

Supporting Information

Transition metal ions as ozonation catalysts: an alternative process of heterogeneous catalytic ozonation

Savvina Psaltou ¹, Konstantina Sioumpoura ², Efthimia Kaprara ², Manassis Mitrakas², and Anastasios Zouboulis^{1,*}

¹Laboratory of Chemical and Environmental Technology, Department of Chemistry, Aristotle University, Thessaloniki, Greece; spsaltou@chem.auth.gr; zoubouli@chem.auth.gr

²Laboratory of Analytical Chemistry, Department of Chemical Engineering, Aristotle University, Thessaloniki, Greece; kaprara@auth.gr; ksioumpou@cheng.auth.gr; mmitraka@auth.gr

* Correspondence: zoubouli@chem.auth.gr

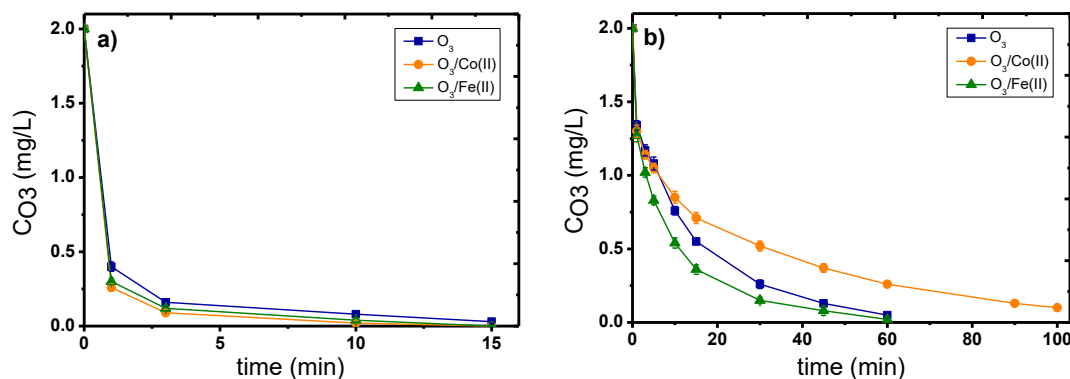


Figure S1. Ozone decomposition during catalytic ozonation of p-CBA with the use of Fe(II) and Co(II) as catalysts in (a) deionized water, and (b) dechlorinated tap water. Experimental conditions: initial p-CBA concentration 0.5 mg/L, ozone concentration 2 mg/L, catalyst concentration 1 mg/L, pH 7.8, Temp. $23 \pm 2^\circ \text{C}$. (Data are the averages of the values obtained in independent experiments conducted in triplicate and the error bars represent the standard deviation of them).

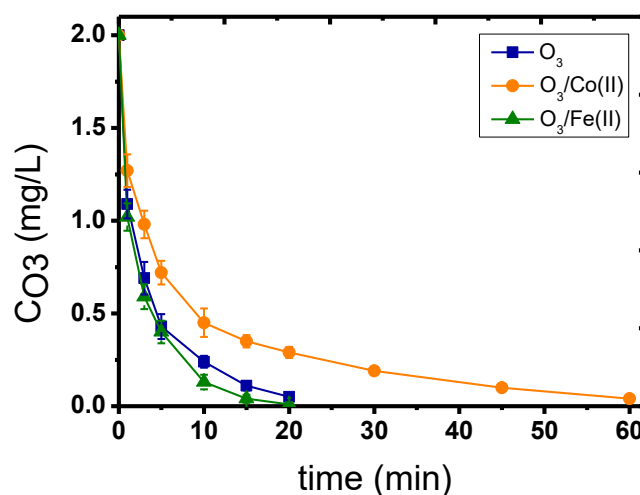


Figure S2. Ozone decomposition during catalytic ozonation of benzotriazole with the use of Fe(II) and Co(II) as catalysts in dechlorinated tap water. Experimental conditions: initial benzotriazole concentration 0.5 mg/L, ozone concentration 2 mg/L, catalyst concentration 1 mg/L, pH 7.8, Temp. $23 \pm 2^\circ \text{C}$. (Data are the averages of the values obtained in independent experiments conducted in triplicate and the error bars represent the standard deviation of them).

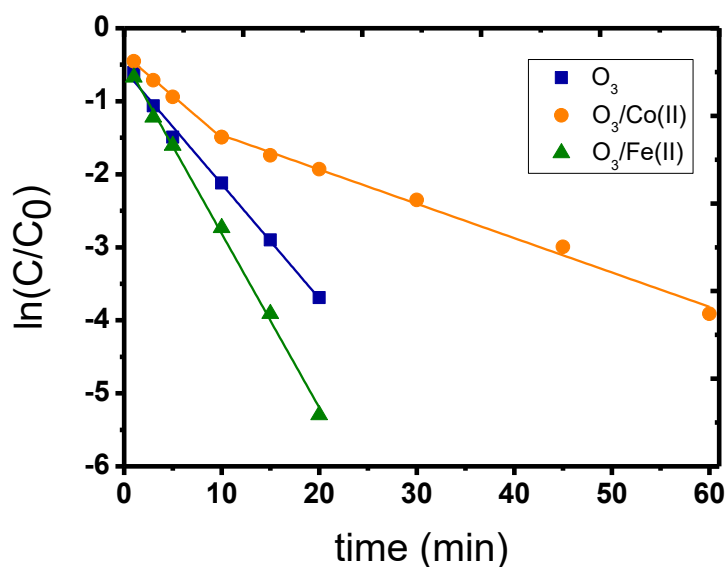


Figure S3. 1st order kinetic model of ozone decomposition during the ozonation of benzotriazole in dechlorinated tap water experiments. Experimental conditions: initial benzotriazole concentration 0.5 mg/L, ozone concentration 2 mg/L, catalyst concentration 1 mg/L, pH 7.8, Temp. 23±2° C.

