Supporting Information

Significance of activated carbon fiber as cathode in electro/Fe^{3+}/peroxydisulfate oxidation process for removing carbamazepine in aqueous environment

Shiqiang Han[a,b,c&], Shabi Ul Hassan[b,c&], Yunhua Zhu[b,c], Shuai Zhang[b,c], Hongguang Liu[a*], Sen Zhang[a,b,c], Junfeng Li[a], Zhaoyang Wang[a], Chun Zhao[a, b,c*]

[a]College of Water & Architectural Engineering, Shihezi University, Shihezi 832000, PR China

[b]State Key Laboratory of Coal Mine Disaster Dynamics and Control (Chongqing University), Chongqing 400044, PR China

[c]Key Laboratory of the Three Gorges Reservoir Region's Eco-Environment, Ministry of Education, Chongqing University, Chongqing, 400045, PR China

[&]These authors contributed equally to this work and should be considered co-first authors

*Corresponding author

Email addresses: pureson@cqu.edu.cn, pureson@163.com (Chun Zhao), liuhongguang-521@163.com (Hongguang Liu)

Text S1 The specific operation of different processes and effects of some parameters

In this study, method of controlling a single variable was adopted in exploring the effects of parameters in ACF-E/Fe^{3+}/PDS process. When one variable changed, the others kept constant. The initial conditions in ACF-E/Fe^{3+}/PDS process were as follows: $[CBZ]_0$=0.04 mM, pH_0=3, [PDS]=2 mM, [Fe^{3+}]=0.4 mM, Current density=7.14 mA/cm^2, T=25 ℃, [Na_2SO_4]=50 mM unless otherwise specified. And keeping the other parameters unchanged when exploring the effects of one parameter.

In the effect of initial pH, the reaction conditions in ACF-E/Fe^{3+}/PDS process were as follows: $[CBZ]_0$=0.04 mM, [PDS]=2 mM, [Fe^{3+}]=0.4 mM, Current density=7.14 mA/cm^2, T=25 ℃, [Na_2SO_4]=50 mM. And initial pH was adjusted to 3, 5, 7, 9, 11 by 0.1 M H_2SO_4 and NaOH.

In the effect of PDS concentration, the reaction conditions in ACF-E/Fe^{3+}/PDS process were as follows: $[CBZ]_0$=0.04 mM, pH_0=3, [Fe^{3+}]=0.4 mM, Current density=7.14 mA/cm^2, T=25 ℃, [Na_2SO_4]=50 mM. And PDS concentration was 0.5, 1, 2, 4, 8 mM.

In the effect of Fe^{3+} concentration, the reaction conditions in ACF-E/Fe^{3+}/PDS

process were as follows: $[CBZ]_0$=0.04 mM, pH_0=3, [PDS]=2 mM, Current density=7.14 mA/cm^2, T=25 ℃, $[Na_2SO_4]$=50 mM. And Fe^{3+} concentration was 0.1, 0.2, 0.4, 0.8, 1.6 mM.

In the effect of current density, the reaction conditions in ACF-E/Fe^{3+}/PDS process were as follows: $[CBZ]_0$=0.04 mM, pH_0=3, [PDS]=2 mM, $[Fe^{3+}]$=0.4 mM, T=25 ℃, $[Na_2SO_4]$=50 mM. And current density was 3.57, 7.14, 10.71, 14.28 mA/cm^2, which was controlled by the DC power.

In the effect of temperature, the reaction conditions in ACF-E/Fe^{3+}/PDS process were as follows: $[CBZ]_0$=0.04 mM, pH_0=3, [PDS]=2 mM, $[Fe^{3+}]$=0.4 mM, Current density=7.14 mA/cm^2, $[Na_2SO_4]$=50 mM. And the temperature was 15, 25, 35, 45 ℃, which was controlled by constant temperature water bath

In the effect of electrolyte concentration (Na_2SO_4), the reaction conditions in ACF-E/Fe^{3+}/PDS process were as follows: $[CBZ]_0$=0.04 mM, pH_0=3, [PDS]=2 mM, $[Fe^{3+}]$=0.4 mM, Current density=7.14 mA/cm^2, T=25 ℃. And the electrolyte concentration (Na_2SO_4) was 25, 50, 100, 200 mM.

