



1 Supplementary Material

Coagulation and Dissolution of CuO Nanoparticles in the Presence of Dissolved Organic Matter Under

4 Different pH Values

Rizwan Khan¹, Muhammad Ali Inam¹, Saba Zam Zam¹, Muhammad Akram², Sookyo Shin¹, and Ick Tae Yeom^{1, *}

Graduate School of Water Resources, Sungkyunkwan University (SKKU) 2066, Suwon 16419, Korea;
rizwankhan@skku.edu (R.K.); aliinam@skku.edu (M.A.I.); sabazamzam@skku.edu (S.Z.Z.);
tkssk08@gmail.com (S.S.)

Shandong Key Laboratory of Water Pollution Control and Resource Reuse, School of Environmental
Science and Engineering, Shandong University, Qingdao 266200, China; m.akramsathio@mail.sdu.edu.cn



* Correspondence: yeom@skku.edu; Tel.: +82-31-299-6699

- Figure S1. (A) Effects of sonication time (5-40 min) on the turbidity of CuO NPs stock suspension (30 mg/L) at pH 9; (B) size distribution by volume (%) of CuO NPs at optimized time (30 min) of sonication; (C) speciation of Fe (III) as a function of solution pH.
- 38

12

13

39



Figure S2. Measured zeta potential of CuO NPs at different pH (3-11) and concentration of HA (0.5,2.5, 5, 10 mg/L) showing ;(A) without FC ;(B) with (0.2 mM) FC dosage.



Figure S3. The species of Fe(III) and Cu ions in supernatant after coagulation without CO₂ showing (A) HA = 0 mg/L; (B) HA = 10 mg/L.



Figure S4. The species of Fe(III) and Cu ions in the supernatant after coagulation with CO₂ showing (A) HA = 0 mg/L; (B) HA = 10 mg/L.



Parameter	Unit	Value
Density	g/cm ³	6.372
Vendor-reported size	nm	>50 nm
TEM particle size measured (n=20)	nm	92-+12
DLS HDD measured in pure water (n=12)	nm	200-+250
BET specific surface area measured (n=3)	m²/g	29.2
pHiep		8.2
Zeta potential in pure water $(pH = 7)$	(mV)	$+10.2 \pm 1.6$
Purity by ICP-MS	wt %	98.81
Moisture content by TGA	wt %	1.15

105

106 The measured CuO NPs showed significantly different between TEM and DLS measurements (p < 0.05). The

107 purity of CuO NPs used in this study was determined through acid (HNO3) digestion, and the concentrations

108 of Cu⁺² were analyzed by inductively coupled plasma mass spectrometry (ICP-OES: Model Varian, Agilent

109 technologies, Sana Clara, CA, USA). HDD; hydrodynamic diameter