Table 1. Average composition of the primary domestic wastewater treated in the raceways (RWs) and in the effluent of the RWs in the steady operation of the four experimental stages.

Stage	Stream	COD (mg L^{-1})	TOC (mg L^{-1})	IC (mg L^{-1})	TN (mg L^{-1})	$N\text{-}NH_4^+$ (mg L^{-1})	$N\text{-}NO_3^-$ (mg L^{-1})	$P\text{-}PO_4^{3-}$ (mg L^{-1})	H. bacteria (cfu 100 mL^{-1})	*E. coli* (cfu 100 mL^{-1})
I	**Influent**	575±84	211±5	117±1	64±15	63±14	1±1	9±3	$(2\pm0.8)\cdot10^7$	$(3\pm0.6)\cdot10^6$
	RW1	81±1	72±0	50±3	23±1	1±1	22±1	6±1	$(3\pm1)\cdot10^6$	$(30\pm4)\cdot10^4$
	RW2	75±2	65±0	77±1	20±1	1±1	19±3	6±0	$(12\pm4)\cdot10^6$	$(16\pm10)\cdot10^4$
	RW3	116±2	76±0	61±2	25±2	1±1	24±1	6±0	$(100\pm16)\cdot10^6$	$(67\pm21)\cdot10^4$
II	**Influent**	744±82	313±2	140±6	52±4	50±3	1±1	11±2	$(2\pm0.7)\cdot10^7$	$(7\pm0.6)\cdot10^6$
	RW1	75±6	57±4	69±3	24±0	4±3	19±0	5±1	$(3\pm2)\cdot10^6$	$(23\pm0)\cdot10^4$
	RW2	103±9	65±5	78±0	15±1	2±1	12±1	5±1	$(12\pm2)\cdot10^6$	$(24\pm5)\cdot10^4$
	RW3	66±4	61±1	73±11	22±3	4±3	18±1	4±2	$(170\pm45)\cdot10^6$	$(70\pm14)\cdot10^4$
III	**Influent**	649±52	244±4	134±1	75±2	74±1	0±0	10±1	$(3\pm1.0)\cdot10^8$	$(7\pm2.0)\cdot10^6$
	RW1	106±5	85±8	84±3	16±1	16±1	0	4±0	$(76\pm1)\cdot10^6$	$(23\pm15)\cdot10^4$
	RW2	105±3	77±5	68±4	7±1	6±2	0	4±0	$(48\pm14)\cdot10^6$	$(176\pm5)\cdot10^4$
	RW3	91±2	74±2	73±3	17±3	17±2	0	3±0	$(36\pm3)\cdot10^6$	$(14\pm14)\cdot10^4$
IV	**Influent**	432±77	181±9	132±23	70±6	66±5	0±0	9±0	$(6\pm1.5)\cdot10^7$	$(4\pm1.0)\cdot10^6$
	RW1	124±1	76±6	82±12	2±0	2±0	0	4±0	$(35\pm16)\cdot10^6$	$(3\pm1)\cdot10^4$
	RW2	95±8	83±10	73±3	2±0	2±0	0	4±0	$(29\pm14)\cdot10^6$	$(2\pm1)\cdot10^4$
	RW3	148±1	81±10	81±12	2±0	2±0	0	4±0	$(30\pm16)\cdot10^6$	$(5\pm2)\cdot10^4$

cfu: colony forming units; H. bacteria= heterotrophic bacteria; *E. coli*= *Escherichia coli*

Table 2. Main operational characteristics in the tested RWs during the four different operational stages. Domestic wastewater additions to replace water evaporation losses are included in the final HRT calculation.

Stage	Elapsed time (d)	HRT (d)	pH Control	CO_2	Objective
I	29	2.7±0.1	RW1=9; RW2=8; RW3=7	Pure CO_2	Influence of different pHs on wastewater treatment and biomass productivity and composition.
II	18	2.8±0.2	RW1=9; RW2=8; RW3=7	CO_2 from flue gas	Comparative evaluation of the influence of the addition of pure CO_2 and CO_2 from flue gas in the culture/ Determination of carbon consumption in the raceways at different pHs.
III	32	6.7±0.4	8	CO_2 from flue gas	Influence of the absence of CO_2 addition on pH evolution on wastewater treatment and biomass productivity and composition..
IV	18	6.0±0.3	Without pH control	No CO_2 addition	

Table 3. Average evaporation rate and light irradiance, maximum light irradiance, average outdoors temperature and number of sun hours in each experimental period at steady state.