Table S1 Average voltage and EE/O values at different Na_2SO_4 concentrations

Na_2SO_4 (mM)	25	50	100	200
Voltage (V)	4.4	3.5	2.9	2.4
EE/O(kWh/m^3)	0.2427	0.2123	0.2367	0.2386

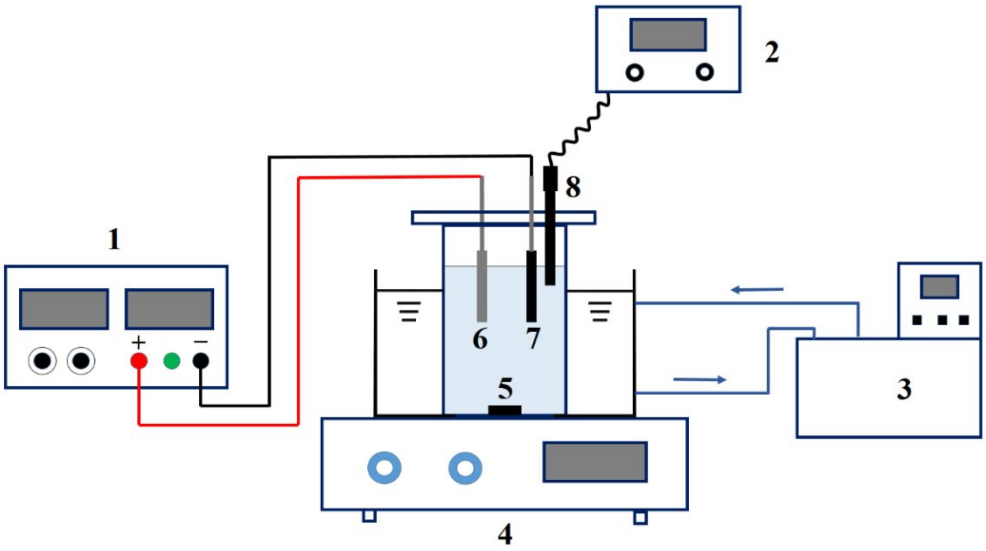


Figure S1. A scheme of the experimental apparatus: (1) DC power supply, (2) pH meter, (3) Constant-temperature water bath, (4) Magnetic stirrer, (5) Magnetic rotor, (6) Pt/Ti anode, (7) ACF cathode, (8) pH meter probe.

