Supplementary Information

Role of Al-based coagulants on hybrid ozonation-coagulation (HOC) process for WWTP effluent organic matter and ibuprofen removal

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**Fig. S1** DOC removal performance at different Al dosages at pH 8

**Fig. S2** Formaldehyde formation at different tBuOH dosages

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**Text.S1.** UV/H$_2$O$_2$ experiment procedures

UV/H$_2$O$_2$ experiment was used to obtain $\sum k_i S_i$. UV/H$_2$O$_2$ was used to generate •OH, and this experiment was conducted in ultrapure water. Experimental details were modified based on previous work$^1$. A Low-pressure mercury lamp (254 nm, 40 W, Cnlight) positioned 5 cm above the water surface of the reactor (φ 5× 4 cm). The solution was adjusted to have concentrations of 12 mg/L [Al], 1 μM pCBA and 2 mM phosphate buffer (pH=8).
During the UV/H$_2$O$_2$ experiment, the rate of $\cdot$OH generation can be calculated from Eq. (S1)$^2$.

$$r_{OH^*} = \Phi_{OH^*}I_0 f_{H_2O_2} (1 - e^{-A})$$  \hspace{1cm} (S1)

Where $\Phi_{OH^*}$ is the quantum yield of $\cdot$OH at 254 nm, and $\Phi_{OH^*}$ is 1.00 in the bulk solution$^3$. $I_0$ is the incident light intensity at 254 nm, and it was measured by an illuminometer (ST-51X, SENTRY, Taiwan); $A$ is the fraction of light absorbed by the bulk solution, and is given by $A = 2.303b(\varepsilon_{H_2O_2}C_{H_2O_2} + \varepsilon_{HO_2^-}C_{HO_2^-} + \varepsilon_SC_S)$, where $\varepsilon_{H_2O_2}$=17.9-19.6 M$^{-1}$ cm$^{-1}$, $\varepsilon_{HO_2^-}$=220 M$^{-1}$ cm$^{-1}$, $\varepsilon_SC_S$ is the absorbance of other compounds in the water matrix at 254 nm, and $b$ is the water path length. In this case, AlCl$_3$•6H$_2$O had no UV adsorption at 254 nm. Parameter $f_{H_2O_2}$ is the fraction of absorbed light that is absorbed by H$_2$O$_2$ and HO$_2^-$, and is given by $f_{H_2O_2}=2.303b(\varepsilon_{H_2O_2}C_{H_2O_2} + \varepsilon_{HO_2^-}C_{HO_2^-})/A$. Based on Eq.(S1), $\cdot$OH formation during UV/H$_2$O$_2$ experiment can be obtained in both ultrapure water and WWTP effluent (Fig. S5).
**Fig. S3** Ozone depletion at pH 8 in the ozonation and HOC processes.

a: ultrapure water; b: WWTP effluent. tBuOH dosage: 10mM.

**Fig. S4** pCBA decomposition at pH=8 in the ozonation and HOC processes.

a: ultrapure water; b: WWTP effluent
**Fig. S5** •OH formation during UV/H₂O₂ experiment in ultrapure water (a) and WWTP effluent (b)

**Fig. S6** pCBA removal during UV/H₂O₂ experiment in ultrapure water (a) and WWTP effluent (b)

**Fig. S7** \(\sum k_i[S_i]\) calculation in (a) ultrapure water \((P = 1E-5)\) and (b) WWTP effluent \((P = 1E-7)\) (Calculated •OH formation vs. \(\int [\cdot \mathrm{OH}] \mathrm{dt}\), the slope indicates \(\sum k_i[S_i]\)
**Fig. S8** $\int [\cdot\text{OH}] \text{dt}$ at different ozone dosages in the HOC process in the ultrapure water

**Fig. S9** $\int [\cdot\text{OH}] \text{dt}$ at different ozone dosages in the HOC process in WWTP effluent. a: without AlCl$_3$·6H$_2$O; b: with AlCl$_3$·6H$_2$O
Fig. S10 The plots of $1/R_{ct}$ vs. $(k_{SS}[S])$ in ultrapure water without AlCl$_3$•6H$_2$O ($P = 5\times10^{-4}$)

References

