

Supporting Information

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

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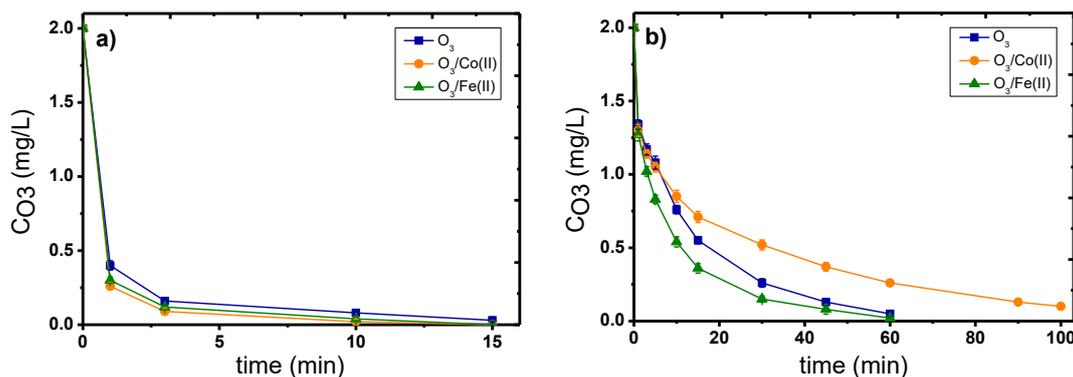


Figure S1. Ozone decomposition during catalytic ozonation of p-CBA with the use of Fe(II) and Co(II) as catalysts in (a) deionized water, and (b) dechlorinated tap water. Experimental conditions: initial p-CBA concentration 0.5 mg/L, ozone concentration 2 mg/L, catalyst concentration 1 mg/L, pH 7.8, Temp. $23\pm 2^\circ$ 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).

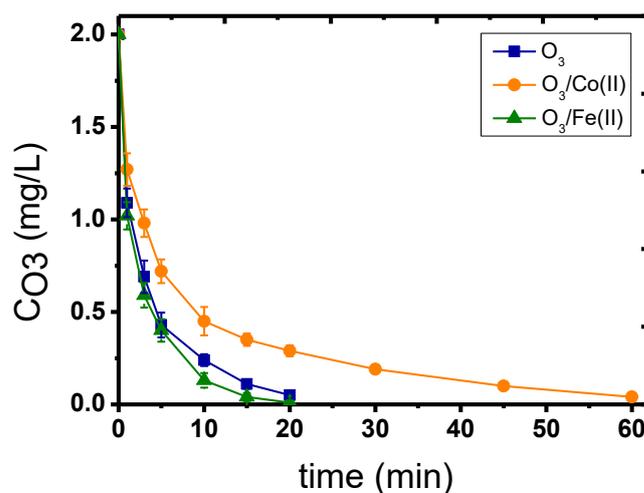


Figure S2. Ozone decomposition during catalytic ozonation of benzotriazole with the use of Fe(II) and Co(II) as catalysts in dechlorinated tap water. Experimental conditions: initial benzotriazole concentration 0.5 mg/L, ozone concentration 2 mg/L, catalyst concentration 1 mg/L, pH 7.8, Temp. $23\pm 2^\circ$ 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).

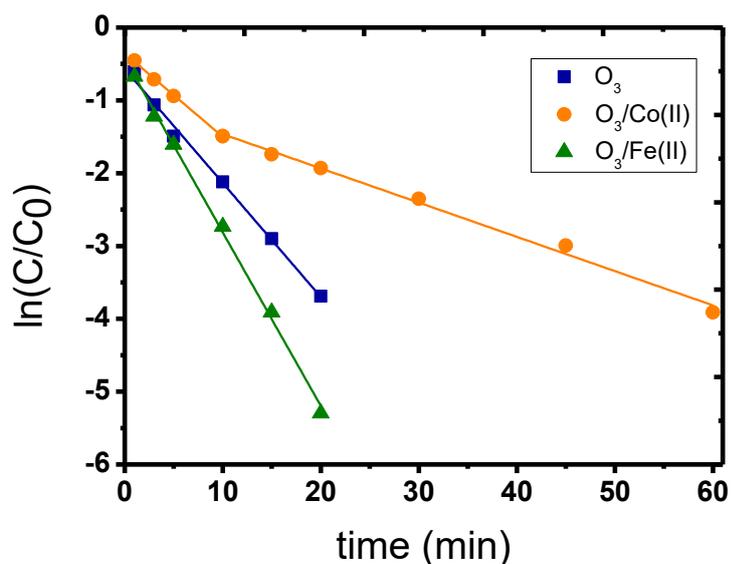


Figure S3. 1st order kinetic model of ozone decomposition during the ozonation of benzotriazole in dechlorinated tap water experiments. Experimental conditions: initial benzotriazole concentration 0.5 mg/L, ozone concentration 2 mg/L, catalyst concentration 1 mg/L, pH 7.8, Temp. 23±2° C.