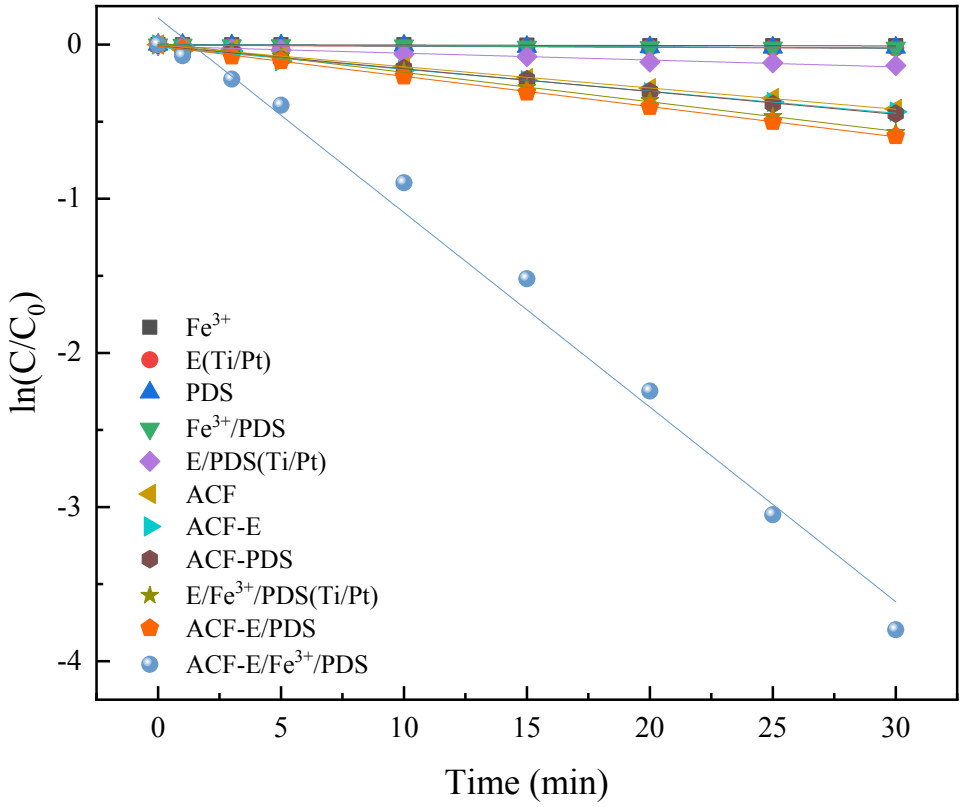
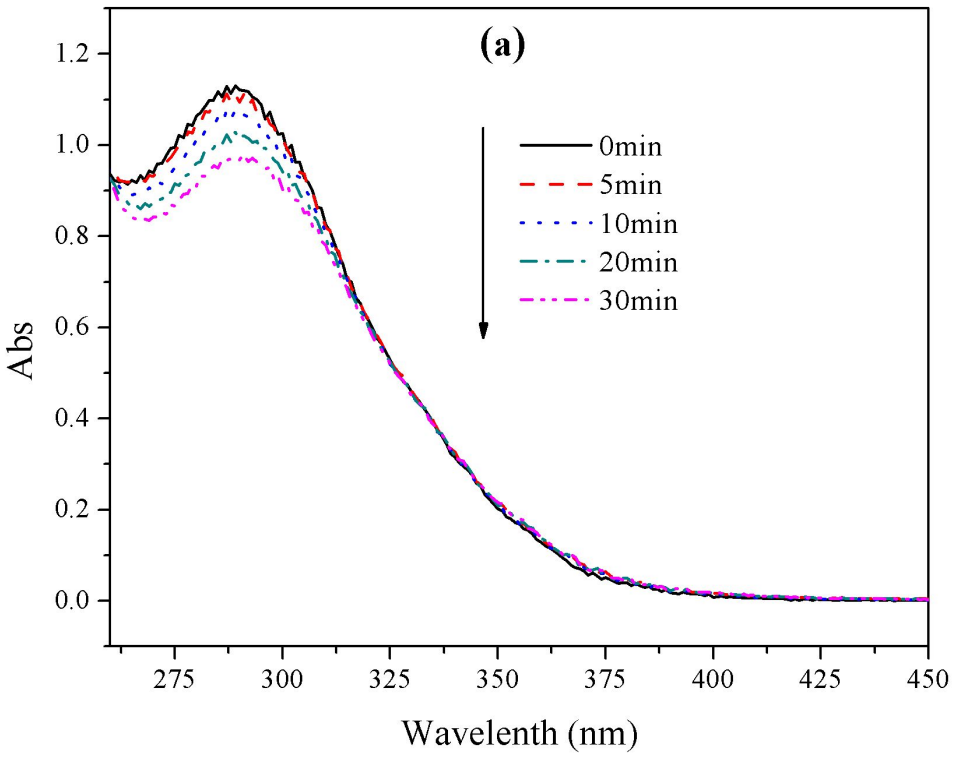


Figure S2. First order dynamics fitting for the removal of CBZ in different processes.


(a)
0min
5min
10min
20min
30min
Abs
Wavelenth (nm)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
275
300
325
350
375
400
425
450