Stage	Evaporation rate ($L\ m^{-2}\ d^{-1}$)	Average light irradiance ($W\ m^{-2}$)	Maximum light irradiance ($W\ m^{-2}$)	Temperature (ºC)	Period of illumination ($h\ d^{-1}$)
I	6.4±1.8	468±292	881	23±1	11
II	5.2±1.2	462±225	780	22±1	10
III	3.4±1.1	306±216	568	14±3	9
IV	2.9±1.4	300±157	461	13±1	7

Table 4. C, N and P content and percentage of lipids, proteins, carbohydrates (expressed ash free basis) and ash in the harvested biomass during each experimental period and RWs at steady state.

Stage	RWs	C (%)	N (%)	P (%)	Lipid (%)	Protein (%)	Carbohydrate (%)	Ash (%)
I	**RW1**	42.9	8.7	1.6	6.0	41.4	52.7	18.0
	RW2	43.9	8.9	1.2	5.8	40.3	53.9	16.8
	RW3	37.5	6.4	1.1	7.2	31.2	61.2	16.6
II	**RW1**	50.4	12.6	2.4	23.0	39.0	38.0	22.6
	RW2	61.5	10.1	2.2	20.4	45.9	38.7	20.8
	RW3	52.8	8.5	2.0	16.7	42.0	41.3	21.8
III	**RW1**	64.8	10.1	2.3	10.3	38.9	50.8	15.7
	RW2	62.3	10.0	2.3	4.9	36.2	58.9	14.0
	RW3	61.6	10.0	2.0	20.5	36.3	43.1	11.4
IV	**RW1**	49.9	8.4	1.3	13.9	38.7	47.4	17.7
	RW2	51.3	8.5	1.2	14.5	28.2	57.4	13.7
	RW3	53.4	9.0	1.3	13.4	30.8	55.8	14.3

Table 5. TSS, Kv/Km, K_a, microalgae and bacteria cell concentration in the culture growth during the steady state in each stage and RW.

Stage	RWs	TSS (mg L^{-1})	Fv/Fm	K_a (g m^{-2})	Microalgae (cell mL^{-1})	Bacteria (cell mL^{-1})
I	**RW1**	448±81	0.33±0.03	0.15	$(29±4)\cdot10^5$	$(10±1)\cdot10^7$
	RW2	494±11	0.34±0.03	0.08	$(26±0)\cdot10^5$	$(8±1)\cdot10^7$
	RW3	430±74	0.33±0.03	0.23	$(13±2)\cdot10^5$	$(5±1)\cdot10^7$
II	**RW1**	407±17	0.32±0.01	0.20	$(12±2)\cdot10^6$	$(13±1)\cdot10^7$
	RW2	432±37	0.35±0.01	0.12	$(11±4)\cdot10^6$	$(8±0.2)\cdot10^7$
	RW3	422±65	0.35±0.02	0.25	$(12±2)\cdot10^6$	$(13±0.3)\cdot10^7$
III	**RW1**	396±10	0.59±0.01	0.15	$(10±3)\cdot10^6$	$(30±8)\cdot10^6$
	RW2	403±31	0.46±0.01	0.16	$(5±1)\cdot10^6$	$(30±3)\cdot10^6$
	RW3	427±4	0.54±0.02	0.20	$(13±1)\cdot10^6$	$(30±2)\cdot10^6$
IV	**RW1**	397±8	0.50±0.01	0.13	$(14±6)\cdot10^6$	$(14±1)\cdot10^7$
	RW2	321±30	0.47±0.05	0.14	$(11±1)\cdot10^6$	$(17±1)\cdot10^7$
	RW3	350±27	0.43±0.04	0.17	$(9±1)\cdot10^6$	$(16±1)\cdot10^7$

Figure 1. a) Flow diagram of the three photobioreactors. White circles in the RWs represent pH control, while grey circles refer to the indicators of dissolved oxygen, temperature, CO_2 molar fraction and time of CO_2 valve opening. Continuous line refer to domestic wastewater distribution and the discontinuous represents CO_2 pipe. b) Schematic diagram of the raceway showing dimensions, paddlewheel and sump.

