Supplementary Material

Viability of SARS-CoV-2 in river water and wastewater at different temperatures and solids content

Leonardo Oliveira[a], Andrés Felipe Torres-Franco[b], Bruna Coelho Lopes[b], Beatriz Senra Álvares da Silva Santos[c], Erica Azevedo Costa[c], Michelle S. Costa[d], Marcus Tulius P. Reis[e], Marília C. Melo[f], Rodrigo Bicalho[g], Mauro Martins Teixeira[a*], César R. Mota[b*]

[a]*Biochemistry and Immunology Department, Federal University of Minas Gerais (UFMG), Belo Horizonte, Minas Gerais, Brazil*

[b]*Sanitary and Environmental Engineering Department, Federal University of Minas Gerais (UFMG), Belo Horizonte, Minas Gerais, Brazil*

[c]*Veterinary School, Federal University of Minas Gerais (UFMG), Belo Horizonte, Minas Gerais, Brazil.*

[d]*Minas Gerais State Health Authority (SES)*

[e]*Sanitation Company for Minas Gerais (COPASA)*

[f]*Minas Gerais Institute for Water Management (IGAM)*

[g]*Regulatory Agency for Water Supply and Sewage Services of the State of Minas Gerais (ARSAE)*

*Corresponding authors' email addresses: cesar@desa.ufmg.br and mmtex.ufmg@gmail.com

Supplementary Material

1. Parameters of log-linear and nonlinear regressions for decay of SARS-CoV-2 in water matrices

Table S.1 Model parameters estimated for the linear and nonlinear regressions for River Water (RW-24°C), Filtered River Water (RWF-24°C), River Water at 4ºC (RW-4°C), Wastewater (WW-24°C), Filtered Wastewater (WWF-24°C) and Wastewater at 4ºC (WW4°C)

Model	Parameters	RMSE	BIC	T_{90} (d)	T_{99} (d)
River Water (RW-24°C)					
Log-linear	0- 10 d; m = -0.0153*; b= -0.3591	0.8017	67.0	2.17	4.02
	R^2 = 0.649; F-value= 43.56*			(1.37-3.05)	(3.19-4.85)
	Shapiro-wilk p<0.05; Skew.ratio -2.04				
Exp-*nls*	a= 0.9744*; b= 0.0646*	0.0559	-69.14	1.46	2.95
Exp-biphasic	a_1= 0.6564*; b_1= 0.1177*;	0.0478	71.09	1.87	5.33
	a_2= 0.3444; b_2= 0.02765*				
Weibull	Asym= 0.999; Drop= 1.0311*	0.0486	70.19	1.91	6.41
	Lrc= 1.7577* ; Pwr= -0.9808*				
Gompertz	Asym= 0.0122*; b_2= -4.39*; b_3= 0.981*	0.0490	-72.83	1.66	>360
Filtered River Water (RWF-24°C**)**					
Log-linear	0- 10 d; m = -0.0135*; b= -0.0755	0.4525	39.58	2.89	5.45
	R^2 = 0.821; F-value= 106.8*			(2.33-3.46)	(4.72-6.17)
	Shapiro-wilk p<0.05; Skew.ratio -3.82				
Exp-*nls*	a= 0.9287*; b= 0.041*	0.0795	-50.15	2.22	4.56
Exp-biphasic	a_1= 0.3837*; b_1= 0.2255*	0.0633	-55.9	2.87	6.36
	a_2= 0.6163*; b_2= 0.0266*				
Weibull	Asym= 0.998; Drop= 1.102*	0.0665	-53.22	3.25	8.48
	Lrc= 1.295*; Pwr= -0.6601*				
Gompertz	*No start parameters found				

