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On the role of operational dynamics in biogeochemical efficiency of a soil aquifer treatment system

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1 TWW composition

1.1 Real TWW chemical composition

Table S1 describes the chemical composition of the TWW collected from the Dresden WWTP before Glucose and NH_4^+ were added to reach similar composition to the synthetic WW.

Table S1. Real TWW chemical composition (as collected from the Dresden WWTP)

Analysis	Concentration (mg/L)
$NH_4^+ - N$	0.94
TKN	5.2
DOC	10.7

2 Soil characterization

Soil from the YAVNE2 pond cluster of the SHAFDAN site was collected. Prior to packing the column, the different layers of the soil were characterized. Particle size distribution , porosity TOC were determined. All soil horizons were found to contain $> 86\%$ of sand with an average porosity of $\sim$0.45. Column was packed according to the layering at the field.

Table S2. Soil characterization: porosity, texture and TOC content

Layer	Top (cm)	Bottom (cm)	Porosity (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	TOC (%)
1	0	153	0.48	0.7	93.9	2.4	3	0.25
2	153	258	0.48	0.6	94.4	2.1	2.9	0.1
3	258	352	0.47	0	99.2	0.1	0.7	0.01
4	352	462	0.42	0	97.4	0.6	2	0.02
5	462	480	-	-	-	-	-	-
6	480	600	0.42	0.4	86.4	5.6	7.6	0.05

3 WC and DO during SW240

Figure S1 presents the Surface head, WC and DO concentrations recorded during SW240.

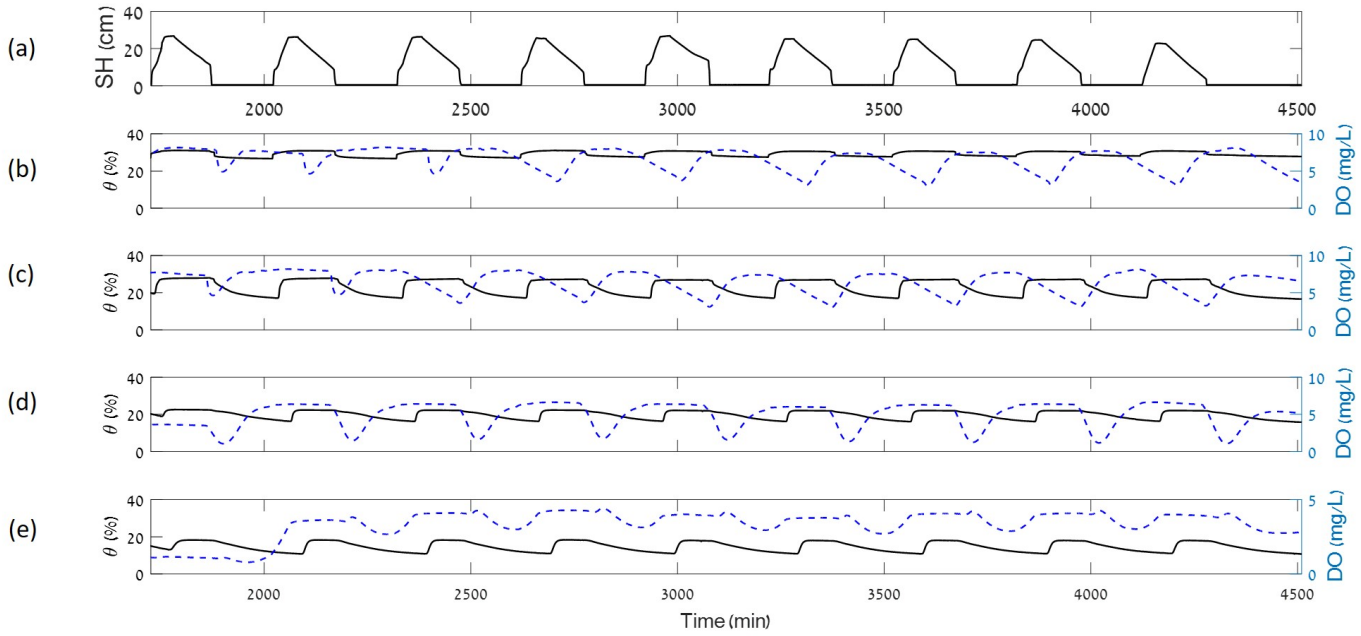

Figure S1. Surface head (SH; S1a), water content (θ) and DO over time at depths of : 25, 75, 175 and 275 cm below soil surface (S1b-S1e respectively) during SW240.