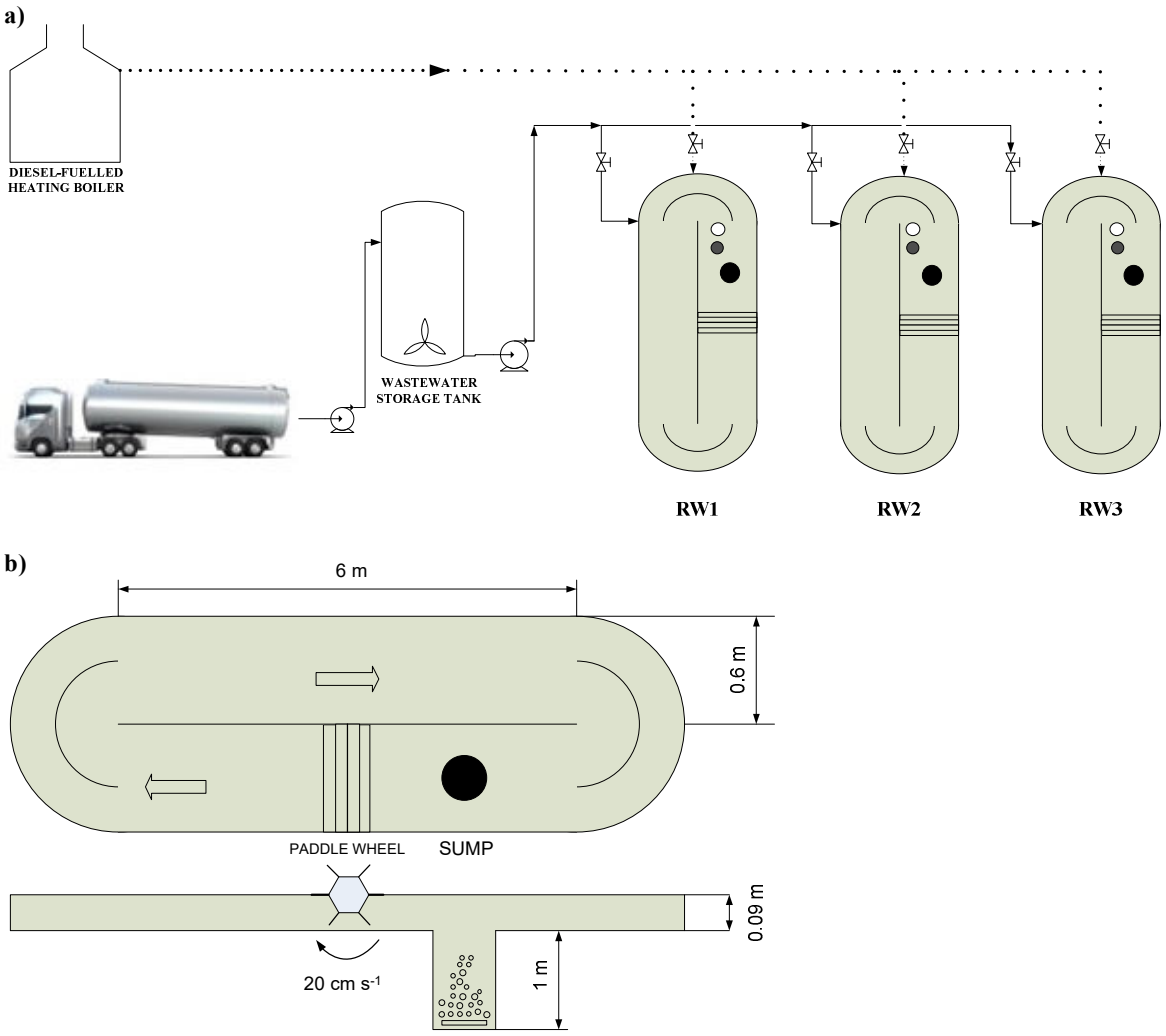

Figure 2. DO (◇), temperature (■), pH (●) and light radiation (Ra) (△)during stage I in RW1 (a), RW2 (b) and RW3(c) and stage II in RW1(d), RW2(e) and RW3(f) under steady state operation.

