





SUPPLEMENTARY MATERIAL

Opportunities and constraints for effective treatment of domestic wastewater in rural onsite wastewater treatment systems operating in a foothill climate

Andrzej Jucherski¹⁾ , Andrzej Walczowski¹⁾ ,
Beata Grabowska-Polanowska¹⁾ , Agnieszka Operacz^{*2)} , Piotr Bugajski²⁾ 

¹⁾ Institute of Technology and Life Sciences – National Research Institute, Al. Hrabka 3, 05-090 Raszyn, Falenty, Poland

²⁾ University of Agriculture in Krakow, Faculty of Environmental Engineering and Land Surveying, Department of Sanitary Engineering and Water Management, Al. Mickiewicza 24/28, 30-059, Kraków, Poland

* Corresponding author

Table S1. Statistical characteristics of pollutant constituents in wastewater after successive treatment stages at facilities No. 1 and 2

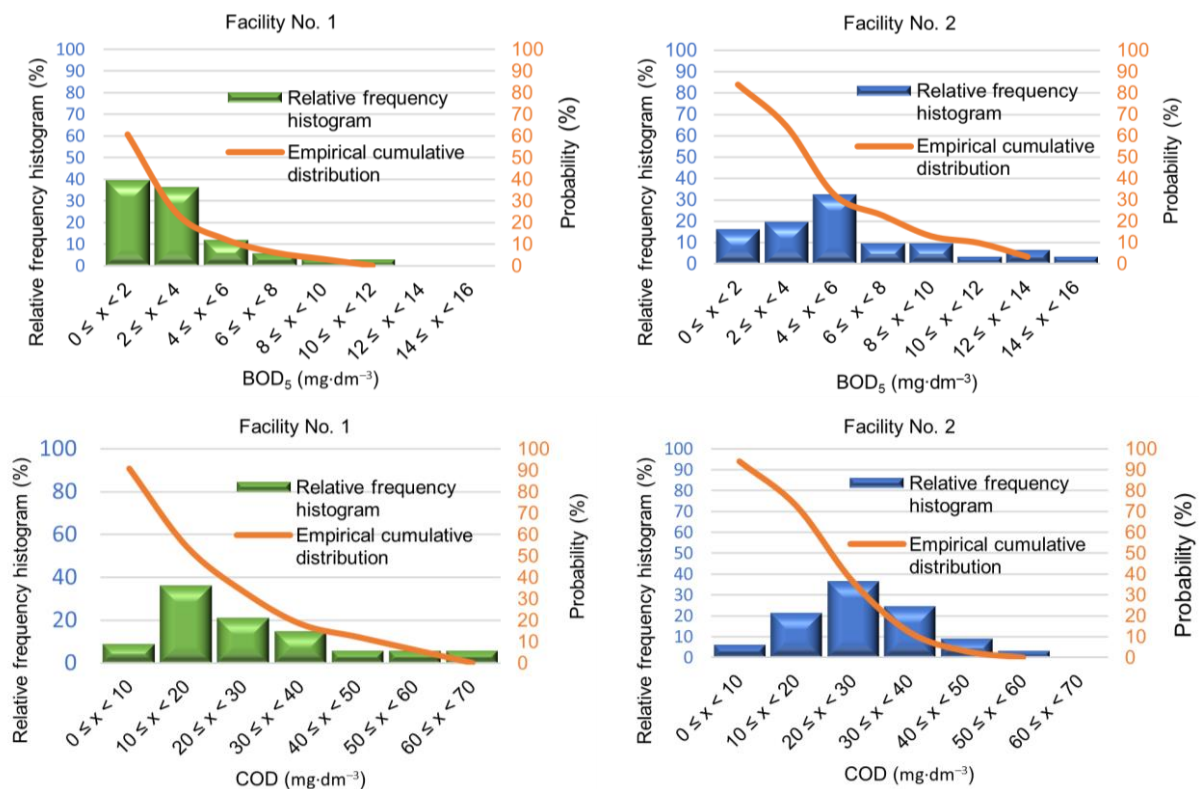
Statistical characteristics	Wastewater discharge from			Wastewater discharge from		
	septic tank	sprayed bed	slope biofilter	septic tank	sprayed bed	slope biofilter
	facility No. 1			facility No. 2		
BOD ₅ (mg O ₂ ·dm ⁻³)						
Average	173.0	34.4	2.7	534.1	76.1	6.5
Median	128.0	30.0	2.0	560.0	52.0	4.5
Minimum	60.0	9.0	0.5	200.0	12.0	0.5
Maximum	480.0	97.0	10.0	830.0	240.0	31.0
Standard deviation	98.5	19.4	2.4	137.1	63.5	6.1
Coefficient of variation (%)	56.9	56.3	87.1	25.7	83.4	94.0
COD (mg O ₂ ·dm ⁻³)						
Average	373.1	104.2	25.5	755.9	106.6	26.9
Median	354.0	89.0	23.0	699.0	102.1	27.0
Minimum	144.0	29.0	5.0	498.0	31.0	7.0
Maximum	641.0	245.0	63.0	1148.0	206.0	55.0
Standard deviation	142.7	56.5	15.7	175.0	49.8	11.2
Coefficient of variation (%)	38.2	54.2	61.7	23.1	46.7	41.7
NH ₄ -N (mg·dm ⁻³)						
Average	78.6	28.2	1.0	132.8	37.8	8.0
Median	80.5	24.0	0.4	132.3	29.4	4.3
Minimum	28.0	4.1	0.1	83.6	7.5	0.2
Maximum	125.8	76.5	4.8	177.8	90.7	30.8