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Model	Parameters	RMSE	BIC	T_{90} (d)	T_{99} (d)
River Water at 4ºC (RW-4°C)					
Log-linear	0- 36 d; m = -0.0065*; b= -0.0191	0.4049	37.69	5.83	10.72
	R^2 = 0.761; F-value= 83.91*			(4.89-9.03)	(9.03-12.41)
	Shapiro-wilk p<0.05; Skew.ratio -5.73				
Exp-*nls*	a= 1.001*; b= 0.018*	0.0827	-48.02	5.25	10.41
Exp-biphasic	a_1= 0.640*; b_1= 0.0399*	0.0633	-56.80	7.83	20.7
	a_2= 0.406*; b_2= 0.007*				
Weibull	Asym= 1.013; Drop= 1.105*	0.0636	-55.65	7.7	18.7
	Lrc= 2.3969*; Pwr= -0.779*				
Gompertz	Asym= 0.0387*; b_2= -3.28*; b_3= 0.992*	0.0728	-51.66	6.95	>360
Wastewater (WW-24°C)					
Log-linear	0- 5 d; m = -0.0348*; b= -0.0399	0.7350	55.8	1.35	2.31
	R^2 = 0.791; F-value= 76.72*			(0.92-1.77)	(1.93-2.69)
	Shapiro-wilk p<0.05; Skew.ratio -1.00				
Exp-*nls*	a= 0.995*; b= 0.0825*	0.0767	-118	1.13	2.31
Exp-biphasic	a_1= 0.8627*; b_1= 0.096*	0.0213	-114.7	1.21	3.12
	a_2= 0.138; b_2= 0.0354*				
Weibull	Asym= 0.997; Drop= 1.015*	0.0224	-111.8	1.17	4
	Lrc= 2.258*; Pwr= -1.300*				
Gompertz	Asym= 7.65E-05*; b_2= -9.47E00*; b_3= 9.90E-01*	0.0214	-117.7	1.21	2.91

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Model	Parameters	RMSE	BIC	T_{90} (d)	T_{99} (d)
Filtered Wastewater (WWF-24°C)					
Log-linear	0- 5 d; m = -0.0334*; b= 0.1503	0.6959	53.5	1.57	2.57
	R^2 = 0.796; F-value= 79.43*			(1.17-1.97)	(2.19-2.95)
	Shapiro-wilk p<0.05; Skew.ratio -1.51				
Exp-*nls*	a= 1.071*; b= 0.054*	0.0827	-52.1	1.46	2.95
Exp-biphasic	*No start parameters found	-	-	-	-
Weibull	Asym= 0.999; Drop= 1.010*	0.052	-66.52	1.54	4.5
	Lrc= 3.796* ; Pwr= -1.636*				
Gompertz	*No start parameters found	-	-	-	-
Wastewater at 4ºC (WW-4ºC)					
Log-linear	0- 36 d; m = -0.008*; b= -0.08	0.5094	50.08	4.67	8.6
	R^2 = 0.752; F-value= 80.77*			(3.72-5.61)	(7.26-9.93)
	Shapiro-wilk p<0.05; Skew.ratio -5.05				
Exp-*nls*	a= 0.9344*; b= 0.027*	0.0867	-49.37	3.33	6.71
Exp-biphasic	a_1= 0.6792*; b_1= 0.0712*	0.0622	-56.79	5.79	17.1
	a_2= 0.3237*; b_2= 0.0084*				
Weibull	Asym= 1.001; Drop= 1.071*	0.0619	-57.11	5.5	17.5
	Lrc= 1.618*; Pwr= -0.6911*				
Gompertz	Asym= 0.058*; b_2= -2.815*;	0.0679	-55.42	4.54	>360
	b_3= 0.9848*				

