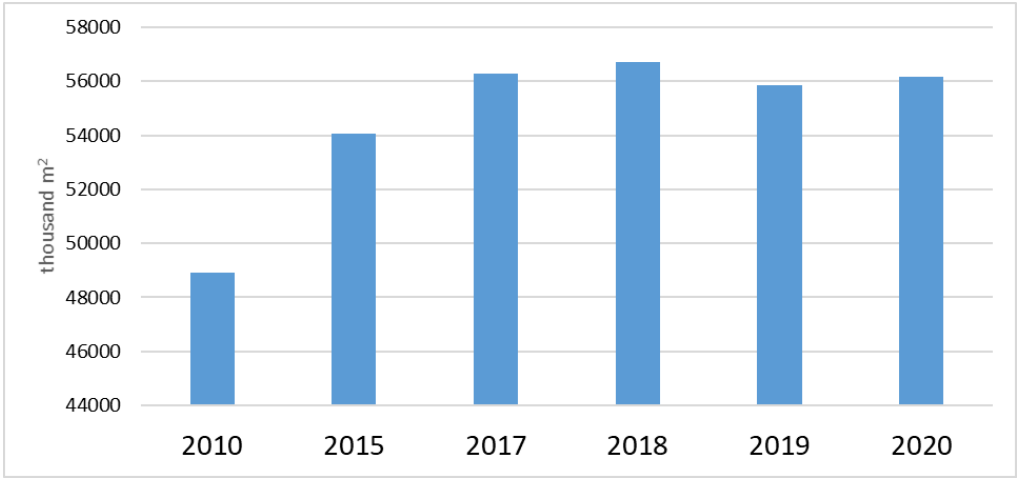
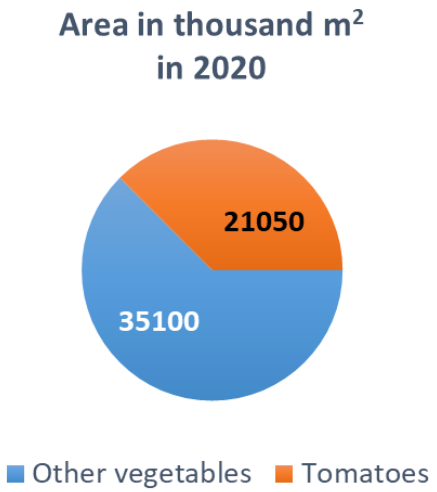
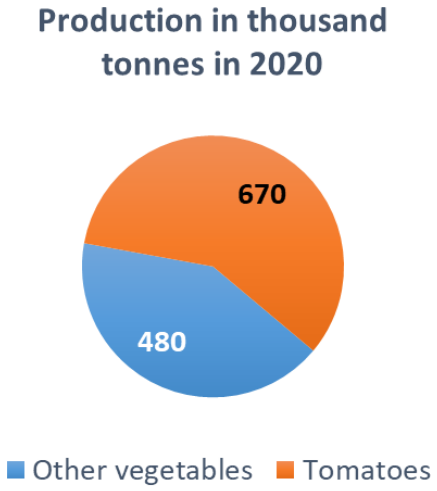
CULTIVATED AREA OF VEGETABLES UNDER ACCESSIBLE COVERS in Poland







Parameters of drainage water from soilless tomato cultivation

Parameters	Value mean	Value minimum	Value maximum	Standard deviation
TOC [mg/L]	15.2	12.8	19.2	2.0
Total nitrogen [mg N/L]	501.8	491.2	516.9	8.8
Nitrate [mg N/L]	489.0	485.0	510.0	16.2
Ammonia nitrogen [mg N/L]	0.084	0.020	0.176	0.056
Nitrite [mg N/L]	0.168	0.017	0.469	0.020
Total phosphorus [mg P/L]	81.0	75.5	91.5	5.2
Calcium [mg Ca/L]	588.8	527.0	591.0	25.9
Magnesium [mg Mg/L]	261.6	198.0	372.0	57.8
Aluminum [mg Al/L]	0.017	0.007	0.024	0.004
Iron [mg Fe/L]	0.591	0.485	0.697	0.066
pH	5.40	4.72	5.59	0.062
Temperature [°C]	19.5	19.0	21.3	0.97
Electrolytic conductivity [mS/cm]	6.09	5.93	6.60	0.20