Statistical characteristics	Wastewater discharge from			Wastewater discharge from		
	septic tank	sprayed bed	slope biofilter	septic tank	sprayed bed	slope biofilter
	facility No. 1			facility No. 2		
Standard deviation	23.3	17.1	1.2	19.9	24.2	8.7
Coefficient of variation (%)	29.7	60.8	118.2	15.0	64.0	108.1
NO₃-N (mg·dm⁻³)						
Average	–	48.2	13.7	–	48.8	9.3
Median	–	51.8	4.5	–	51.2	5.2
Minimum	–	0.2	0.2	–	6.1	0.5
Maximum	–	84.2	56.1	–	97.1	34.6
Standard deviation	–	18.8	15.4	–	24.5	8.5
Coefficient of variation (%)	–	39.0	112.3	–	50.2	91.8
TN (mg·dm⁻³)						
Average	104.1	92.0	21.5	153.8	104.8	24.1
Median	112.0	100.0	11.0	152.3	103.7	23.2
Minimum	47.0	18.8	2.3	120.2	68.7	4.7
Maximum	149.3	142.2	73.7	219.9	148.4	66.0
Standard deviation	28.3	29.4	19.8	23.2	16.9	14.8
Coefficient of variation (%)	27.2	31.9	92.2	15.1	16.1	61.5
PO₄-P (mg·dm⁻³)						
Average	10.6	9.7	1.3	16.5	12.8	5.1
Median	10.7	9.5	1.0	16.1	12.6	5.2
Minimum	3.6	3.2	0.2	8.5	6.4	0.6
Maximum	24.4	17.5	3.6	22.9	20.3	12.1
Standard deviation	3.9	3.5	0.9	3.2	2.8	3.1
Coefficient of variation (%)	36.2	35.6	66.9	19.7	22.1	61.6
TSS (mg·dm⁻³)						
Average	58.0	31.9	8.0	142.4	55.8	8.6
Median	48.2	28.0	5.0	136.0	43.8	8.0
Minimum	21.4	10.0	1.0	66.6	22.6	0.6
Maximum	166.8	104.0	40.0	290.8	158.6	19.2
Standard deviation	32.8	19.7	8.3	58.1	30.0	4.8
Coefficient of variation (%)	56.6	61.6	104.2	40.8	53.9	55.4
Oxygen content (mg·dm⁻³)						
Average	1.3	3.8	8.6	0.4	2.7	7.9
Median	0.9	4.1	8.5	0.3	2.7	7.1
Minimum	0.1	0.1	5.6	0.1	0.2	4.6
Maximum	4.1	7.9	12.5	2.1	6.8	12.5
Standard deviation	1.0	2.0	1.8	0.4	2.0	2.1
Coefficient of variation (%)	81.7	52.3	21.4	91.2	76.2	27.3

Statistical characteristics	Wastewater discharge from			Wastewater discharge from		
	septic tank	sprayed bed	slope biofilter	septic tank	sprayed bed	slope biofilter
	facility No. 1			facility No. 2		
Temperature (°C)						
Average	11.7	10.9	8.4	11.6	9.7	8.9
Median	10.7	9.9	8.5	12.0	9.9	9.0
Minimum	3.8	3.7	0.8	4.3	1.2	0.1
Maximum	18.9	18.5	15.8	18.9	18.1	17.2
Standard deviation	4.8	4.9	4.9	4.9	5.4	5.7
Coefficient of variation (%)	40.9	44.7	58.6	42.0	56.3	64.1
Daily wastewater discharge from the house (dm ³ ·d ⁻¹)						
Average	539	–	–	515	–	–
Median	480	–	–	518	–	–
Minimum	364	–	–	360	–	–
Maximum	1037	–	–	734	–	–
Standard deviation	164	–	–	98	–	–
Coefficient of variation (%)	31	–	–	19	–	–

Explanations: BOD₅ = biochemical oxygen demand over five days, COD = chemical oxygen demand, TSS = total suspended solids, TN = total nitrogen.

