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Article

Supplementary of "Environmental and Economic Evaluation of Downflow Hanging Sponge Reactors for Treating High-Strength Organic Wastewater"

Determination of kinetic constant for First-order model

Using the First-order kinetic equation:

$$\frac{S_i - S_e}{HRT} = K_1 S_e$$

where, S_i and S_e denote the feed and effluent substrate concentrations (g/L), respectively, HRT is the hydraulic retention time (d), and K_1 is the speed constant of the First-order model for removing organic matter (1/d)

The plot of $(S_i-S_e)/HRT$ versus S_e gets a slope of K_1 (Figure S1):

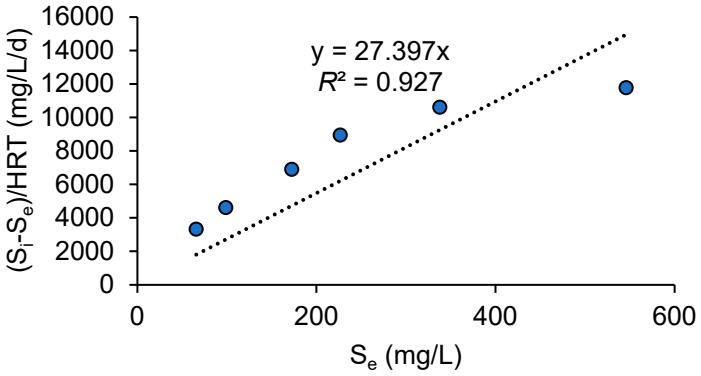


Figure S1. Determination of kinetic constant (K_1) of First-order model

Determination of kinetic constant for Stover-Kincannon model

Using the Stover-Kincannon kinetic equation:

$$\frac{V}{Q(S_i - S_e)} = \frac{K_B}{U_{max}}\left(\frac{V}{Q \times S_i}\right) + \frac{1}{U_{max}}$$

where, U_{max} represents the maximum utilization rate constant (g/L/d), and K_B represents the saturation value constant (g/L/d)

The plot of $V/Q(S_i-S_e)$ versus $V/(Q\times S_i)$ gets the kinetics U_{max} and K_B (Figure S2):

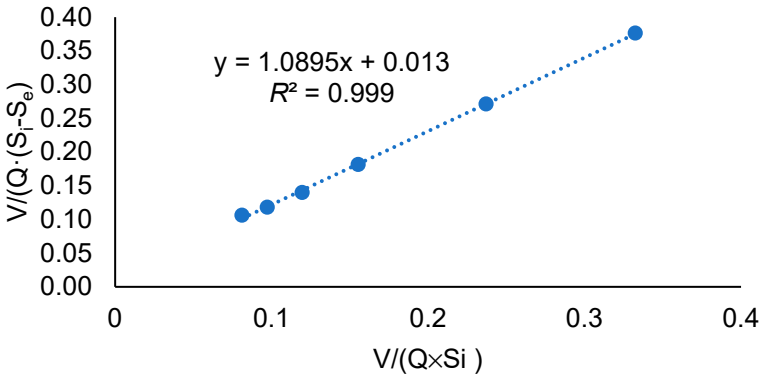


Figure S2. Determination of kinetic constants (U_{max} and K_B) for modified Stover-Kincannon model

Model testing

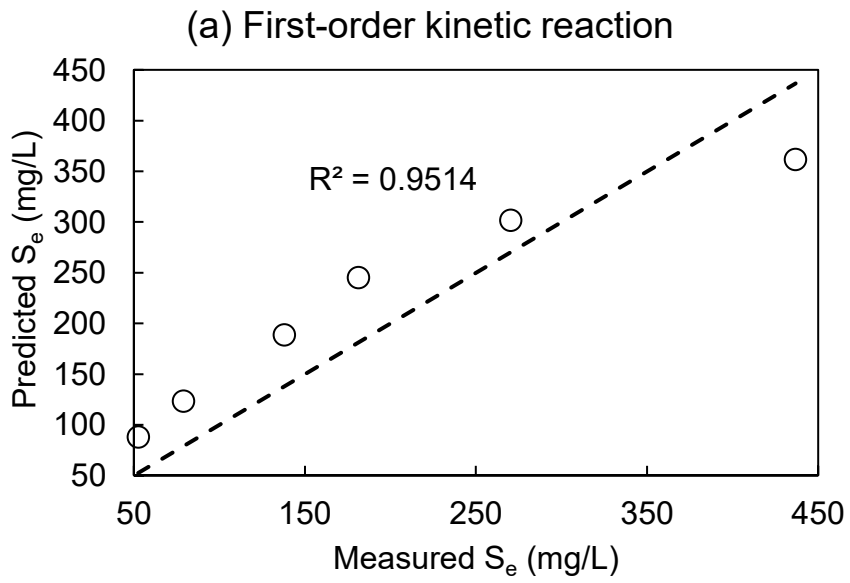
Table S1. Comparison of predicted and experimental (observed) results for first-order and modified Stover-Kincannon kinetic model at different OLRs