4 DO depletion in a preliminary experiment

In a preliminary experiment, cycles of 60 minutes FP and 150 minutes DP were implemented, using synthetic WW. Figure S2 shows that after $\sim$ 3000 minutes, complete DO depletion was observed at the 175 cm DO sensor.

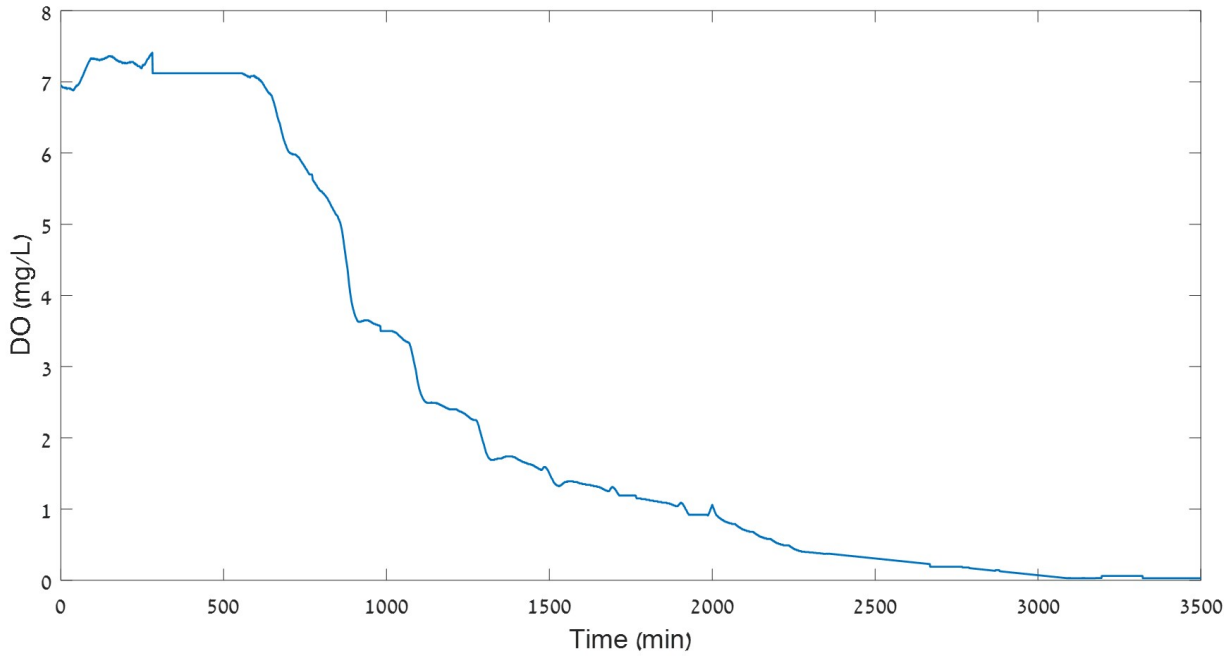

Figure S2. DO concentrations during a preliminary experiment. synthetic WW were used and cycles were of 60 minutes FP and 150 minutes DP

5 ORP during RW150 and RW240 at a depth of 75cm

Figure S3 presents the ORP at a depth of 75 cm recorded during RW150 (blue line) and RW240 (red line). These results show that the longer DP had a beneficial effect on the ORP at this depth - in RW240, ORP values were significantly higher compared to RW150, throughout the majority of the experiment, ORP values were greater than 200 mV and reached ∼400 mV periodically, suggesting that the longer DP contributed to enhanced aeration that in turn resulted in higher outflow quality.

