OXIDATIVE DEGRADATION OF BISPHENOL A IN AQUEOUS SOLUTION USING BICARBONATE ACTIVATED HYDROGEN PEROXIDE

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Introduction

Due to its widespread use, BPA is found in foods, beverages, wastewater and surface waters. The presence of BPA in rivers is due to the drainage of waste water, the continuous leakage of plastics and resins or the plastic thrown directly into the rivers. This leads to numerous harmful effects on the human body which include: effects on the prostate, promotion of cancer cells, problems of metabolism, diabetes, effects on the reproductive system and hormonal disruptor, BPA being a mimetic of estrogen. Due to its very high presence and numerous adverse effects, the degradation of bisphenol A from wastewater is considered to be an emergency, in the last year (2020) more than 2000 articles being published on this subject.

Among them, advanced oxidation processes (AOPs) have become very useful in the treatment of wastewater due to its high reactivity and non-specific, broad-spectrum efficacy on several organic pollutants. AOPs involve the use of oxidants, such as oxygen, hydrogen peroxide and ozone, to produce extremely oxidizing radicals (like hydroxyl, superoxide radical, hydroxy peroxyl radical and singlet oxygen) to degrade and even completely mineralize organic pollutants like BPA.

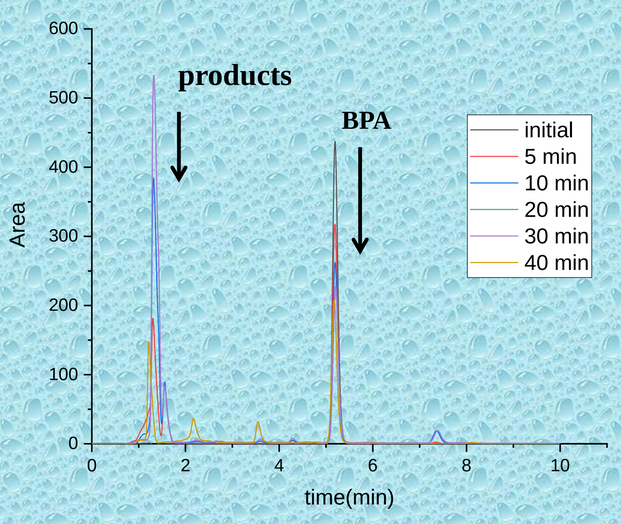
The hydrogen peroxide-sodium bicarbonate (BAP) system is characterized by high efficiency because the bicarbonate anion is one of the most abundant freshwater anions and is relatively non-toxic. BPA oxidation occurs due to the attack of the radicals formed in the oxygenated water/sodium bicarbonate system. In the case of using the Co/AO/BIC system, it is assumed that in the first stage a complex is formed between bivalent cobalt and sodium bicarbonate, a complex that binds oxygenated water with radical formation and the BPA to be degraded.

In this paper we used the bicarbonate activated hydrogen peroxide (BAP) system activated either by $CoSO_4$ or $NaNO_2$ for BPA degradation.

Experimental

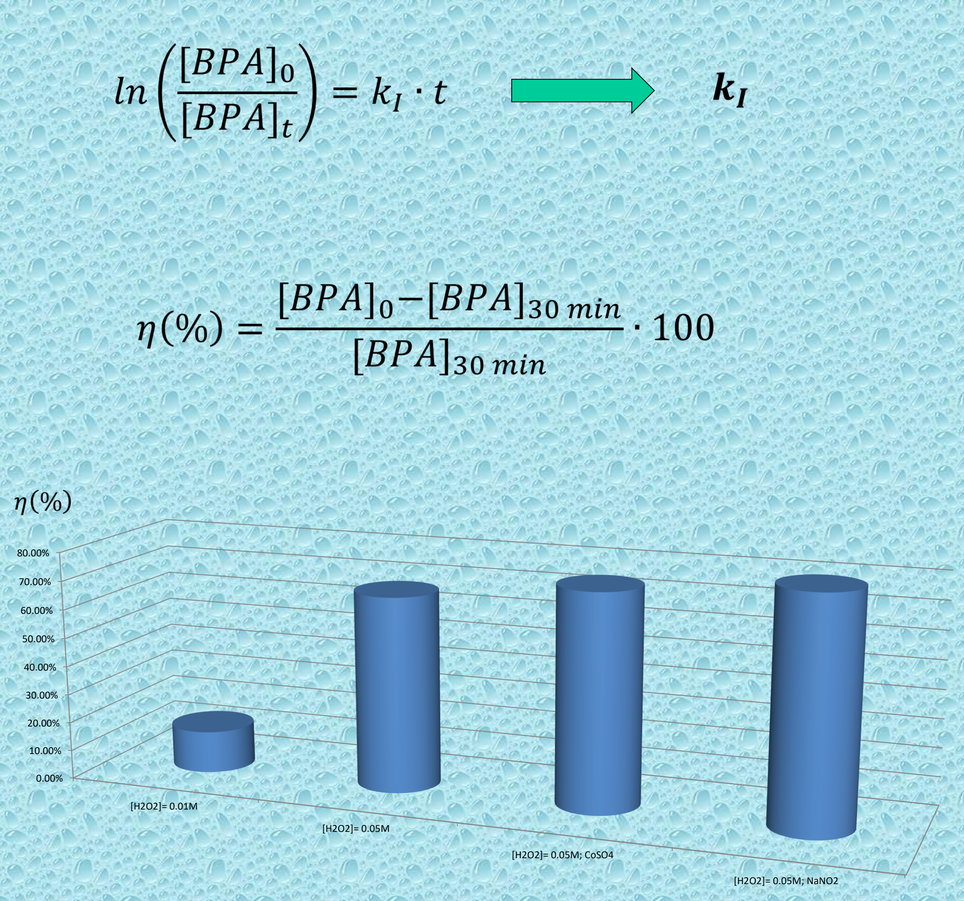
The BPA (0.3mM) oxidation was performed with a system consisting of hydrogen peroxide 0.05M and sodium bicarbonate 0.05M and $CoSO_4$ 4µM or $NaNO_2$ 50µM (as activators) in a small batch reactor (5mL). Samples of 20 µL were taken over time and analyzed by HPLC (C8 colum, 15 x 0.46 cm, 5µm, elution system acetonitril: 0.1% phosphoric acid in water 50:50 in isocratic mode, 1ml/min flow rate) using a UV-VIS detector at λ=278nm. In these conditions BPA has a retention time of 5.4 min.

