Supporting Information

1 Specific steps of jar tests

First, adding different amount of sediments to every 1 L tap water until the SS was about 350 mg/L. Then, determine the COD, NH_4^+-N and TP. The added COD, NH_4^+-N and TP are the difference of target concentration minus determined concentration. The mass ratio of sediment, glucose, ammonium chloride and potassium dihydrogen phosphate can be calculated and used in subsequent experiments. Finally, after adding above substance, pH was adjusted to 7–8 by hydrochloric acid and sodium hydroxide solution if necessary.

2 On-site coagulation/flocculation simulation device

Annular water tank developed by Shanghai Tongji University, China (Patent number: 201310120205.9) can simulate the water flow by rotating the tank and driving the water flowing, as shown in Fig. 2. The device was equipped with an ultrasonic flowmeter at the bottom of the tank to measure the relative velocity between the tank and the water. The actual velocity of the water can be calculated according to the Eq. (1). The transmission distance of the water flowing is the actual velocity multiply rotating time (Eq. (2)).

$$V_{flow}=V_{linear\ velocity}-V_{flowmeter}\quad, \tag{1}$$

$$S=V_{flow}\times t\quad, \tag{2}$$

where V_{flow} is the actual velocity of the water (m/s), $V_{linear\ velocity}$ is the linear velocity at the place of where the flowmeter is (m/s), $V_{flowmeter}$ is the velocity measured by the flowmeter (m/s), S is the distance of the water flowing (m), t is the rotating time of the device (s).

The control cabinet uses to direct the running of the device and can adjust different rotation speeds. There are 5 sampling holes in different depth at the side of the tank, which are attached with solenoid valves and can realize automatic sampling by manipulating the control cabinet.

According to the statistics on daily rainfall data (1991–2003) in Shanghai (China), the total number of rainfalls that greater than 2 mm (assuming runoff less than 2 mm does not produce runoff) is 1010 times, and more than 85% of rainfall events is less than 25.4 mm. Rainfall duration is set at 3 h. The runoff coefficient is 0.6 and the end pipe diameter is 2.4 m (for a pump station in Shanghai). The calculated average velocity is 1.167 m/s, which was used as the typical velocity in annular water tank. Before starting the annular water tank simulation tests, the relationship between the water flow velocity and the rotational speed of the tank was found. Table S1 gives the flow velocities and rainfalls at different rotation speeds.

3 Calculation of Reynolds number (*Re*)

$$R_e = \frac{\rho v d}{\mu} \quad , \qquad (3)$$

where ρ is density of fluid (kg/m^3), v is the flow velocity of fluid (m/s), d is the diameter of round pipes or equivalent diameter of pipes with other shapes (m), μ is dynamic viscosity of fluid (N·s/m^2). Normally $R_e < 2000$ indicates laminar flow and $R_e > 4000$ represent turbulent flow and 2000–4000 is transition flow.

Here the v was from 0.51 m/s, 0.81 m/s, 1.13 m/s and 1.80 m/s, d was taken 2.4 m (the diameter of terminal rain pipe before a pumping station). We considered the simulated water as pure water as ideal condition, ρ is 1000 kg/m^3 and μ is 0.8937 N·s/m^2 (25°C). The calculated R_e were 1369.6, 2175.2, 3034.6 and 4833.8 respectively, which indicates the flow would change from laminar to turbulent as the flow velocity from 0.51 to 1.80 m/s.