Table S1. Parameters of 1st order kinetic model of ozone decomposition during the ozonation of benzotriazole in dechlorinated tap water. Experimental conditions: initial benzotriazole concentration 0.5 mg/L, ozone concentration 2 mg/L, catalyst concentration 1 mg/L, pH 7.8, Temp. 23±2° C.

Catalyst	Time (min)	1 st order kinetic constant (min ⁻¹)	Equation	R ²
/	1-20	0.156	y= -0.156x-0.569	0.994
Co(II)	1-10	0.114	y= -0.114x-0.357	0.998
Co(II)	10-60	0.047	y=-0.047x-0.993	0.993
Fe(II)	1-20	0.238	y=-0.238x-0.428	0.998

Table S2. Iron and cobalt concentration in different time intervals with and without the addition of ozone.

[Fe] (mg/L)		
Time (h)	[O ₃] = 0 mg/L	[O ₃] = 2 mg/L
0	1	1
0.5	0.1	0.1
1	0.05	0.07
4	0.03	0.02
24	0.02	0
[Co] (mg/L)		
0	1	1
0.5	1	1
1	1	1
4	1	1
24	1	1

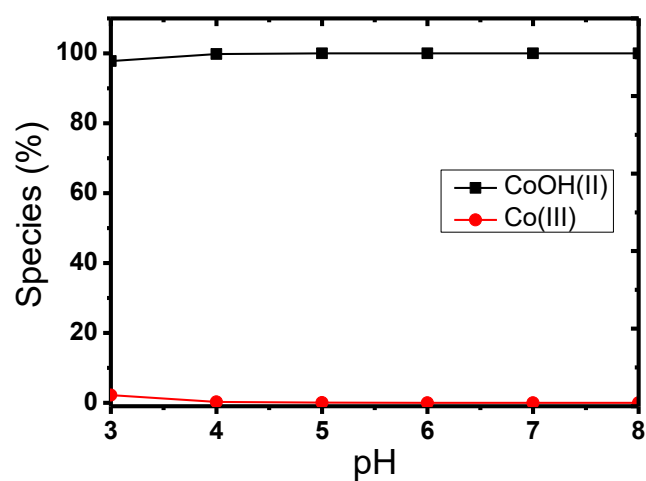


Figure S4. Soluble species of Co(III) for the initial metal ion concentration 1 mg/L in different pH values and in aqueous solutions.

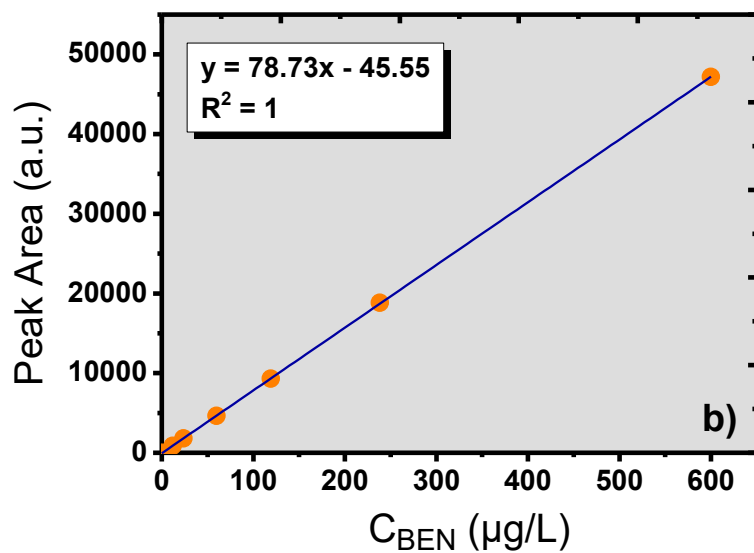
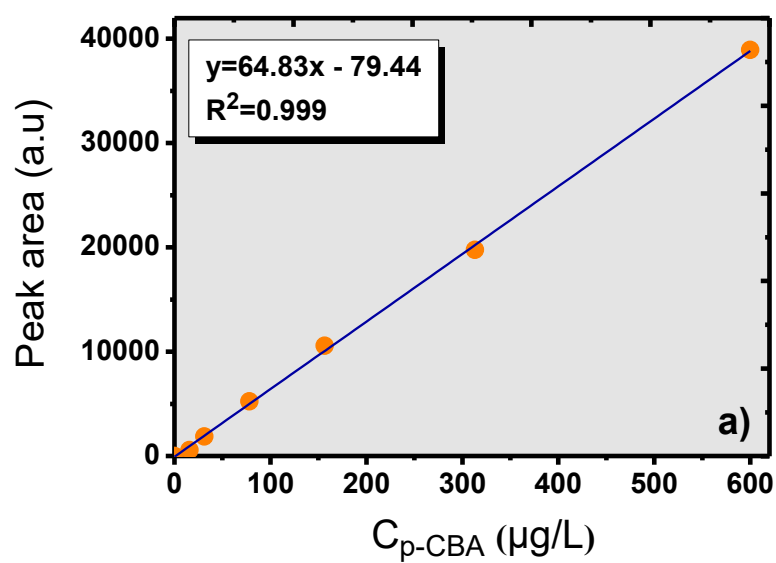


Figure S5. Linear response for the determination of (a) p-CBA and (b) benzotriazole concentrations (by HPLC) in the concentration range 0-600 $\mu\text{g/L}$.