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) | | |
|--------------------|---------------------------------|---------------------------------|
| <i>Time (h)</i> | <i>[O₃] = 0 mg/L</i> | <i>[O₃] = 2 mg/L</i> |
| 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 |

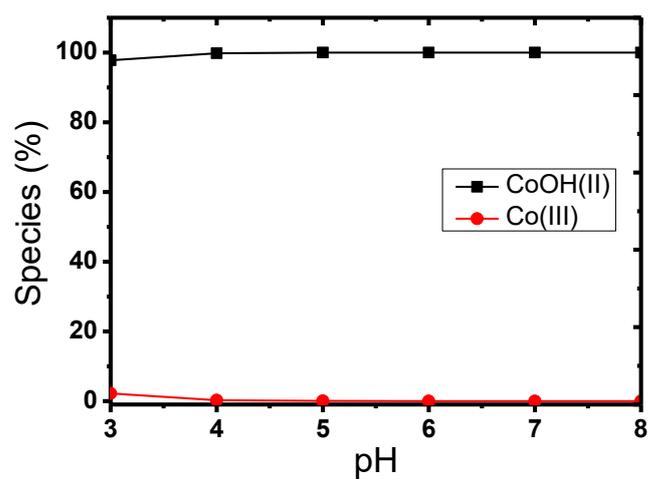


Figure S4. Soluble species of Co(III) for the initial metal ion concentration 1 mg/L in different pH values and in aqueous solutions.

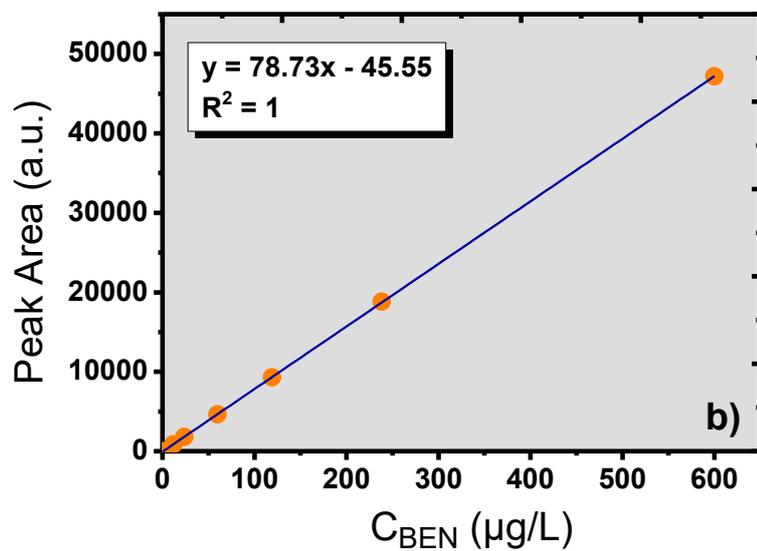
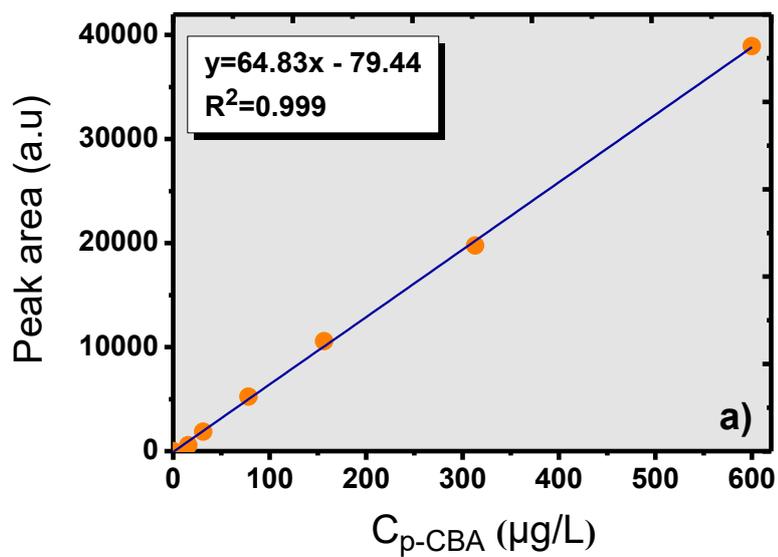


Figure S5. Linear response for the determination of (a) p-CBA and (b) benzotriazole concentrations (by HPLC) in the concentration range 0-600 $\mu\text{g/L}$.