Source: own study.



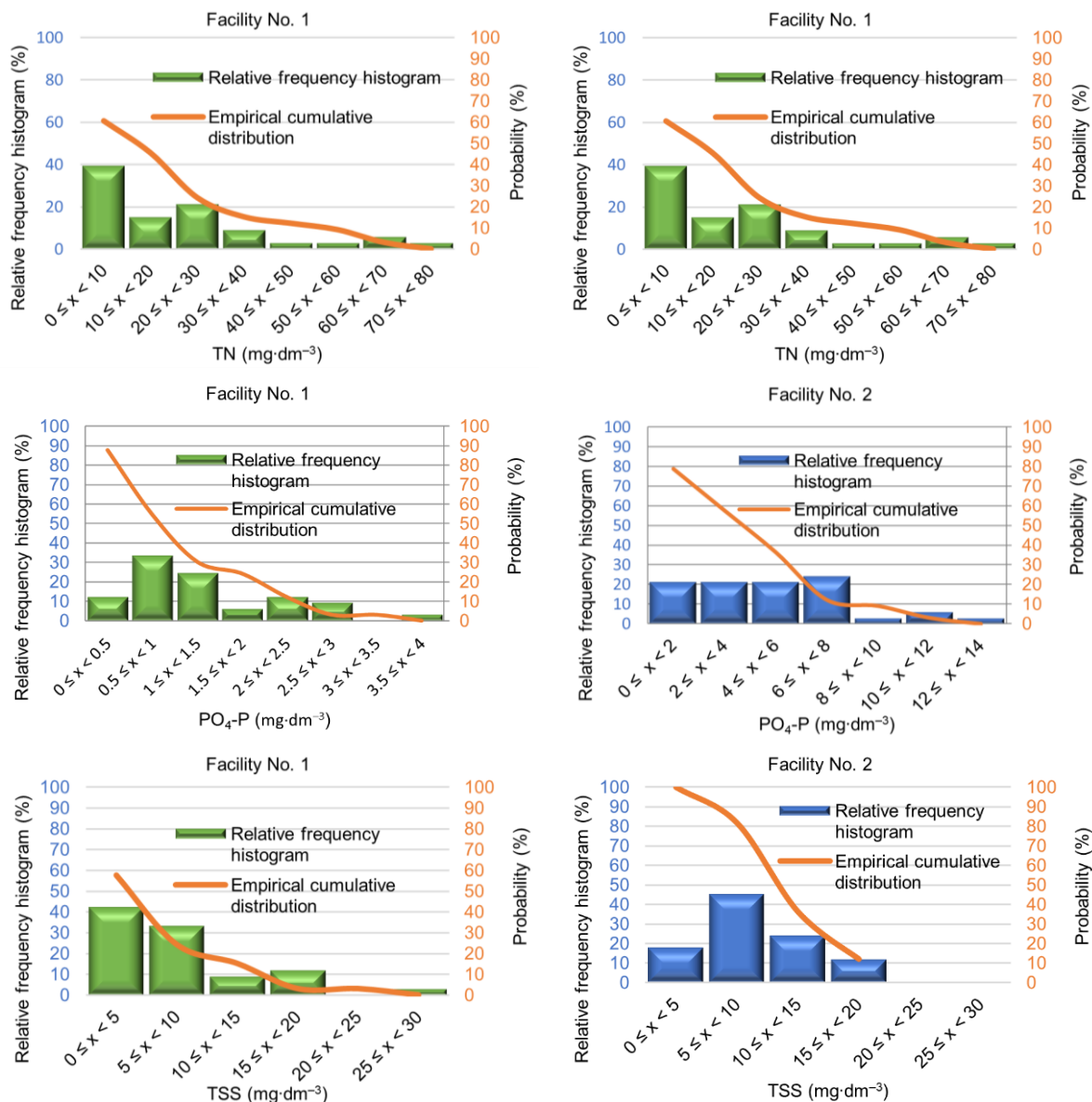
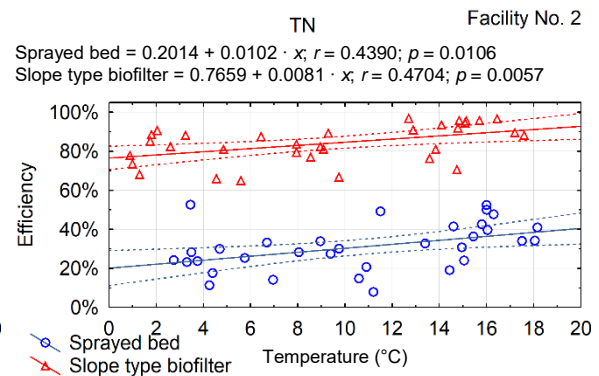
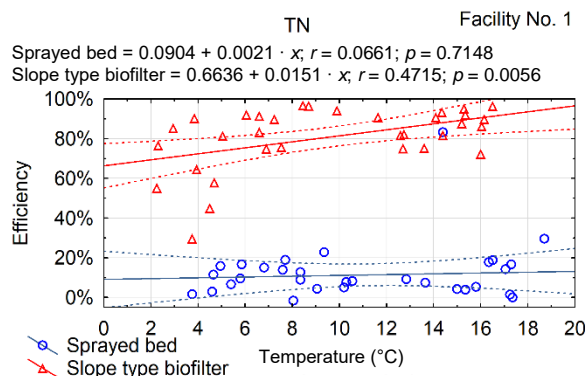
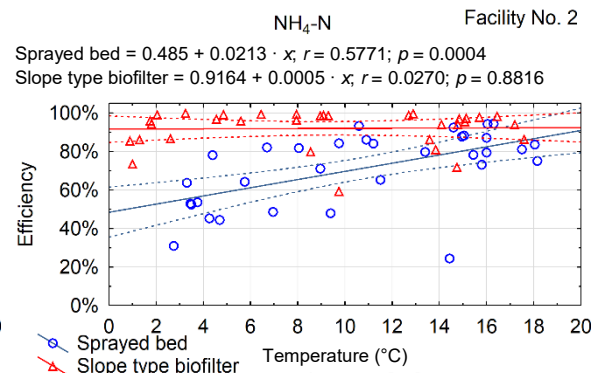