1 m^2 of cultivation → 4.5 – 12.6 L drainage water per day

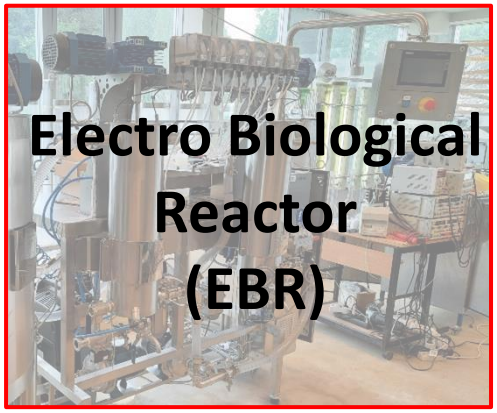
10000 m^2 of cultivation → **13 635 – 38 178 m^3** drainage water per year

soilless tomato cultivation

Raw Wastewater (drainage water)

?

Treated Wastewater



natural environment

Can we use EBR for drainage water treatment?

Should we use single-stage or two-stages treatment process?

LIDER

The National Centre for Research and Development

Development a precise treatment of wastewater from soilless tomato cultivation technology using electro biological hybrid reactor LIDER/4/0019/L-10/18/NCBR/2019

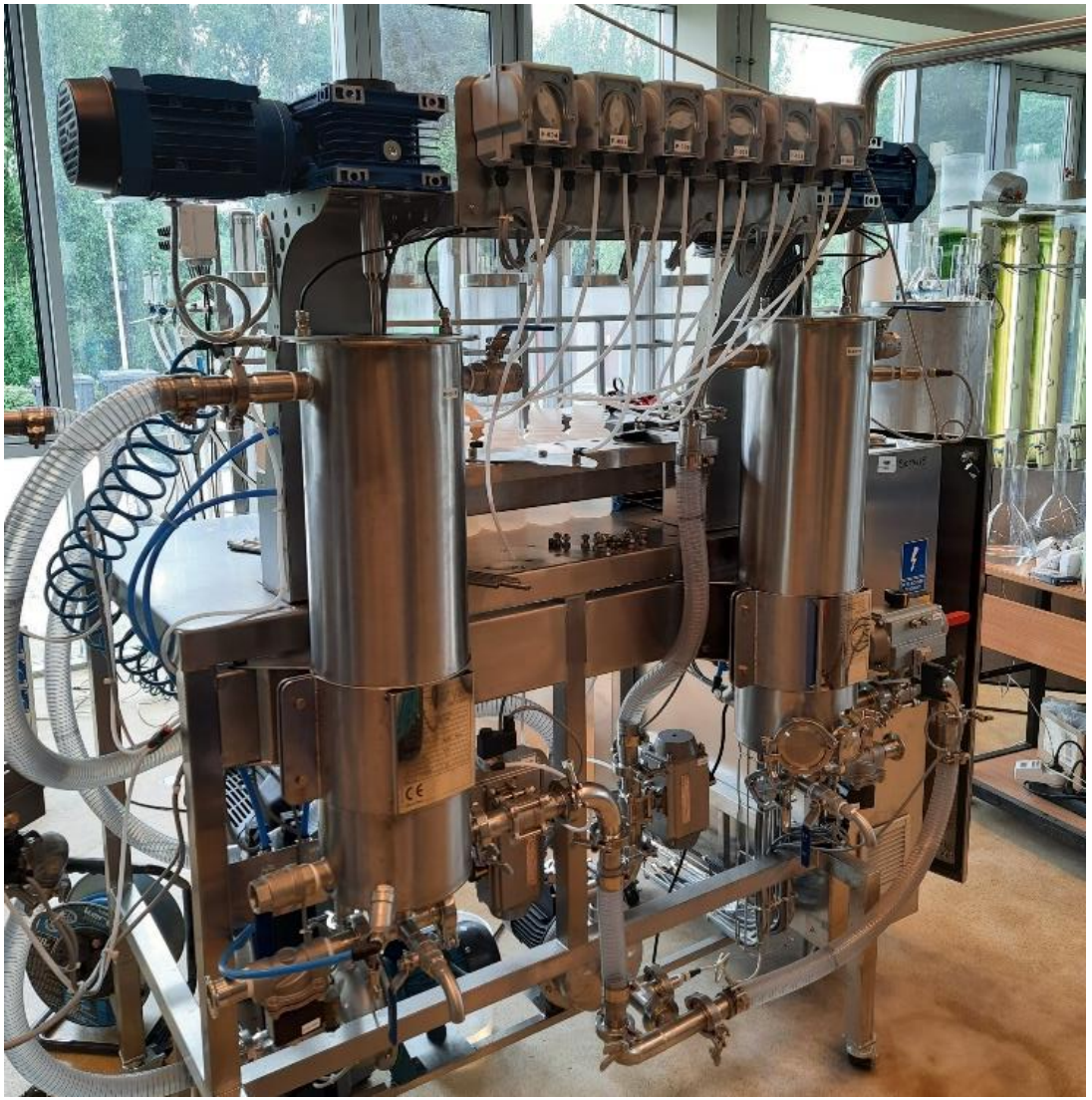
University of Warmia and Mazury in Olsztyn