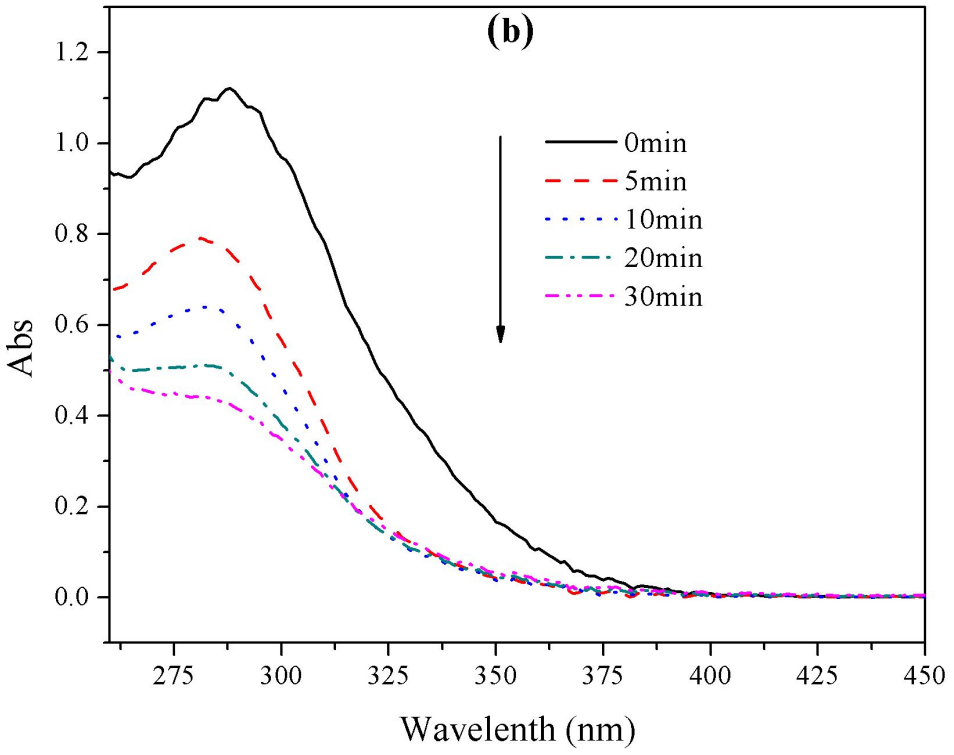

(b)
0min
5min
10min
20min
30min
Abs
Wavelenth (nm)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
275
300
325
350
375
400
425
450

Figure S3. UV-vis spectral analysis of CBZ in (a) E/Fe^{3+}/PDS and (b) ACF-E/Fe^{3+}/PDS process.

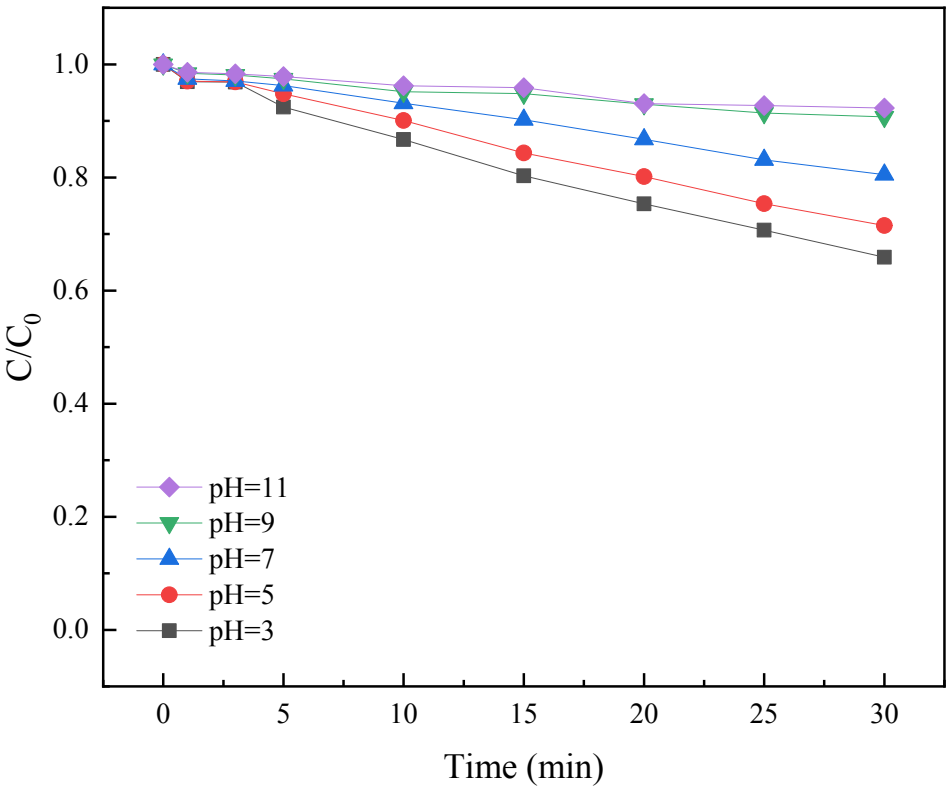


Figure S4. Effect of initial pH on removal of CBZ by ACF adsorption ($[CBZ]_0$=0.04 mM, T=25 ℃).

