Supplementary Materials

New optimization framework for improvement sustainability of wastewater treatment plants

Hang LI,[1,2] Fei PANG,[2] Di XU,[3,*] Lichun DONG[1,*]

[1]School of Chemistry and Chemical Engineering, Chongqing University, Chongqing 400044, P. R. China

[2] Chongqing Three Gorges Water YuBei Drainage Co., Ltd., Chongqing 401120, P. R. China

[3]College of Chemistry and Chemical Engineering, Chongqing University of Science and Technology, Chongqing 400044, P. R. China

Corresponding Authors: Lichun Dong (lcdong72@cqu.edu.cn); Di Xu (xdcq86@163.com)

S1. Collected original data in the case study

S2. Normalized data in the interval CRITIC in the case study

S1. Collected original data in the case study

The original data in Tables S1-S3 were collected from Internal Research Report, Chongqing Three Gorges Water YuBei Drainage Co., Ltd.

Table S1. Original data of O_1 (discharged pollution reduction) with respect to taking each alternative retrofit technology

Category	ΔBOD_5	ΔTN	ΔTP
Unit	mg/L	mg/L	mg/L
T1	-	(0.8-1.5)	-
T2	-	-	(0.2-0.4)
T3	-	(1.5-4.5)	(0.1-0.1)
T4	(0.5-1.0)	(3.0-6.0)	(0.1-0.1)
T5	(1.0-2.0)	(1.5-3.0)	(0.1-0.2)
T6	(1.0-1.0)	(3.0-3.0)	(0.1-0.2)
T7	-	-	-
T8	-	-	-
T9	-	-	-
T10	-	-	-

Note: "-" means no effect

Table S2. Original data of O_2 (operational cost reduction) with respect to taking each alternative retrofit technology

Category	$OR_{Tj\text{-}energy}$	$OR_{Tj\text{-}material}$	$OR_{Tj\text{-}staff}$	$OR_{Tj\text{-}other}$ (cost regarding sewage sludge)
Unit	CNY/m^3	CNY/m^3	CNY/m^3	CNY/m^3
T1	(0.0292-0.0584)	-	-	-
T2	-	(0.0066-0.0082)	-	-
T3	(0.0155-0.0164)	-	-	(0.0120-0.0301)
T4	-	+(0.0699-0.0699)	-	+(0.006-0.012)
T5	+(0.0350-0.0526)	-	-	(0.0301-0.0301)
T6	+(0.0088-0.0175)	-	-	(0.012-0.012)
T7	(0.0443-0.0591)	-	+(0.0164-0.0164)	(0.1505-0.1505)
T8	-	-	+(0.0164-0.0164)	(0.3010-0.4013)
T9	+(0.2066-0.2066)	-	+(0.0164-0.0164)	(0.4274-0.4274)
T10	(0.0443-0.0443)	-	+(0.0088-0.0088)	

Note: "-" means no effect; "+" means increasement instead of reduction is found, highlighted with red color

Table S3. Original data of O_3 (GHG emissions reduction) with respect to taking each alternative retrofit technology

Category	$CR_{Tj\text{-}electricity}$	$CR_{Tj\text{-}chemicals}$
Unit	kg CO_2-eq/m^3	kg CO_2-eq/m^3
T1	(0.034-0.069)	-
T2	-	(0.018-0.018)
T3	(0.018-0.019)	-
T4	-	+(0.009-0.009)
T5	+(0.041-0.062)	-
T6	+(0.010-0.021)	-
T7	(0.052-0.070)	-
T8	-	-
T9	+(0.049-0.049)	-
T10	(0.052-0.052)	-

Note: "-" means no effect; "+" means increasement instead of reduction is found, highlighted with red color; the GHG emissions regarding the sewage sludge treatment is not considered in Table S3.

S2. Normalized data in the interval CRITIC in the case study

Table S4. Normalized data in the interval CRITIC in the case study

$\left[\bar{z}_{ij}^{\,L}, \bar{z}_{ij}^{\,U}\right]$	O_1	O_2	O_3
T_1	[0.083, 0.167]	[0.238, 0.301]	[0.732, 0.993]
T_2	[0.333, 0.667]	[0.190, 0.193]	[0.609, 0.609]
T_3	[0.250, 0.667]	[0.234, 0.275]	[0.609, 0.617]
T_4	[0.500, 1.000]	[0.000, 0.013]	[0.402, 0.402]
T_5	[0.500, 1.000]	[0.127, 0.165]	[0.000, 0.157]
T_6	[0.667, 0.833]	[0.164, 0.182]	[0.314, 0.392]
T_7	[0.000, 0.000]	[0.558, 0.589]	[0.868, 1.000]
T_8	[0.000, 0.000]	[0.785, 1.000]	[0471, 0.471]
T_9	[0.000, 0.000]	[0.613, 0.613]	[0.101, 0.101]
T_{10}	[0.000, 0.000]	[0.252, 0.252]	[0.868, 0.868]