Drainage water

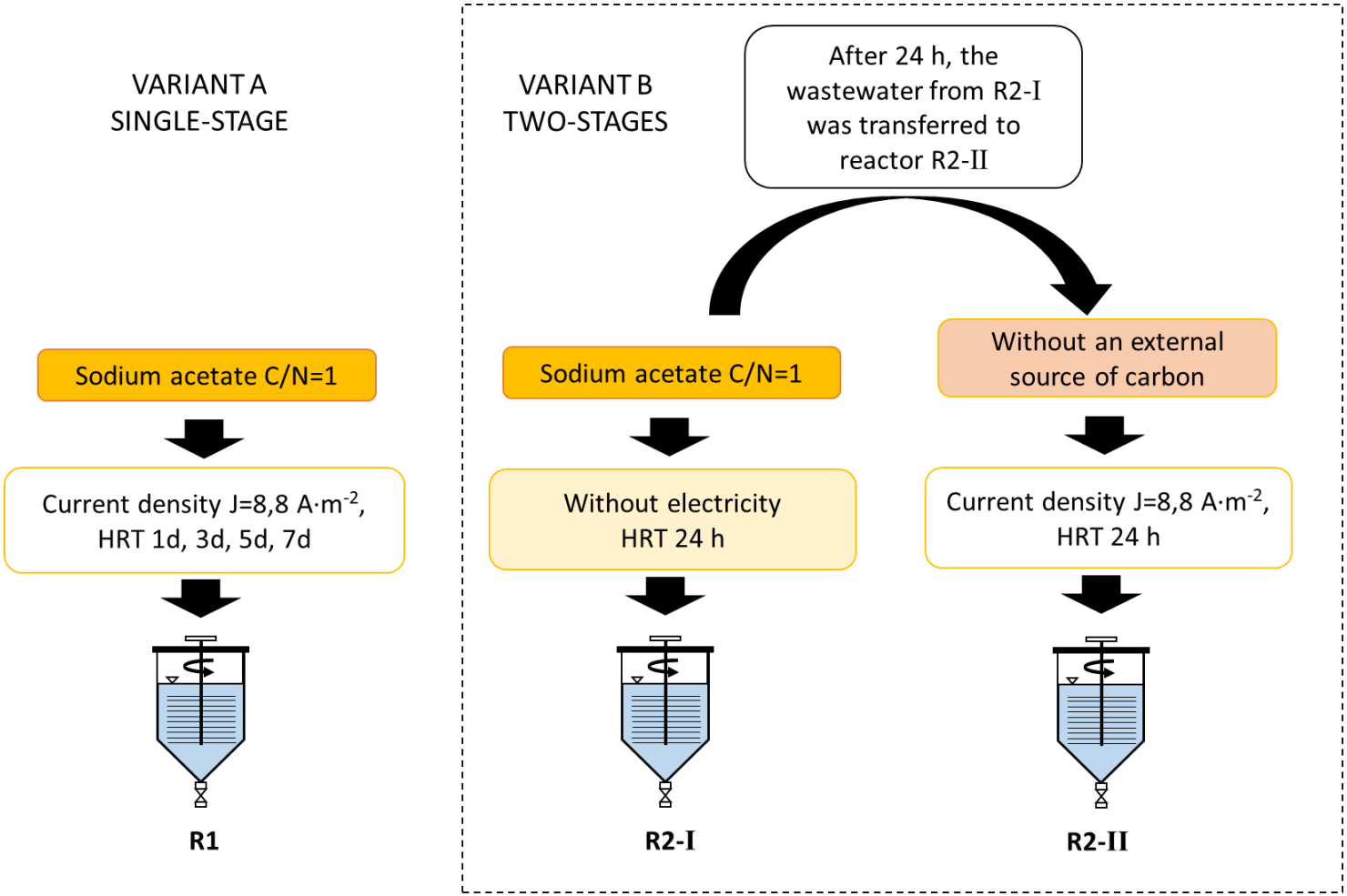
FULL-TECHNICAL SCALE SOILLESS TOMATO CULTIVATION in the north-eastern Poland (Europe)