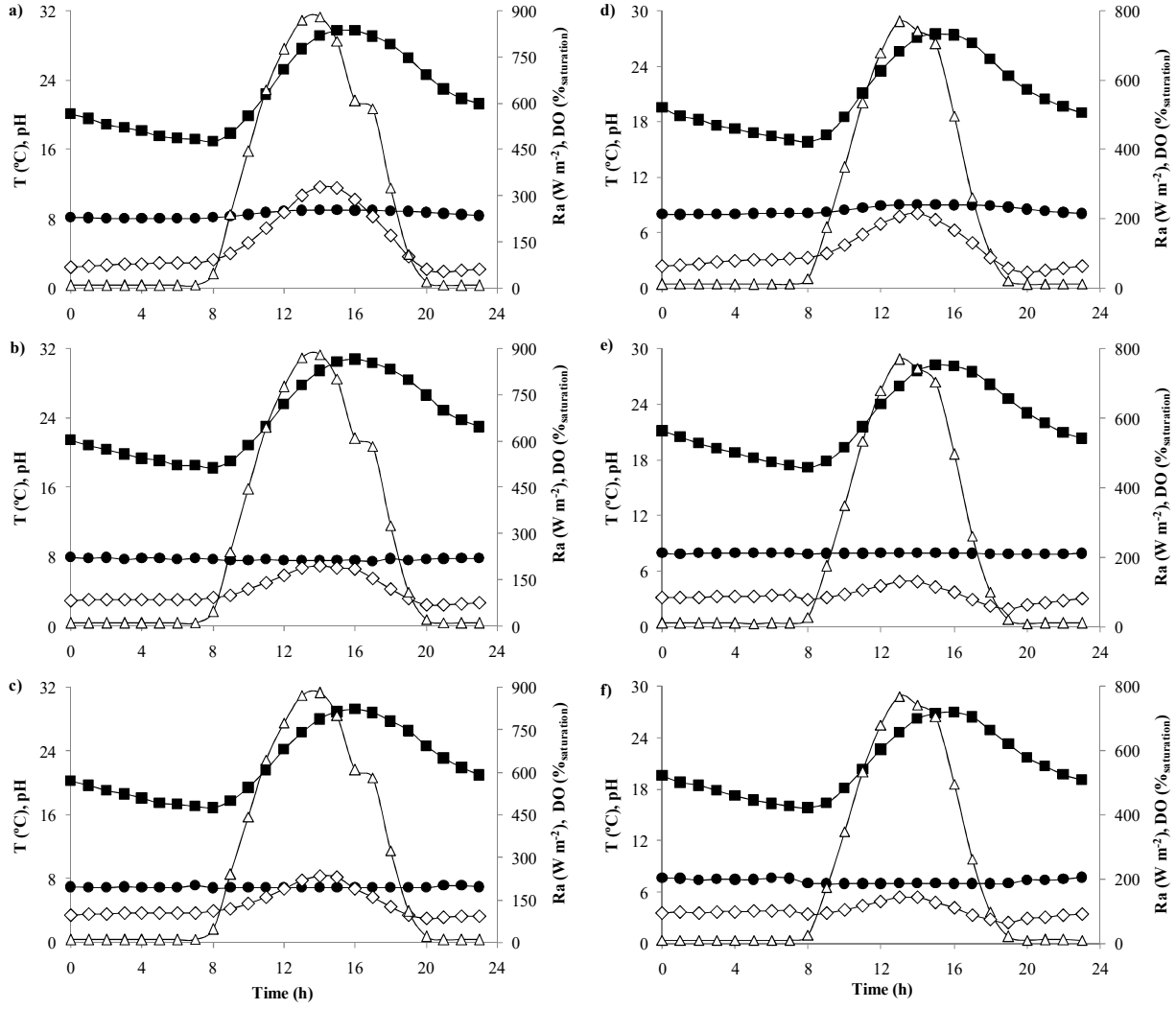

Figure 3. DO (◇), temperature (■), pH (●) and light radiation evolution during stages III in RW1 (a), RW2 (b) and RW3(c) and IV in RW1(d), RW2(e) and RW3(f).