2. Parameters of log-linear and nonlinear regressions for decay of SARS-CoV-2 in water matrices

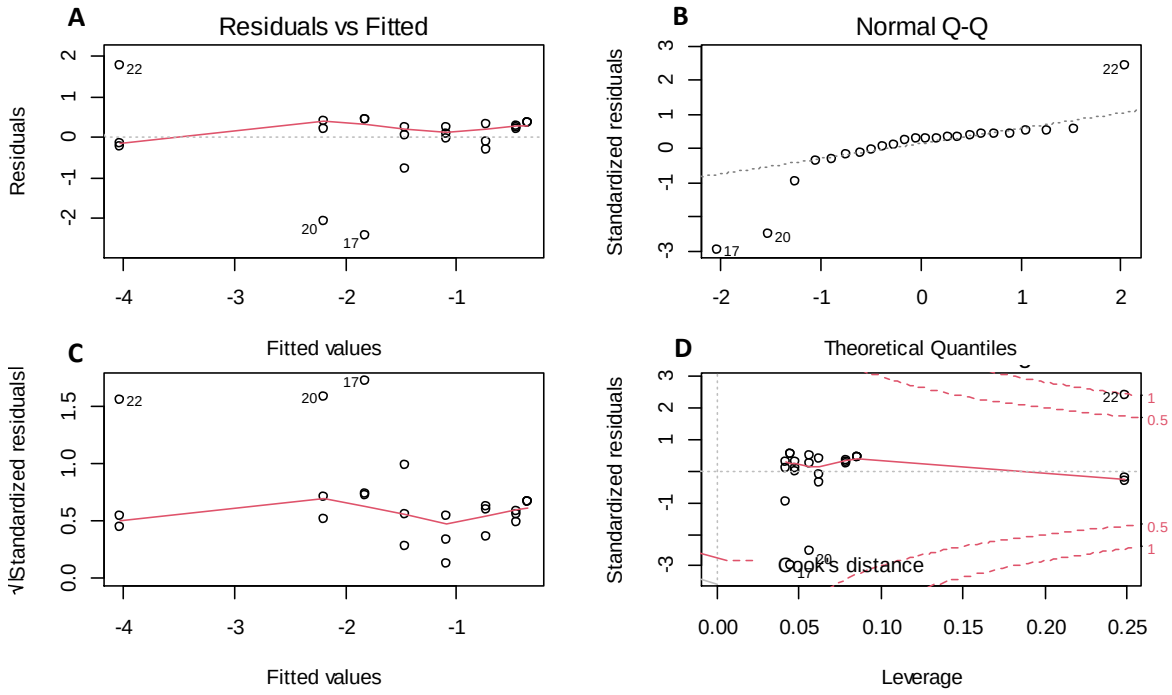

Figure S1 Linear model fit on Log-transformed data of virus survival in River Water (RW-24°C) assessed by graphs of (a) Residuals Vs Fitted values (b) Normal Q-Q plot; (c) Scale Location and (d) Outliers identification by Leverage and Cook Distance