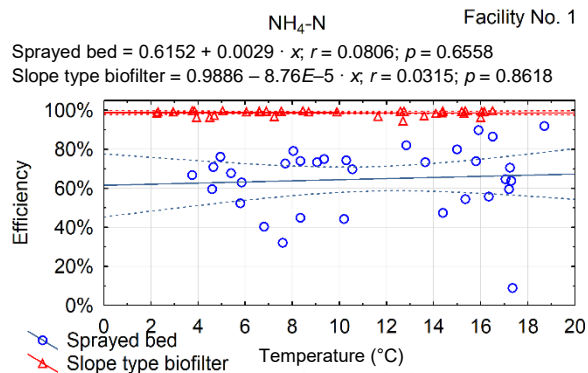
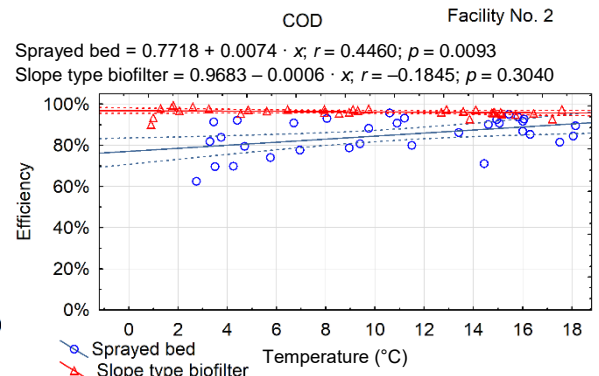
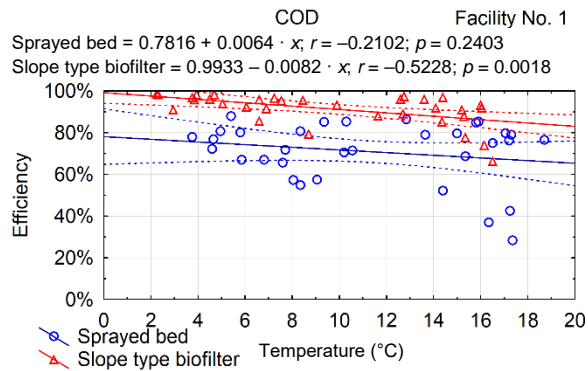
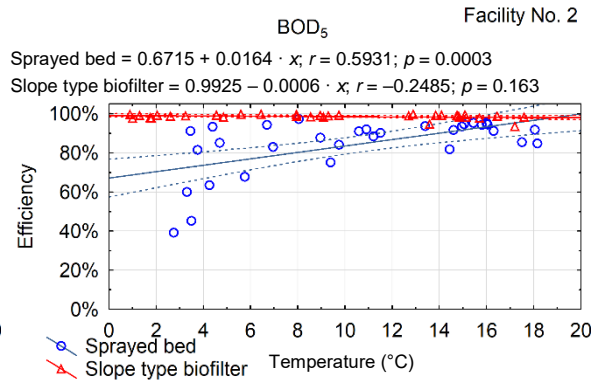
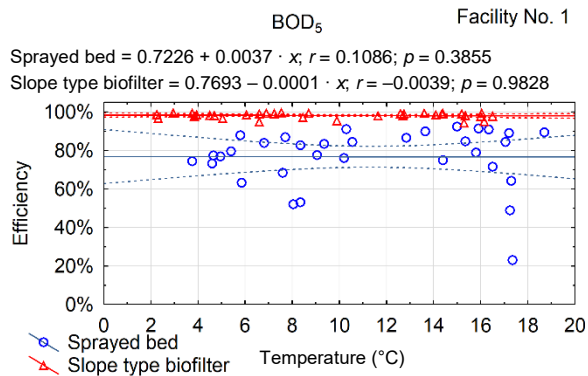