175 000 m^2

EBR laboratory instalation

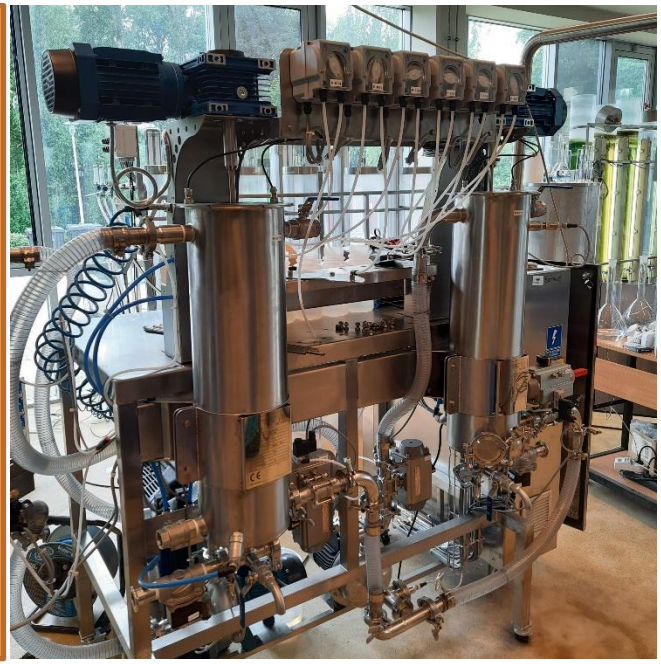


Experimental design



Methods

EBR laboratory instalation



Physicochemical analysis of raw and treated wastewater included:

- nitrate, nitrite, ammonium and total nitrogen concentration,
- total organic carbon (TOC),
- phosphorus, iron and aluminum concentration,
- pH, electrical conductivity (EC) and temperaturę.