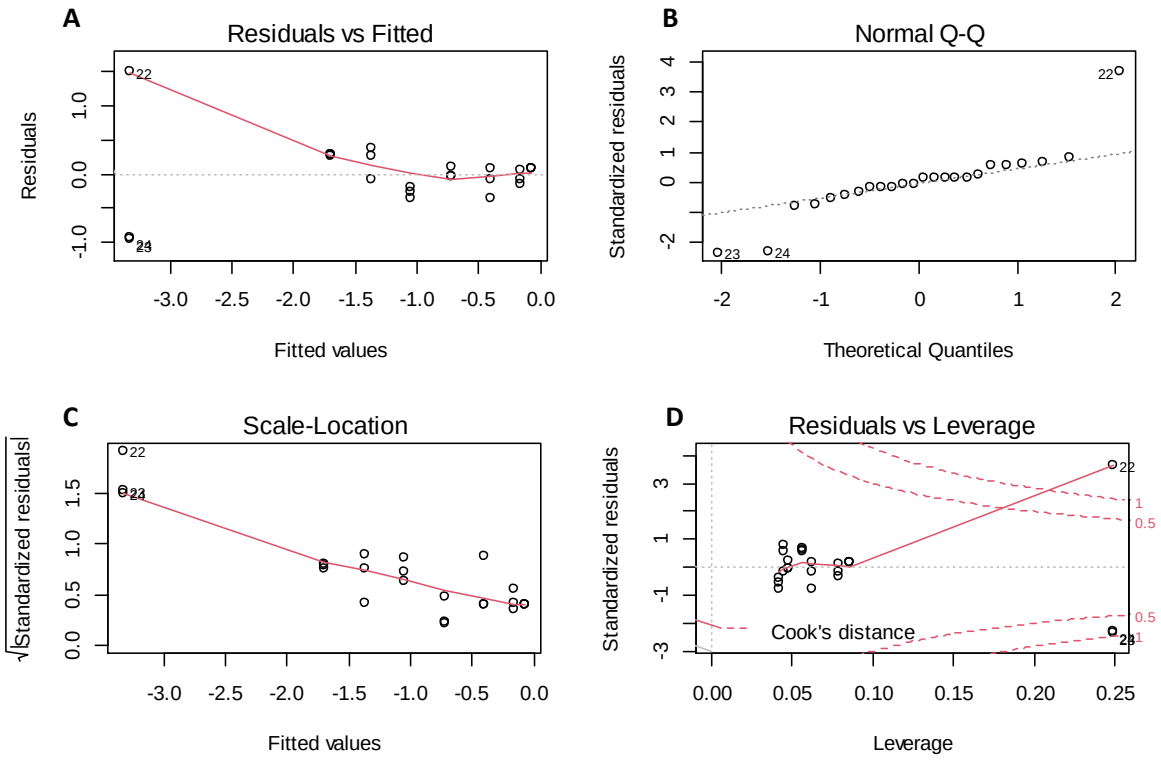

Figure S2. Linear model fit on Log-transformed data of virus survival in Filtered River Water (RWF-24°C) assessed by graphs of (a) Residuals Vs Fitted values (b) Normal Q-Q plot; (c) Scale Location and (d) Outliers identification by Leverage and Cook Distance

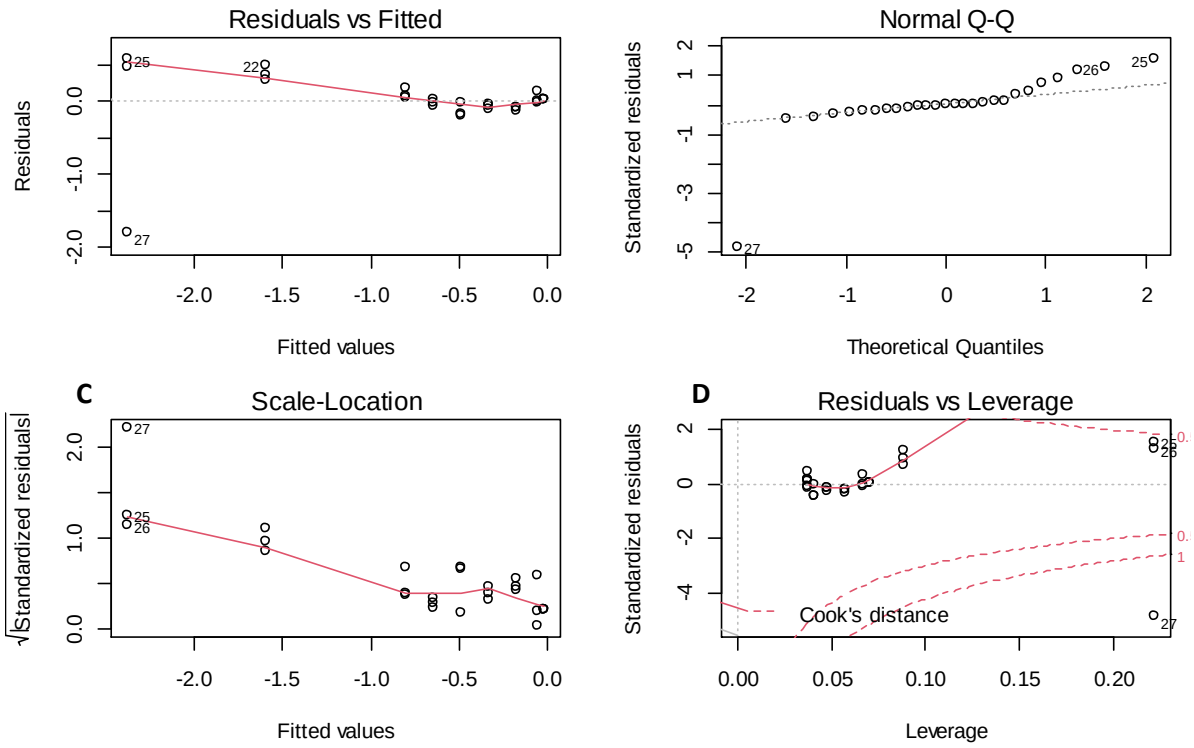

Figure S3. Linear model fit on Log-transformed data of virus survival in River Water at 4ºC (RW-4ºC) assessed by graphs of (a) Residuals Vs Fitted values (b) Normal Q-Q plot; (c) Scale Location and (d) Outliers identification by Leverage and Cook Distance