Fig. S1. Graphs of the probability of exceeding the permissible values of the analysed pollutant indicators in the treated wastewater at the two sites in comparative terms; source: own study



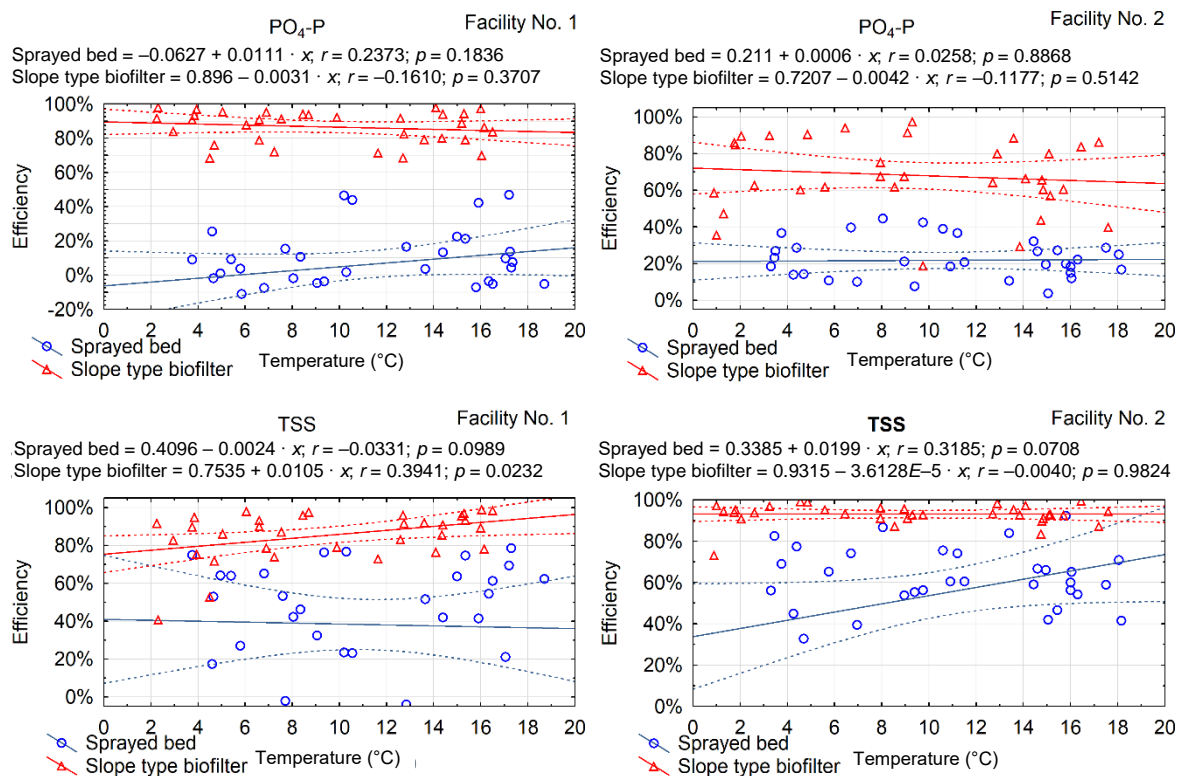


Fig. S2. Scatter plots with regression lines and 95% confidence levels illustrating correlations between pollutant removal efficiency and temperature of treated effluent in successive process units of both facilities; source: own study