Results

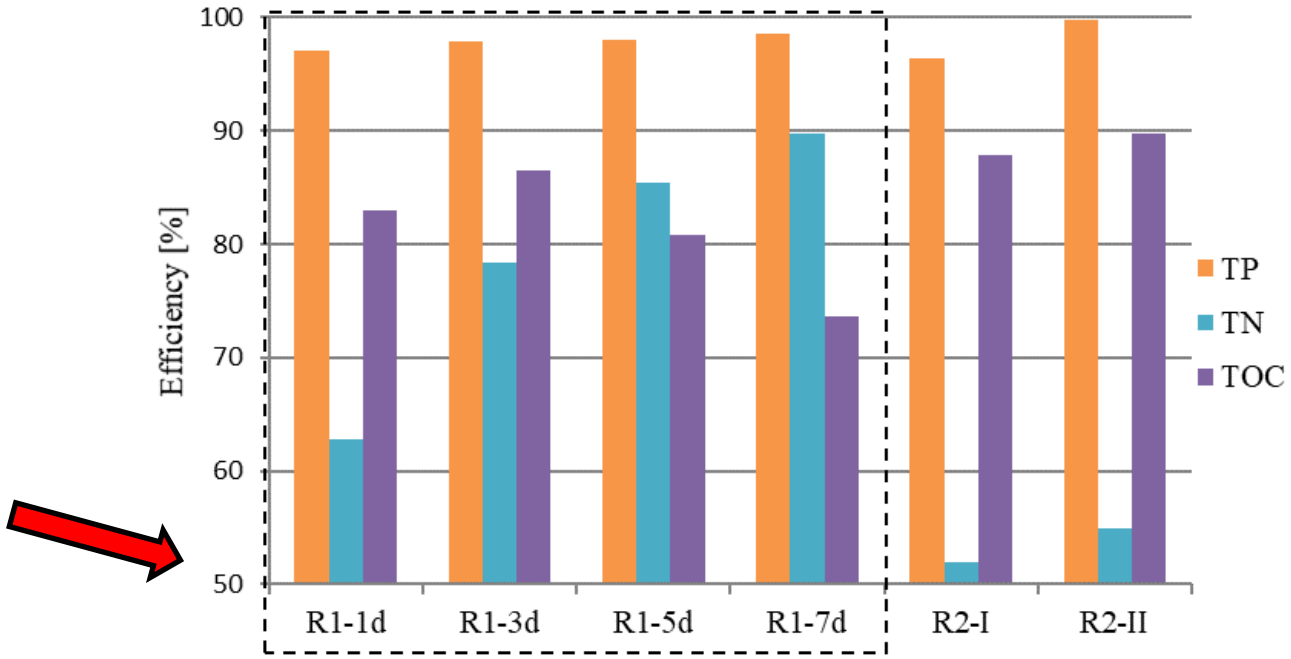


Figure 1. The effectiveness of TP, TN, and TOC removal in R1 at HRT of 1d, 3d, 5d, and 7d, and in R2 reactors (R2-I, R2-II)