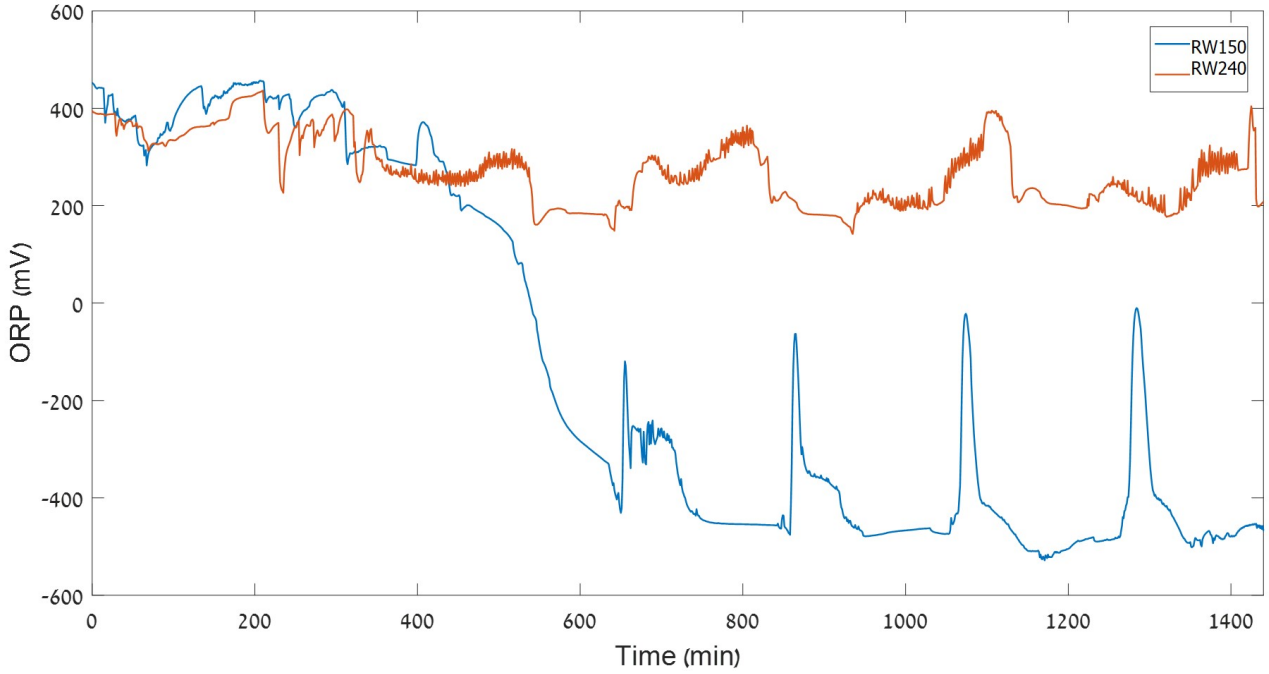

Figure S3. ORP at a 75 cm during RW150 (blue line) and RW240 (red line)

6 DO concentrations during RW150

Figure S4 shows DO concentrations at depths of 175 and 275 cm recorded during RW150. DO depletion occurred after ∼850 and ∼1400 minutes from the beginning of the experiment (for 175 and 275 cm respectively).