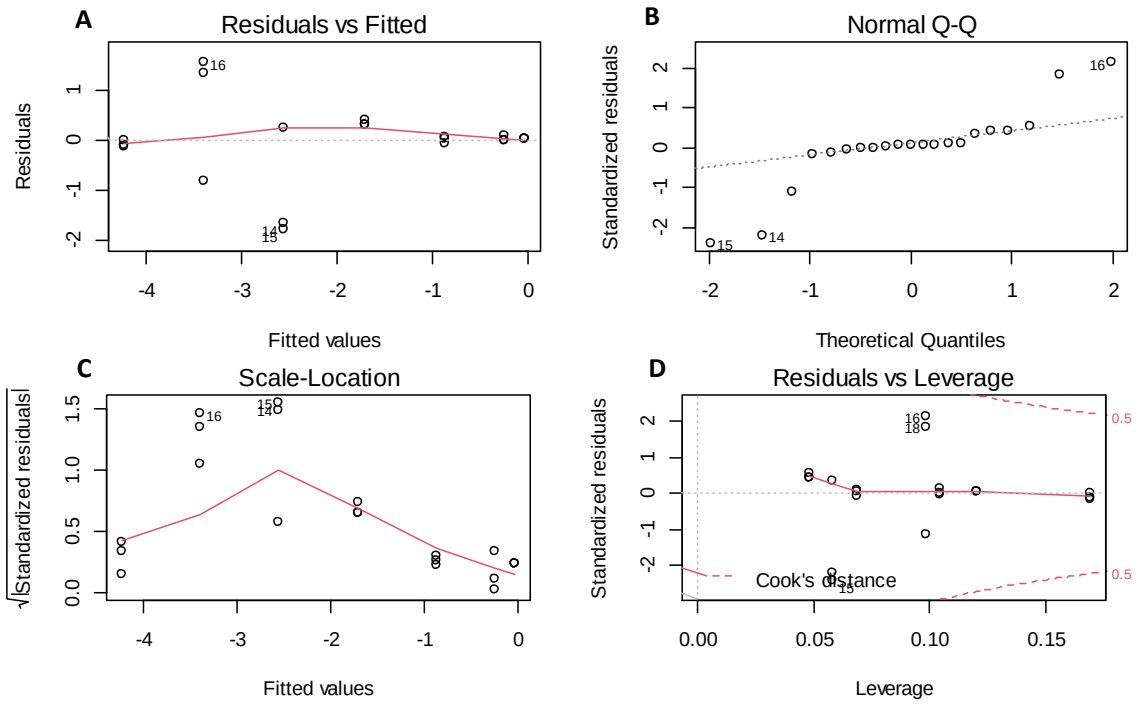

Figure S4. Linear model fit on Log-transformed data of virus survival in Wastewater (WW-24°C) assessed by graphs of (a) Residuals Vs Fitted values (b) Normal Q-Q plot; (c) Scale Location and (d) Outliers identification by Leverage and Cook Distance

