Supporting Information

Synthesis of a Cationic Polyacrylamide by Photocatalytic Surface-Initiated Method and Evaluation of Its Flocculation and Dewatering Performance: Nano-TiO₂ as Photo Initiator

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This file contains three Texts, two Table and two Figures.

Text S1. Measurement of Intrinsic Viscosity

The intrinsic viscosity of TPADs was measured by the One Point Method [28,29]. The intrinsic viscosity of TPADs was determined using Ubbelohde capillary viscometer (Shanghai Shenyi Glass Instrument Co., Ltd., China) at 30±0.05 °C. The viscosity average molecular weight of the polymers was calculated according to their intrinsic viscosities. The calculation equation according to Formula (1) (GB/T 12005.10-1992), as follows:

\[
M_r = 802[\eta]^{1.25}
\]  
Formula (1)

In this formula, \(M_r\) is the viscosity average molecular weight, \([\eta]\) is the intrinsic viscosity (mL/g).
**Text S2. Calculation method of supernatant turbidity (ST) and filter cake moisture content (FCMC)**

Supernatant turbidity (ST) was measured with a HACH (HACH 2100Q, American Hach Company) turbidity meter at the depth 2 cm below the liquid surface. FCMC was calculated by the Formula (3).

\[
\text{FCMC}\% = \frac{M_1 - M_2}{M_1 - M_0} \times 100\% \quad \text{Formula (3)}
\]

Where \(M_1\) is the total weight of the filter cake and crucible before drying, \(M_2\) is the total weight of the filter cake and crucible after drying, and \(M_0\) is the weight of the crucible.

**Text S3. Calculation method of specific resistance to filtration (SRF) and sludge flocs size**

The quantitative paper with a 30-50 \(\mu\text{m}\) pore size was cut to 7 cm in diameter and then was putted in Buchner funnel. The raw and conditioned sludge was poured into the Buchner funnel to filter under a pressure of 0.5-0.6 MPa of vacuum filtration. The volume change of filtrate was recorded every 10 s until vacuum breaking. The SRF of sludge was calculated by the Formula (4).

\[
\text{SRF} = \frac{2bPA^2}{\mu W} \quad \text{Formula (4)}
\]

Where SRF is the specific resistance to filtration of sludge (cm/g), \(P\) is the filtering pressure (Pa), \(A\) is the filtering area (cm\(^2\)), \(\mu\) is the kinetic viscosity (Pa·s), \(b\) is the slope of the filtration equation curve in the Formula (5), and \(W\) is the filter cake weight per unit volume filter (g/mL), which can be calculated by the Formula (6).

\[
\frac{t}{v} = bv + a \quad \text{Formula (5)}
\]

Where \(t\) is the filtering time (s), and \(v\) is the filtrate volume (mL).

\[
W = \frac{C_0 \cdot C_b}{C_0 - C_b} \quad \text{Formula (6)}
\]

Where \(C_0\) is the moisture content of the initial sludge (g/mL) and \(C_b\) is the moisture content of the filter cake (g/mL).

Sludge flocs size were measured using a laser diffraction instrument (Mastersizer, 2000; Malvern, UK).

**Table S1. Physical properties of the copolymers.**

| Sample | Parameter |
|--------|-----------|
|        |           |
Table S2. Details of used flocculant in flocculation and dewatering test.

| Flocculant | TiO₂ (wt %) | Cationic degree (%) | [η] (mL/g) | M₄ × 10⁴ |
|------------|-------------|---------------------|------------|-----------|
| TPAD1      | 0.125       | 30                  | 1487       | 740       |
| TPAD2      | 0.250       | 30                  | 1724       | 890       |
| TPAD3      | 0.375       | 30                  | 1690       | 869       |
| TPAD4      | 0.500       | 30                  | 1553       | 781       |
| PAD1       | 0           | 30                  | 1430       | 705       |
| CPAM       | 0           | 30                  | 1450       | 717       |

* TPAD (1-4): poly(AM-DAC) by photocatalytic surface-initiated polymerization using nano-TiO₂ as initiator; PAD1: poly(AM-DAC) by UV-initiation using VA-044 as initiator; CPAM: commercial poly(AM-DAC).

Figure S1. Floc photographs for (a) TPAD2 and (b) CPAM (Experimental conditions: 8 mg/L of dosage, pH=7.5).
(a) PAD1
\[ d_{10} = 252.855 \, \mu m \]
\[ d_{25} = 742.464 \, \mu m \]
\[ d_{50} = 1398.718 \, \mu m \]

(b) TPAD1
\[ d_{10} = 602.566 \, \mu m \]
\[ d_{25} = 1004.051 \, \mu m \]
\[ d_{50} = 1564.389 \, \mu m \]
Figure S2. Sludge floc size distribution and Photographs for (a) TPAD1 and (b) PAD1 (Experimental conditions: 20 mg/L of dosage, pH=6.5).