

Principal Component Weighted Index for Wastewater Quality Monitoring

Petr Praus

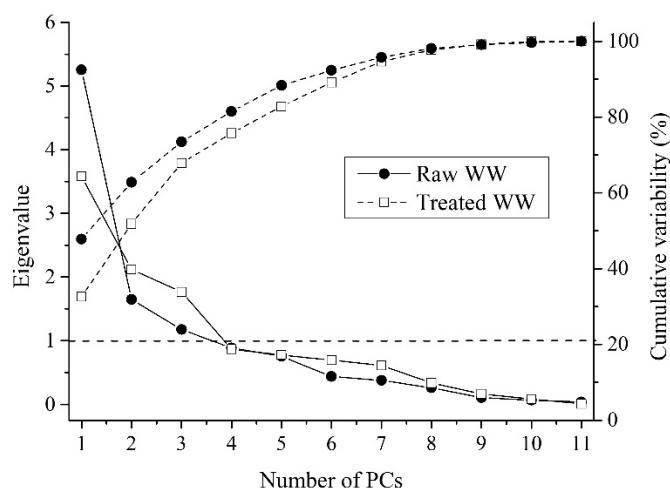


Figure 1. Eigenvalue scree and cumulative variability plots for raw and treated wastewaters.

Table 1. Composition of outlying samples.

No.	NH ₄ ⁺ mg/l	BOD mg/l	COD mg/l	NO ₃ ⁻ mg/l	NO ₂ ⁻ mg/l	PO ₄ ³⁻ mg/l	TN mg/l	TSS mg/l	TP mg/l	pH	TDS mg/l
Raw wastewater											
35	56.5	122	265	4.17	5.14	24.0	49.2	173	9.79	7.75	1532
51	68.1	161	338	0.5	0.177	30.9	54.4	187	12.4	7.63	565
62	76.4	139	375	1.24	0.080	30.8	65.8	122	12.5	7.78	610
Treated wastewater											
17	0.057	2.4	25.1	52.4	0.029	6.54	16.6	5	2.22	7.06	370
22	9.64	12.1	46.6	69.8	14.0	21.1	28.6	10	7.71	7.24	795
35	18.6	3.3	22.2	75.4	0.216	21.1	39.6	2	7.19	7.51	1580

Note: Parameters in bold are of unusual values.

Table 2. Spearman's correlation matrix of original parameters and PCWI of raw wastewater.

	NH ₄ ⁺	BOD	COD	NO ₃ ⁻	NO ₂ ⁻	PO ₄ ³⁻	TN	TSS	TP	pH	TDS	PCWI
NH ₄ ⁺	1	0.582	0.750	-0.366	-0.255	0.804	0.924	0.374	0.772	0.254	0.194	0.898
BOD	0.582	1	0.818	-0.238	-0.134	0.505	0.614	0.422	0.489	0.039	0.306	0.782
COD	0.750	0.818	1	-0.314	-0.177	0.680	0.801	0.456	0.636	0.106	0.202	0.889
NO ₃ ⁻	-0.366	-0.238	-0.314	1	0.606	-0.348	-0.369	-0.114	-0.277	-0.148	0.141	-0.365
NO ₂ ⁻	-0.255	-0.134	-0.177	0.606	1	-0.218	-0.204	-0.037	-0.125	-0.040	0.187	-0.225
PO ₄ ³⁻	0.804	0.505	0.680	-0.348	-0.218	1	0.794	0.364	0.949	0.191	0.059	0.851
TN	0.924	0.614	0.801	-0.369	-0.204	0.794	1	0.460	0.792	0.180	0.134	0.917
TSS	0.374	0.422	0.456	-0.114	-0.037	0.364	0.460	1	0.436	-0.135	0.023	0.553
TP	0.772	0.489	0.636	-0.277	-0.125	0.949	0.792	0.436	1	0.098	0.071	0.835
pH	0.254	0.039	0.106	-0.148	-0.040	0.191	0.180	-0.135	0.098	1	-0.182	0.196
TDS	0.194	0.306	0.202	0.141	0.187	0.059	0.134	0.023	0.071	-0.182	1	0.211
PCWI	0.898	0.782	0.889	-0.365	-0.225	0.851	0.917	0.553	0.835	0.196	0.211	1

Note: PCWI values in bold are different from 0 at a significance level $\alpha = 0.05$.

Table 3. Spearman's correlation matrix of original parameters and PCWI of treated wastewater.

	NH ₄ ⁺	BOD	COD	NO ₃ ⁻	NO ₂ ⁻	PO ₄ ³⁻	TN	TSS	TP	pH	TDS	PCWI
NH ₄ ⁺	1	0.458	0.117	-0.497	0.678	0.037	0.022	0.162	0.035	0.412	0.140	0.029
BOD	0.458	1	0.348	-0.309	0.272	-0.252	0.031	0.531	-0.252	0.087	0.202	0.003
COD	0.117	0.348	1	0.092	0.117	0.172	0.325	0.302	0.223	-0.305	0.329	0.436
NO ₃ ⁻	-0.497	-0.309	0.092	1	-0.109	0.415	0.647	-0.232	0.423	-0.510	0.252	0.583
NO ₂ ⁻	0.678	0.272	0.117	-0.109	1	0.048	0.035	0.074	0.083	0.055	0.144	0.061
PO ₄ ³⁻	0.037	-0.252	0.172	0.415	0.048	1	0.599	-0.389	0.950	-0.015	0.221	0.812
TN	0.022	0.031	0.325	0.647	0.035	0.599	1	-0.257	0.575	-0.163	0.385	0.811
TSS	0.162	0.531	0.302	-0.232	0.074	-0.389	-0.257	1	-0.294	-0.252	-0.050	-0.227
TP	0.035	-0.252	0.223	0.423	0.083	0.950	0.575	-0.294	1	-0.081	0.211	0.817
pH	0.412	0.087	-0.305	-0.510	0.055	-0.015	-0.163	-0.252	-0.081	1	-0.318	-0.317
TDS	0.140	0.202	0.329	0.252	0.144	0.221	0.385	-0.050	0.211	-0.318	1	0.562
PCWI	0.029	0.003	0.436	0.583	0.061	0.812	0.811	-0.227	0.817	-0.317	0.562	1

Note: PCWI values in bold are different from 0 at a significance level $\alpha = 0.05$.

Table 4. Medians of raw wastewater parameters in 1997–2001.

	NH ₄ ⁺ mg/l	BOD mg/l	COD mg/l	NO ₃ ⁻ mg/l	NO ₂ ⁻ mg/l	PO ₄ ³⁻ mg/l	TN mg/l	TSS mg/l	TP mg/l	pH mg/l	TDS mg/l
1997	36.4	66.8	173	1.04	0.546	15.7	33.5	53	6.41	7.33	628
1998	39.9	111	222	1.00	0.253	19	40.9	96	6.89	7.57	438
1999	37.5	84.3	182	1.81	0.463	17.45	36.7	94	7.29	7.52	461
2000	45.6	90.7	184	0.79	1.174	23.1	43.8	96	9.06	7.75	502
2001	58.0	111	232	0.50	0.169	24.35	49.8	98	8.90	7.78	548

Note: Statistically different medians are in bold.