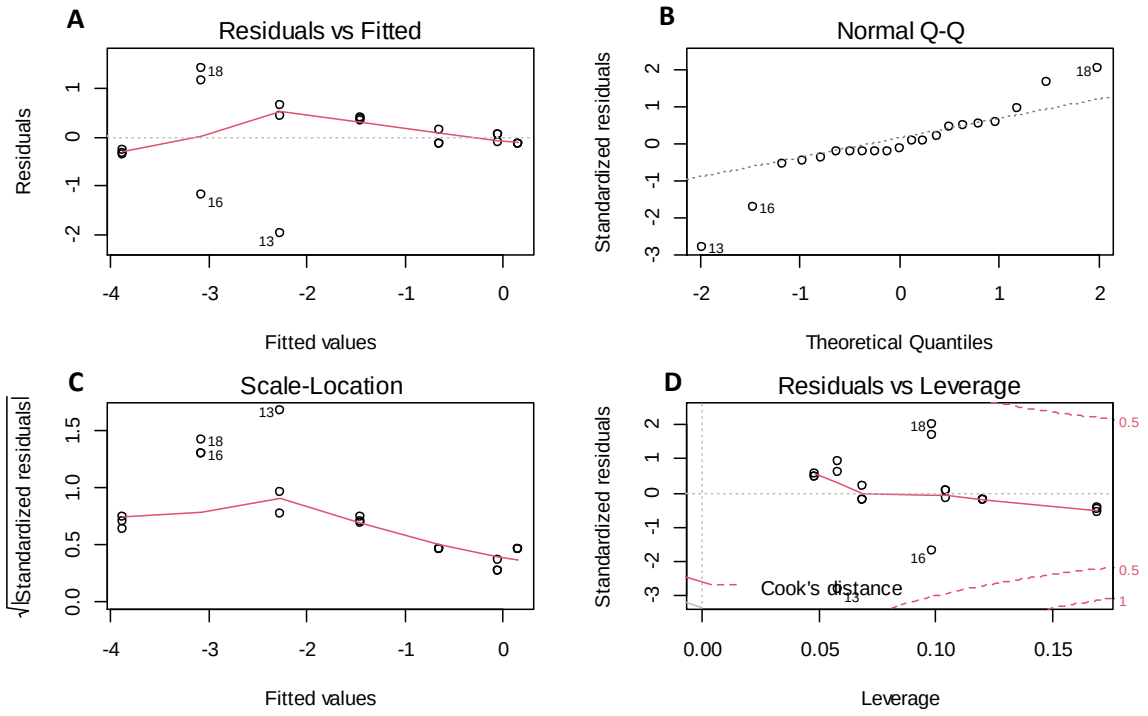

Figure S5. Linear model fit on Log-transformed data of virus survival in Filtered Wastewater (WWF-24°C) assessed by graphs of (a) Residuals Vs Fitted values (b) Normal Q-Q plot; (c) Scale Location and (d) Outliers identification by Leverage and Cook Distance