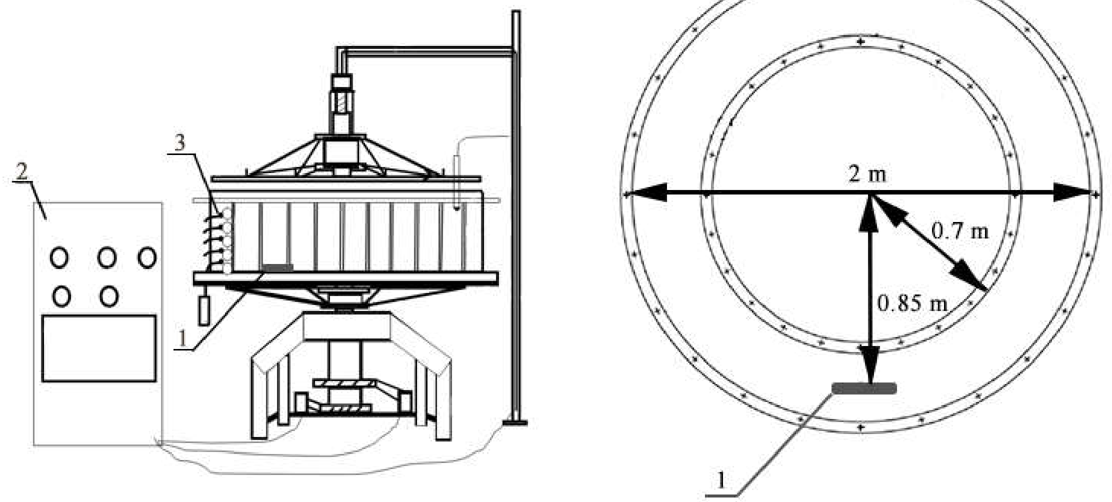

Fig. S1 The structure of the annular water tank.

1-ultrasonic flowmeter; 2-control cabinet; 3-sampling hole

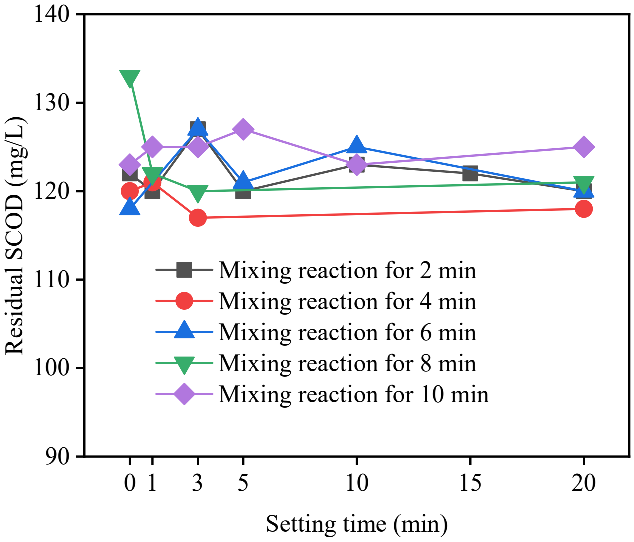

Fig. S2 Residual concentration of SCOD different reaction time and different settling time (flow velocity = 1.13 m/s)

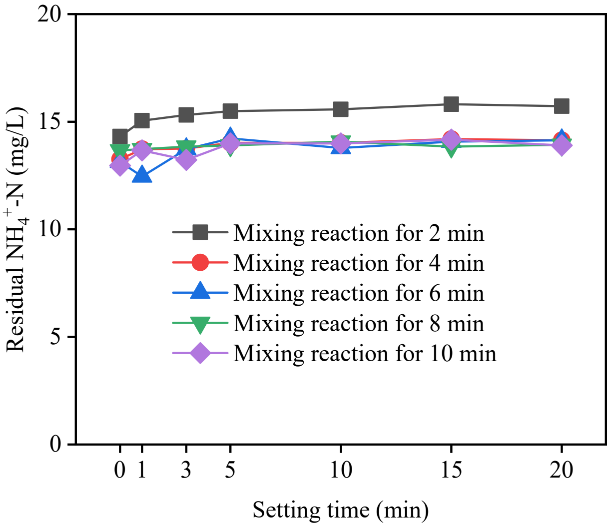

Fig. S3 Residual concentration of NH_4^+-N different reaction time and different settling time (flow velocity = 1.13m/s)