Results

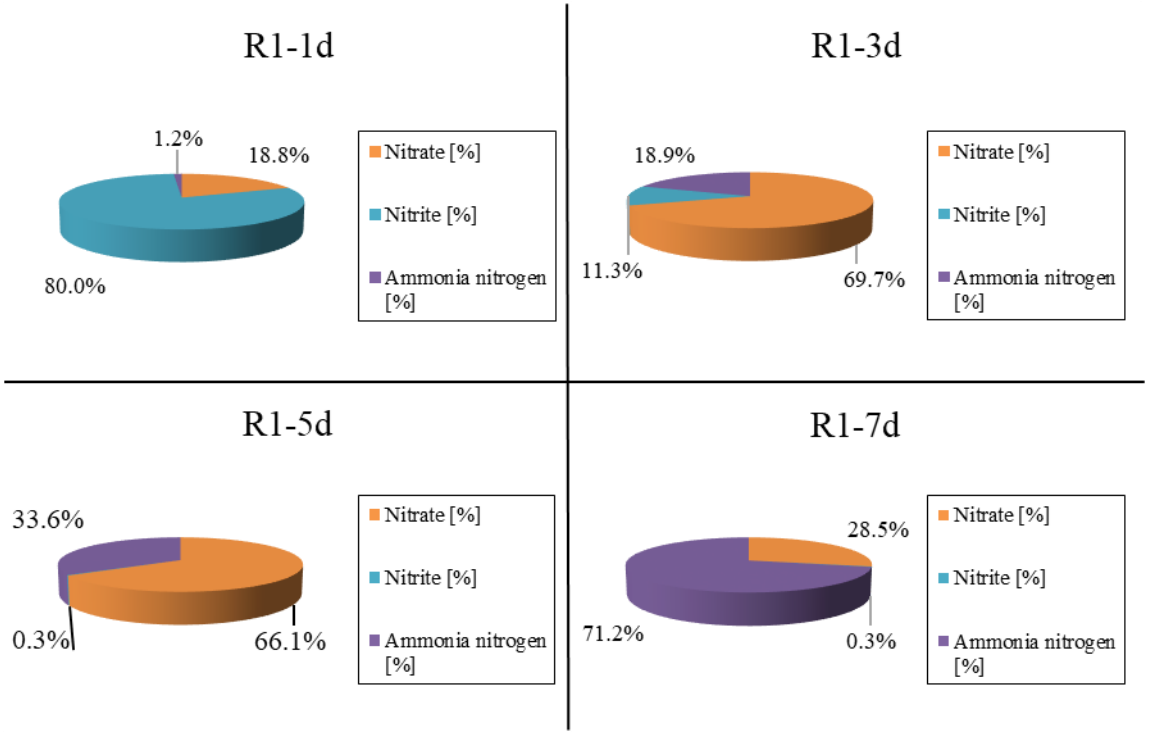


Figure 2. The percentage share of nitrate, nitrite and ammonia nitrogen in effluent from R1 depending on HRT