Results

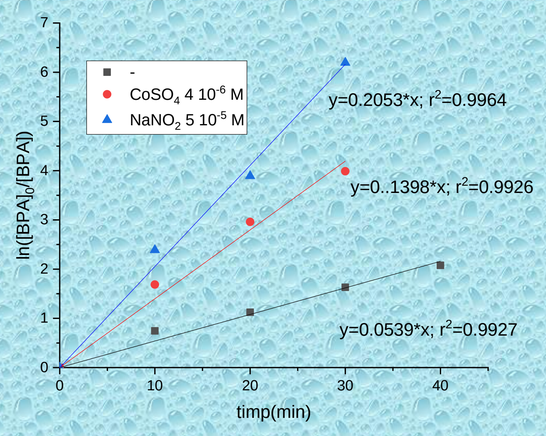


$$ln\left(\frac{[BPA]_0}{[BPA]_t}\right) = k_I \cdot t \quad \Rightarrow \quad k_I$$

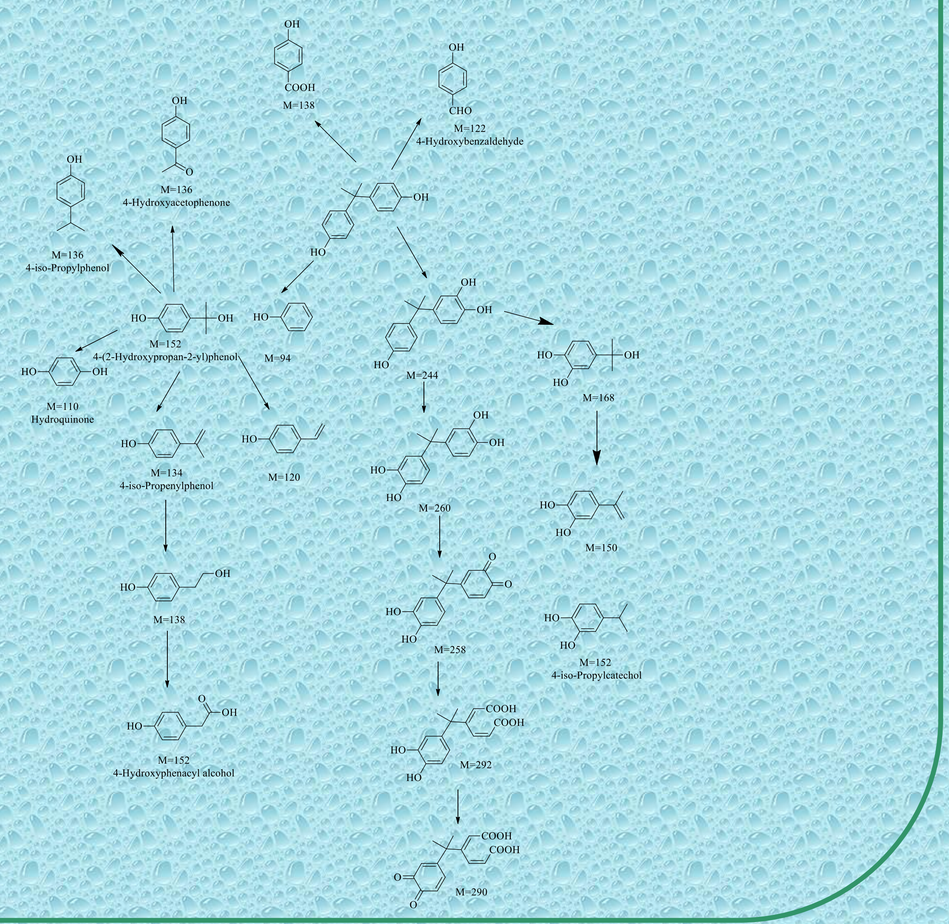
$$\eta(\%) = \frac{[BPA]_0 - [BPA]_{30\,min}}{[BPA]_{30\,min}} \cdot 100$$



Influence of Co^{2+} and NO_2^-



Degradation pathway of BPA



Conclusions

- ✓ **Regarding the degradation efficiency at 30 minutes, we obtained values over 90% both in the presence of nitrite (90.86%) and for Co^{2+} (97%); these values seem to be very good, being greater than other values reported in the literature.**
- ✓ **Since in the reaction, other organic products were obtained, they were quantified via HPLC-MS; the results show a complex mechanism for BPA degradation, with a mineralization degree of 77%.**