OLR (kg COD/m^3_{sponge}/d)	Effluent (measured) COD (mg/L)	Predicted COD (mg/L)	
		First-order*	Modified Stover-Kincannon**
3.76	52.60	88.30	51.41
4.22	79.06	123.79	79.78
6.44	138.00	188.92	142.48
8.36	181.27	245.56	207.58
10.28	270.33	301.93	281.53
12.33	436.72	361.99	369.70

* Estimated from $S_e = \frac{S_i}{1+HRT \cdot K_1} = \frac{S_i}{5.11}$

** Estimated from $S_e = S_i - \frac{U_{max} \cdot S_i}{K_B + \left(\frac{Q \cdot S_i}{V}\right)} = S_i - \frac{76.92 S_i}{83.81 + 0.00667 S_i}$

Prediction accuracy of the kinetic models



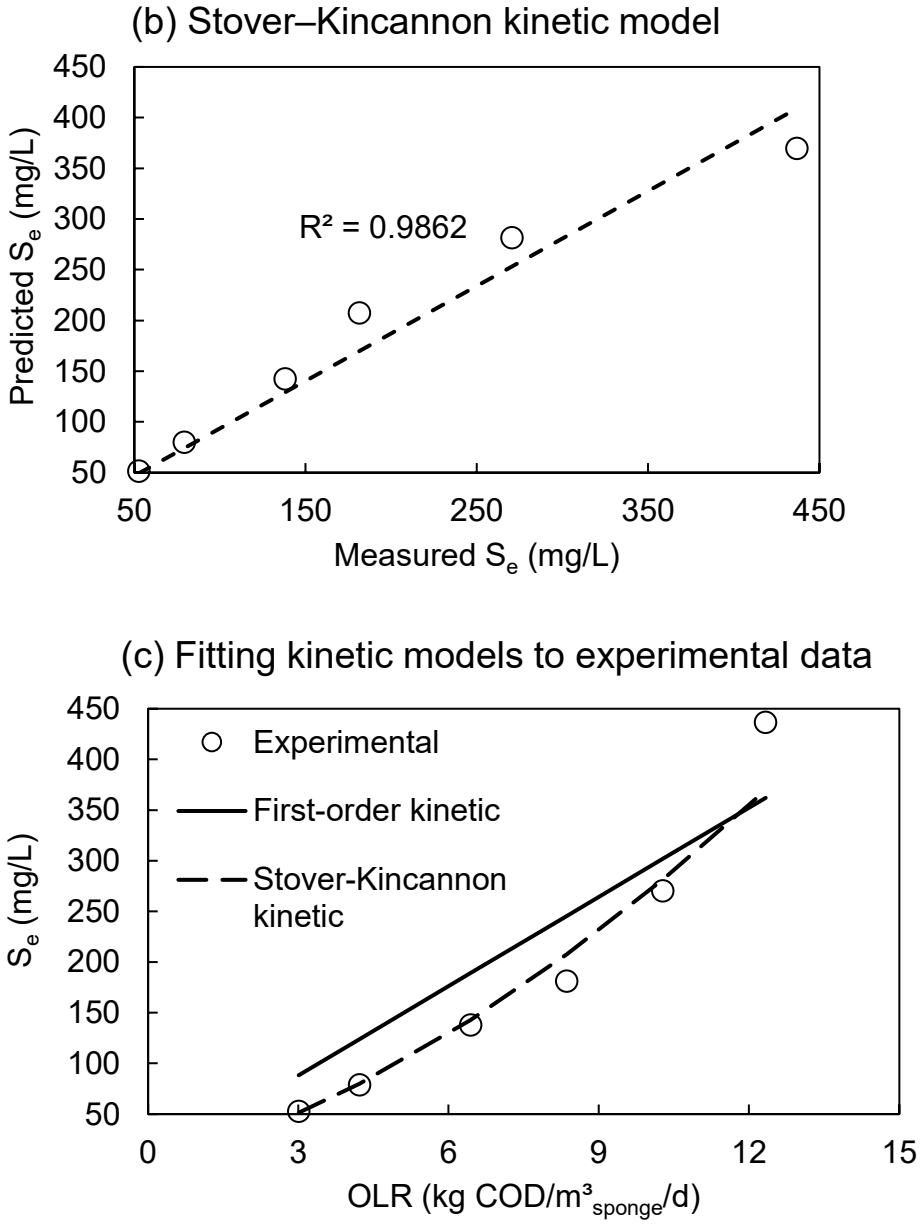