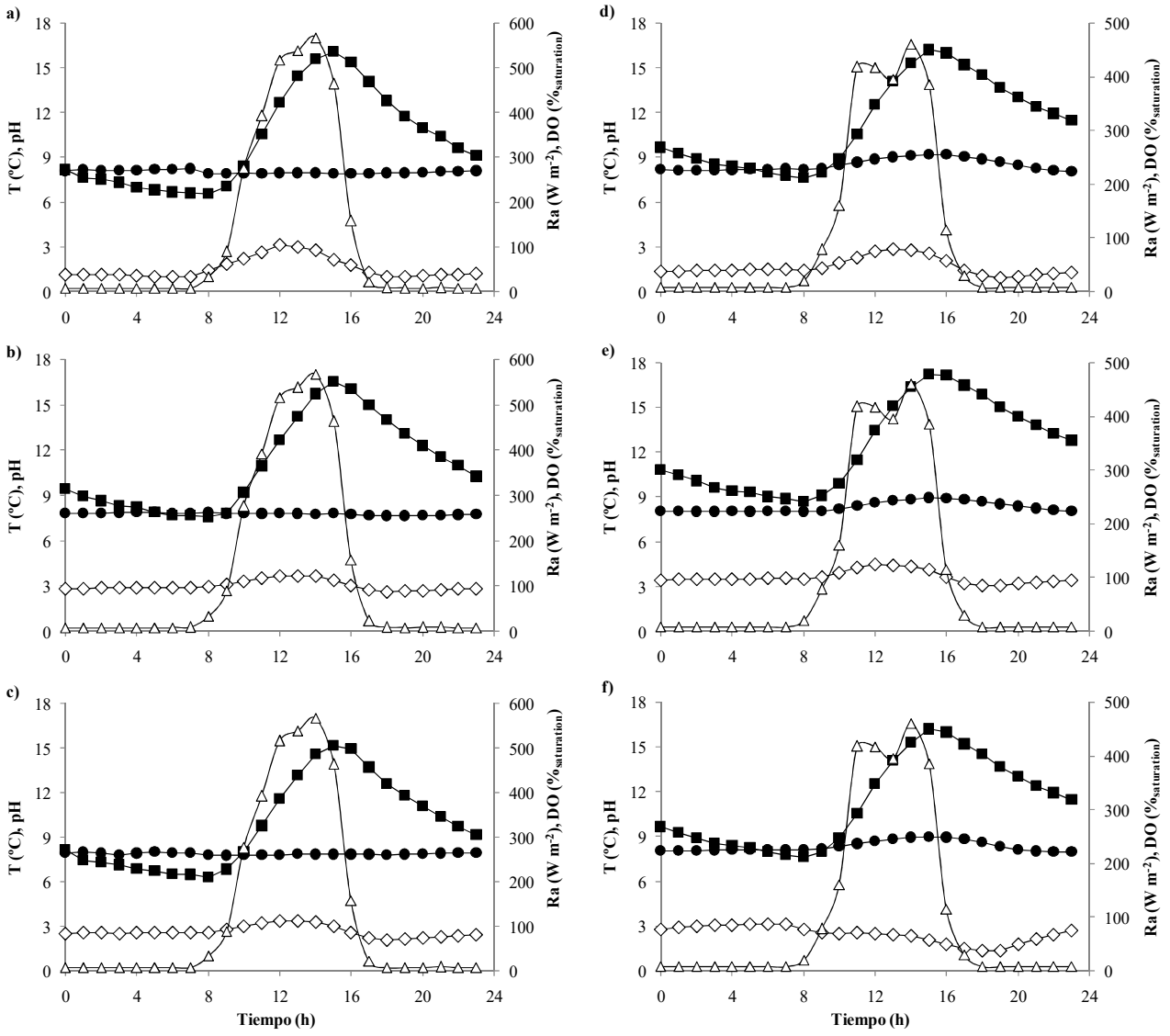

Figure 4. Removal efficiency of (a) COD, (b) TOC, (c) TN, (d) $N\text{-}NH_4^+$, (e) $P\text{-}PO_4^{3-}$, (f) Heterotrophic bacteria and (g) *Escherichia coli* in RW1 (□), RW2 (■) and RW3 (■) during the four operational stages.