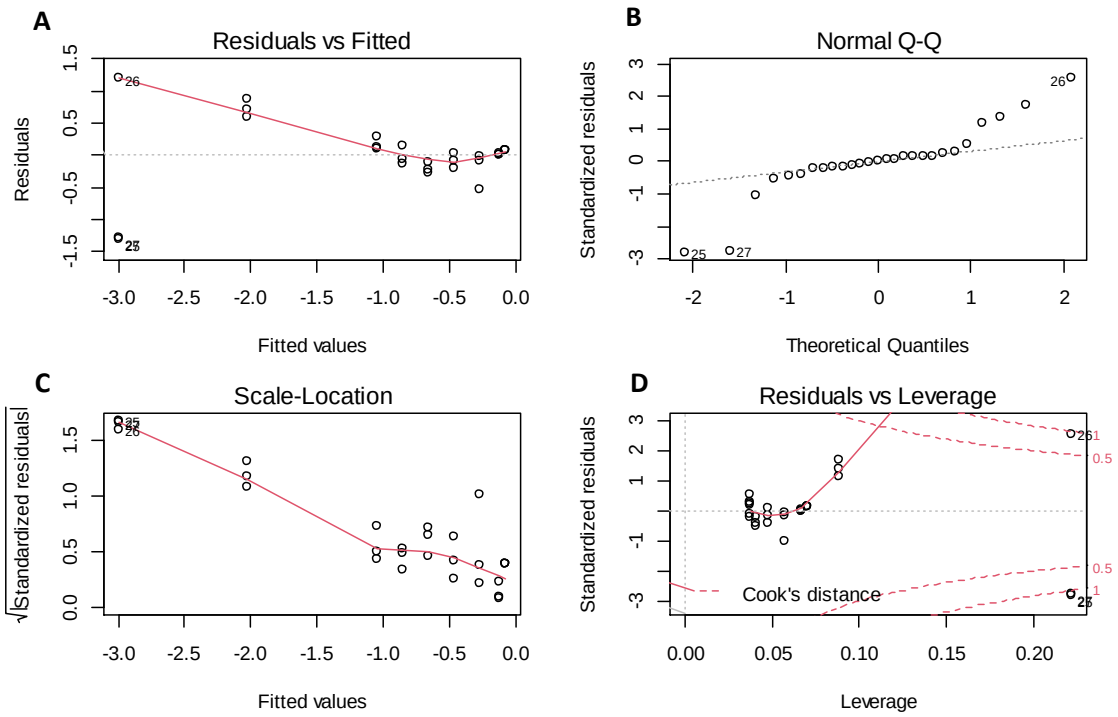

Figure S6. Linear model fit on Log-transformed data of virus survival in Wastewater at 4°C (WW-4°C) assessed by graphs of (a) Residuals Vs Fitted values (b) Normal Q-Q plot; (c) Scale Location and (d) Outliers identification by Leverage and Cook Distance

3. Estimation of Arrhenius equation´s parameters o

Arrhenius equation: The effect of temperature on the inactivation rate was modelled using the Arrhenius equation as presented in eq S.1

$$\text{Ln(k)} = \left(\frac{E_a}{R}\right)\left(\frac{1}{T}\right) + \ln(A)$$

Where k is the first-order decay constant (1/min), E_a in the energy of activation of the decay reaction, T is the temperature in Kelvin, R is the gas constant (8.31J·/(mol k)) and ln(A) is the intercept in 1/min. E_a was determined from the slopes in Figure S.7

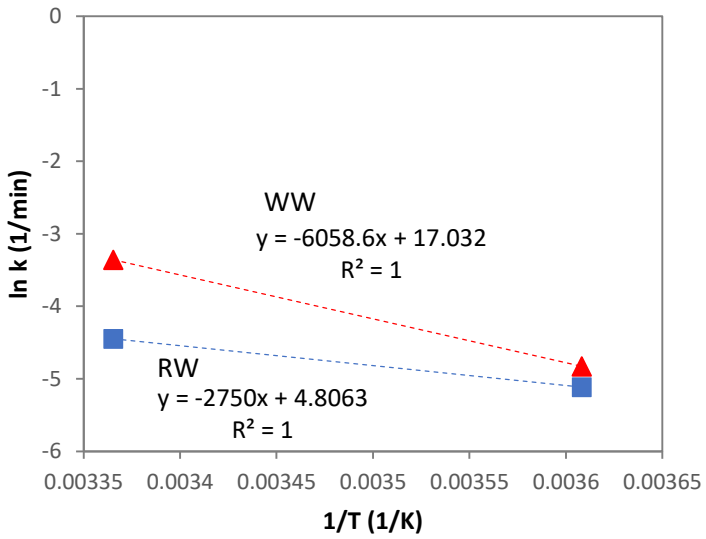

Figure S7. Arrhenius equation solutions for river water (RW) and wastewater (WW) calculated from first-decay constants at 24 °C and 4 °C.

4. Spearman correlations between physicochemical composition and Weibull-estimated T_{90} and T_{99} values

Table S.2 Spearman correlations between physicochemical composition and Weibull-estimated T_{90} and T_{99} values

	pH	Turbidity	Ammonia-N	COD	T_{90}	T_{99}
pH		0.33333	0.5	0.16667	0.16667	0.16667
Turbidity	0.94281		0.66667	0.33333	0.33333	0.33333
Ammonia-N	0.63246	0.44721		0.33333	0.33333	0.33333
COD	0.94868	0.89443	0.8		0.083333	0.083333
T_{90}	-0.94868	-0.89443	-0.8	-1		0.083333
T_{99}	-0.94868	-0.89443	-0.8	-1	1	