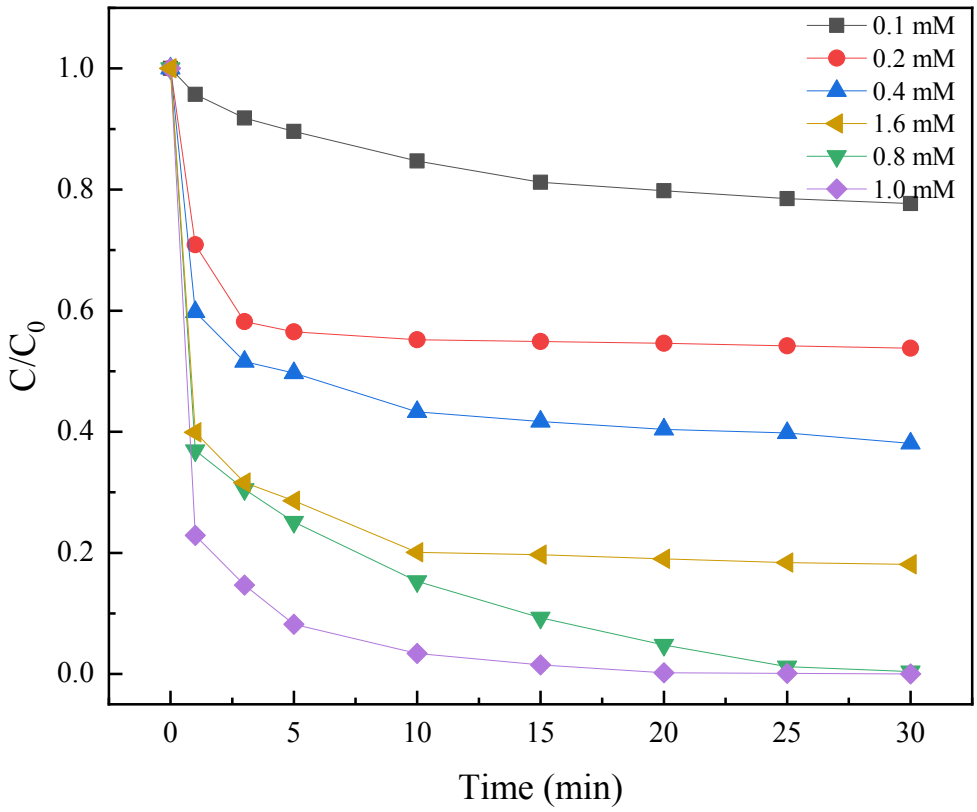


Figure S5. Fe^{2+} concentration on CBZ removal in ACF-E/Fe^{3+}/PDS process ($[CBZ]_0$=0.04 mM, pH_0=3, [PDS]=2 mM, Current density=7.14 mA/cm^2, T=25 ℃, $[Na_2SO_4]$=50 mM).