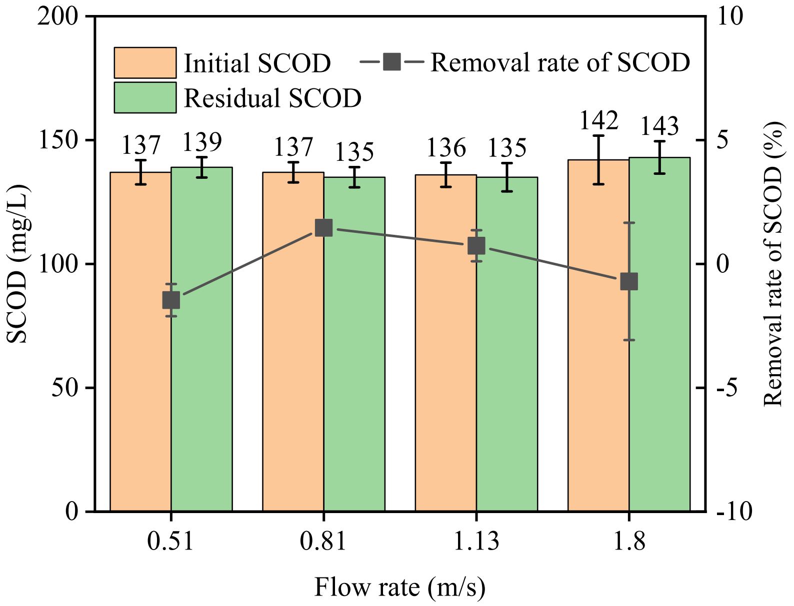

Fig. S4 The change of SCOD before and after reaction at different flow velocities and corresponding removal rate

Table S1 The $V_{linear\ velocity}$, $V_{flowmeter}$, V_{flow} and corresponding rainfalls at different rotation speeds

Rotation speed (r/min)	$V_{linear\ velocity}$ (m/s)	$V_{flowmeter}$ (m/s)	V_{flow} (m/s)	Rainfalls (mm)
1	0.0890	0.000227	0.09	1.9
2	0.1780	0.000182	0.18	3.9
3	0.2670	0	0.27	5.8
4	0.3560	0	0.36	7.8
5	0.4451	0.0309	0.41	9.0
6	0.5341	0.02036	0.51	11.2
7	0.6231	0.0015	0.62	13.5
8	0.7121	0.001682	0.71	15.5
9	0.8011	0.019091	0.78	17.0
10	0.8901	0.0448	0.85	18.4
11	0.9791	0.05436	0.92	20.1
12	1.0681	0.09475	0.97	21.2
13	1.1572	0.472276	0.68	14.9
14	1.2462	0.479333	0.77	16.7
15	1.3352	0.5228	0.81	17.7
16	1.4242	0.522781	0.90	19.6
17	1.5132	0.643871	0.87	18.9
18	1.6022	0.629615	0.97	21.2
19	1.6912	0.717929	0.97	21.2
20	1.7802	0.651034	1.13	24.6
21	1.8692	0.666053	1.20	26.2
21.2	1.8870	0.647409	1.24	27.0
21.4	1.9049	0.100364	1.80	39.3
21.6	1.9227	0.062955	1.86	40.5
21.8	1.9405	0.073957	1.87	40.6
22	1.9583	0.086925	1.87	40.7
23	2.0473	0.075237	1.97	42.9
24	2.1363	0.083159	2.05	44.7
25	2.2253	0.1008	2.12	46.3

Table S2 Volume equivalent diameter D10, D50, D90 and average particle size after adding different dosage of APAM

PAS (mg/L)	APAM (mg/L)	D10[a] (μm)	D50[b] (μm)	D90[c] (μm)	Average diameter (μm)
100	0	20.6	62	288	119
100	0.5	23.3	66.7	347	129
100	1	24.2	70.7	326	132
100	1.5	32.6	86.6	316	146
100	2	37	98.1	390	164

Notes: a), b), c) D10, D50 and D90 are equivalent diameters with cumulative distribution of 10%, 50% and 90% in the sample distribution curves

Table S3 Removal rate of turbidity at 100 mg/L and different dosage of APAM (the origin turbidity was 190.0 NTU)

PAS (mg/L)	APAM (mg/L)	Turbidity (NTU)	Removal rate of turbidity (%)
100	0	14.2	92.5
100	0.5	2.9	98.5
100	1	3.3	98.3
100	1.5	2.3	98.8
100	2	2.3	98.8