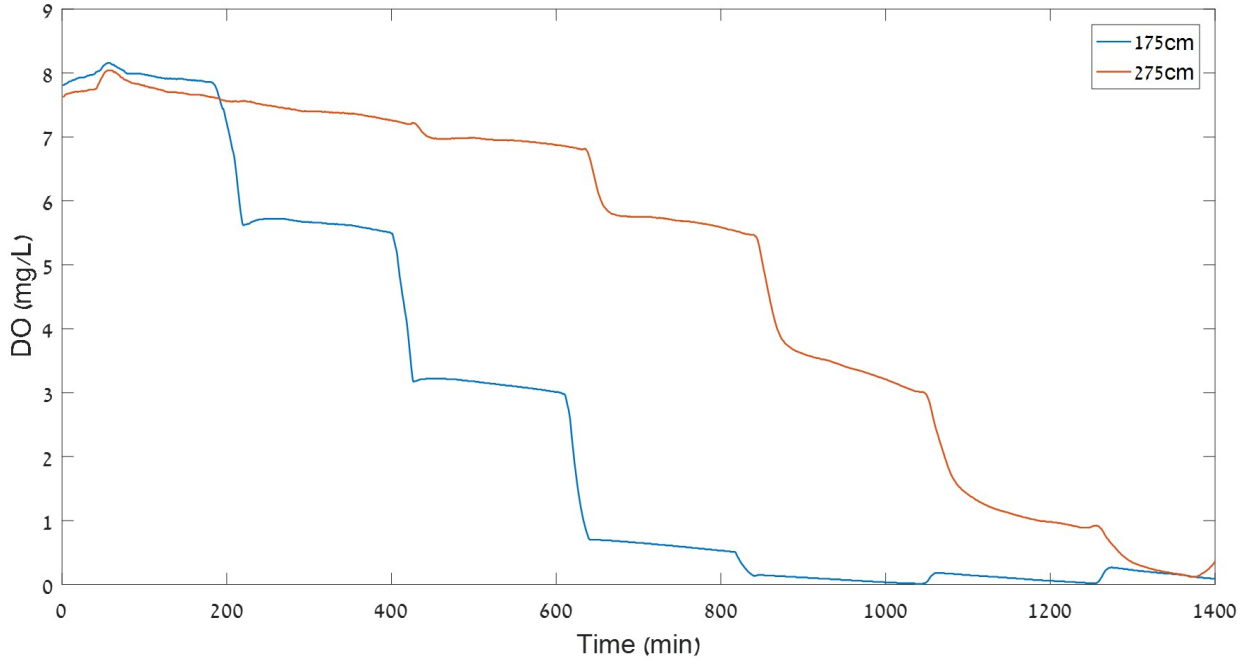

Figure S4. DO concentrations at 175 and 275 cm during RW150

7 ORP and DO values during SW150 and SW240

Figure S5 shows DO and ORP concentrations recorded during SW150 and SW240 at a depth of 75 cm. A correspondence between the two monitored parameters is observed.

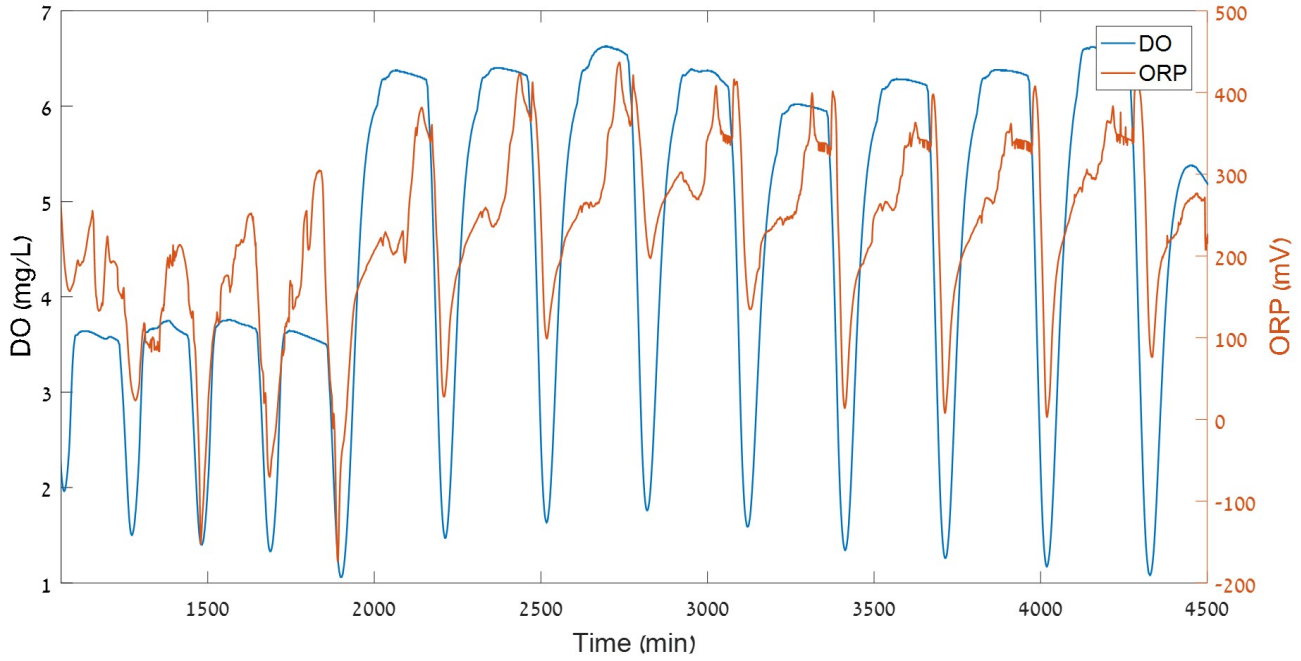

Figure S5. DO and ORP concentrations at 75 cm depth during SW150 and SW240

8 The Israeli SHAFDAN SAT site

In Israel, the SHAFDAN site, which is the largest WWTP in the country, treats $\sim$ 150 million m^3 of wastewater originating from the city of Tel Aviv and surrounding municipalities annually. Following the SAT process, the treated water is recovered through recovery wells located 1–2 km away from the infiltration basins, transported to the south of Israel and is used by farmers for crop irrigation. Effluents of the wastewater treatment plant are first treated in the mechanical, biological treatment plant and then recharged into a section of the sandy Israeli coastal aquifer in which the groundwater table lies $\sim$30-40 m below ground surface. Sediments are mainly composed of sand and silty sand from the Kurkar formation. Hydraulic loading in each of the infiltration basins is $\sim$ 80-150 m/y (depending on the basin's capacity). Hydraulic operation is composed of $\sim$24 h flooding periods, and a drainage period of 48–72 h.