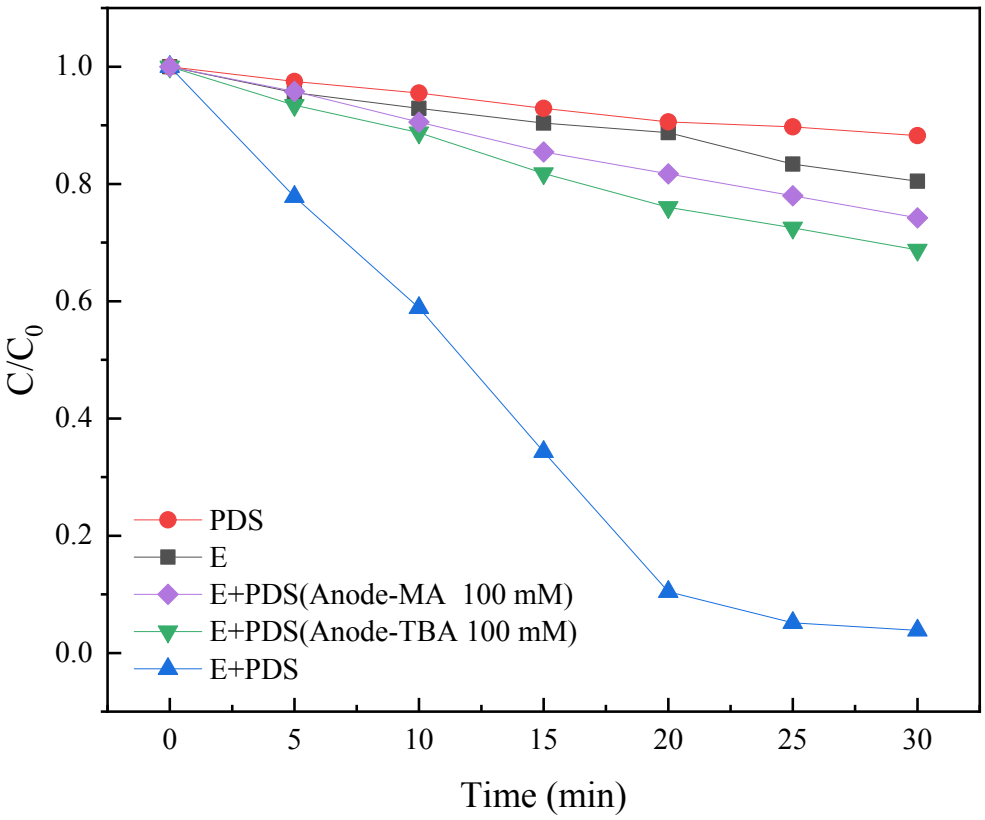


Figure S6. Effect of anodic (Ti/Pt electrode) oxidation on removal of CBZ ($[CBZ]_0$=0.04 mM, pH_0=3, [PDS]=100 mM, Current density=28.6 mA/cm^2, T=25 ℃, $[Na_2SO_4]$=50 mM).

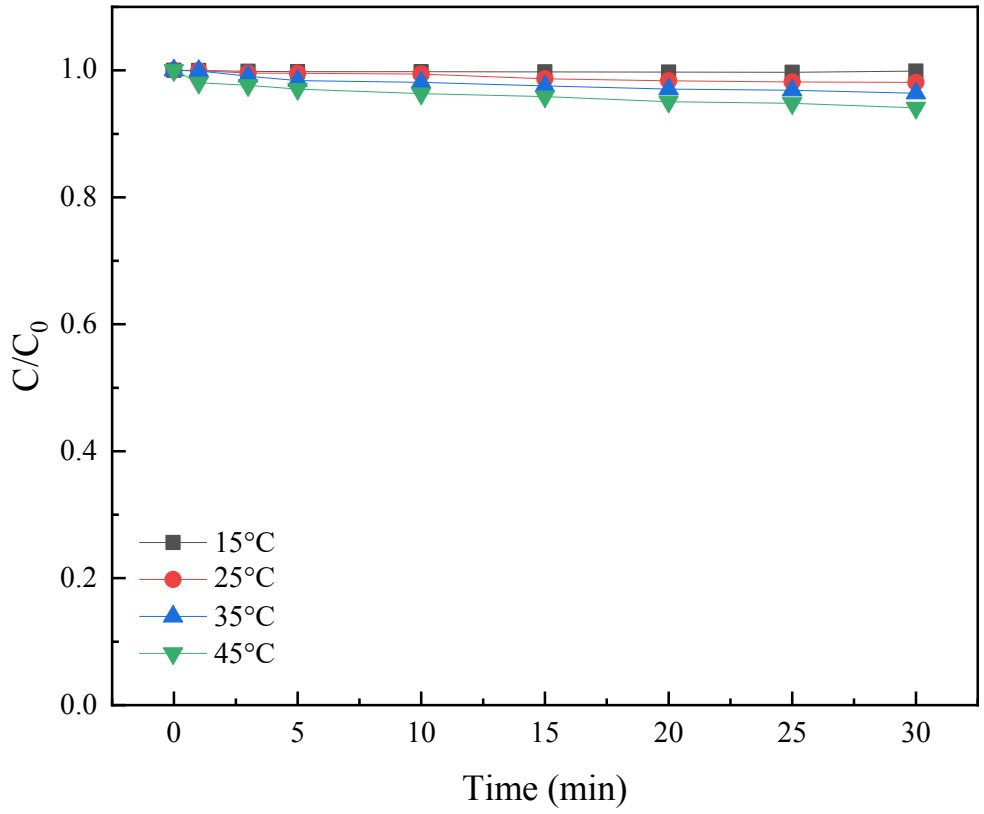


Figure S7. Effect of temperature on CBZ removal by PDS oxidation ($[CBZ]_0$=0.04 mM, [PDS]=2 mM, pH_0=3).