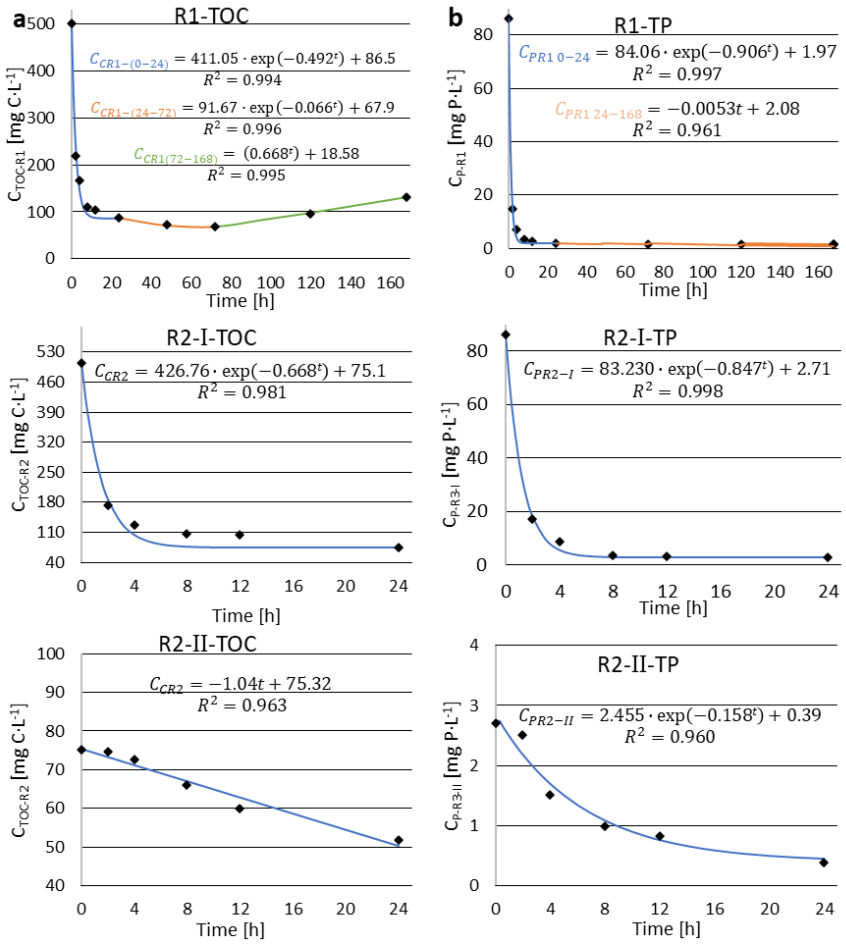


Figure 3. Profiles of changes in the concentration of TOC (a) and TP (b) within a full working cycle of the EBR

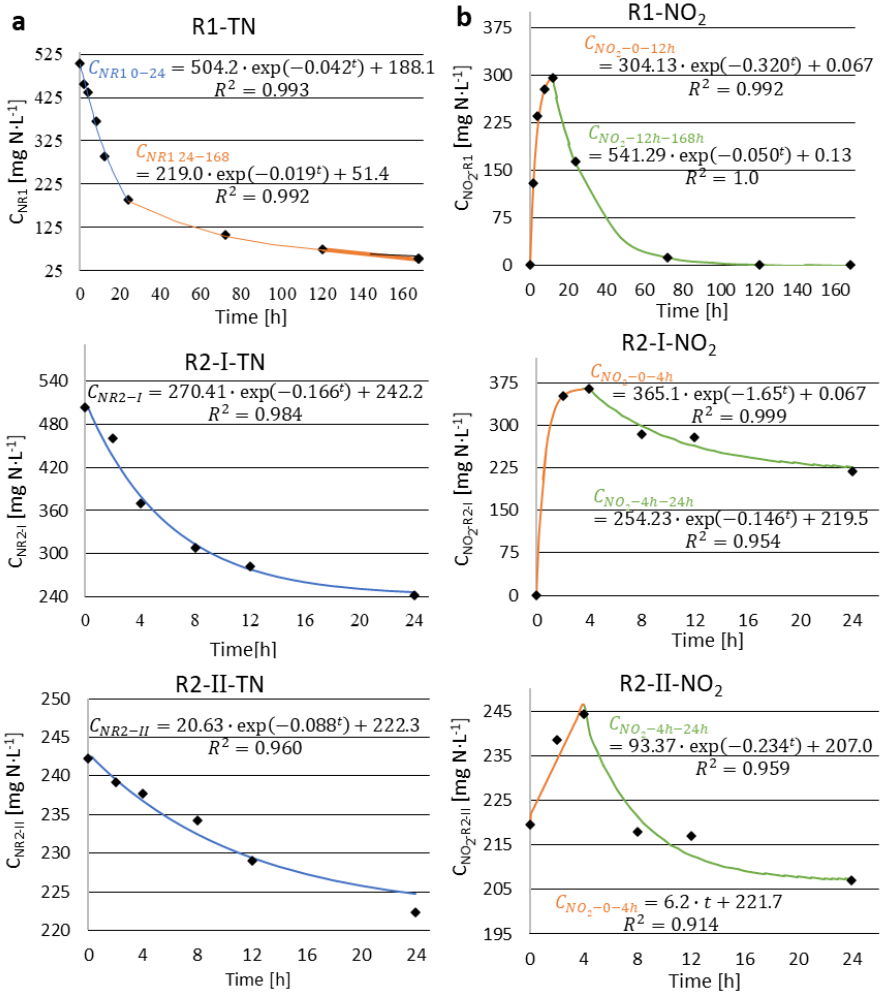


Figure 4. Profiles of changes in the concentration of TN (a) and NO2 (b) within a full working cycle of the EBR

Conclusions

- application of alternating current increases denitrification effectiveness,
- separation of biological and electrochemical processes is unfavorable action,
- nitrogen removal effectiveness depends on HRT and organic substrate dose,
- modification of drainage pH affects phosphorus removal rate

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