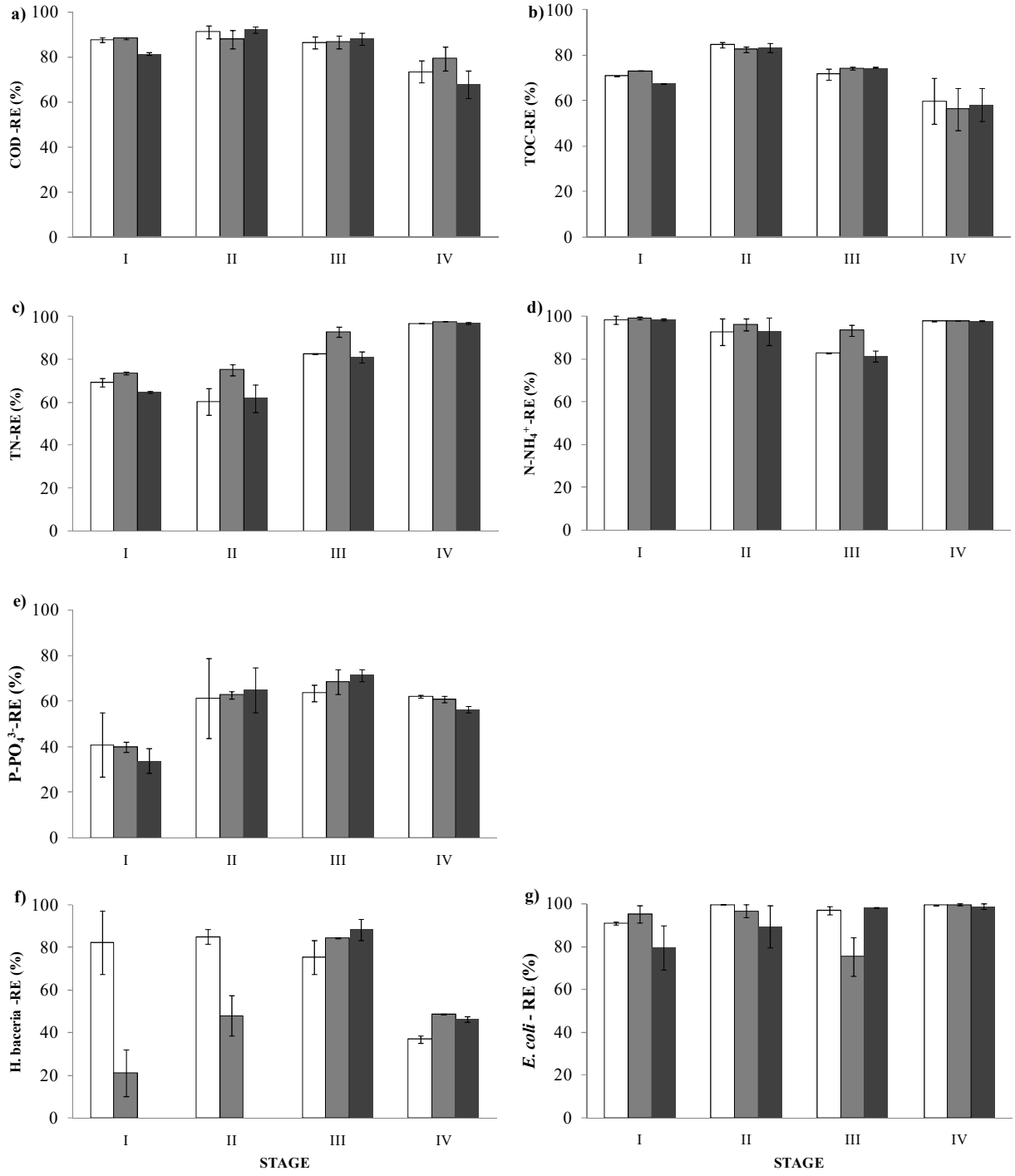

Figure 5. (a) Biomass productivity and (b) percentage of biomass settleability in the culture broth in RW1 (□), RW2 (■) and RW3 (■) during the four operational stages.