Figure S3. Correlation between measured and predicted S_e values using (a) First-order kinetic model, and (b) Stover–Kincannon kinetic model, and (c) fitting kinetic models to of experimental data

Performance of sequential DHS system for wastewater treatment

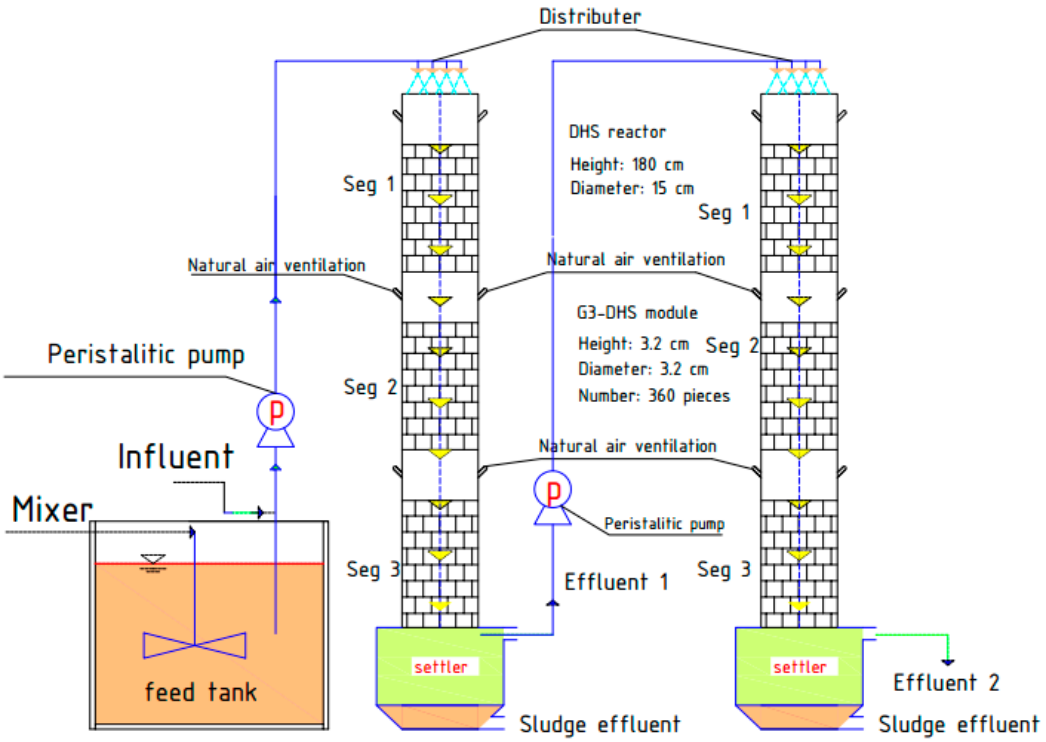

Distributer
DHS reactor
Height: 180 cm
Diameter: 15 cm
Seg 1
Seg 1
Natural air ventilation
Natural air ventilation
G3-DHS module
Height: 3.2 cm
Diameter: 3.2 cm
Number: 360 pieces
Seg 2
Seg 2
Peristaltic pump
Influent
Natural air ventilation
Mixer
Peristaltic pump
Seg 3
Effluent 1
Seg 3
settler
settler
Effluent 2
feed tank
Sludge effluent
Sludge effluent



Figure S4. Sequential DHS system for wastewater treatment