REMTECH EXPO
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Treatment of Amoxicillin Formulation Effluent by Ozone Technology

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Session 14
25th, September

Introduction

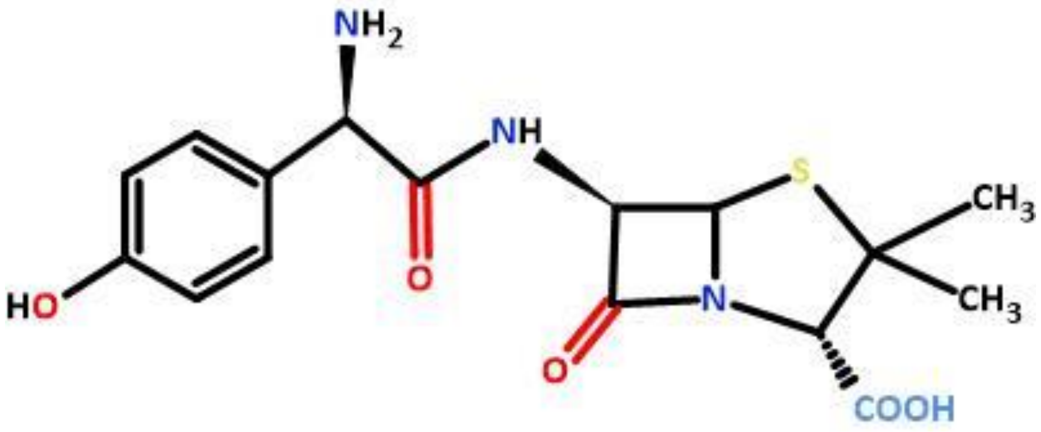


Fig. 1. Amoxicillin structure

((2S,5R,6R)-6-[[(2R)-2-amino-2-(4-hydroxyphenyl)acetyl]amino]-3,3-dimethyl-7-oxo-4-thia-1-azabicyclo[3.2.0]heptane-2-carboxylic acid)

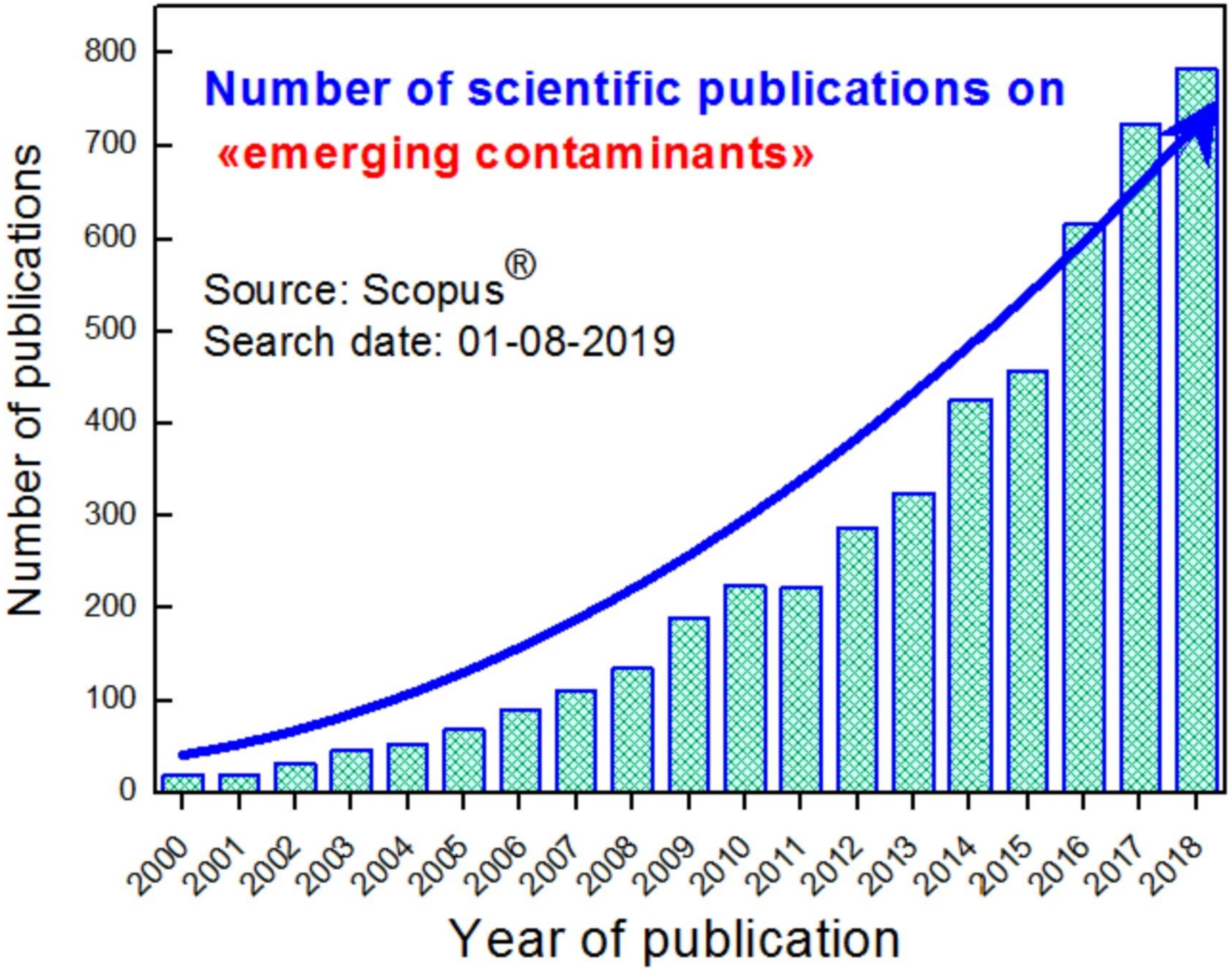
With chemical formula $C_{16}H_{19}N_3O_5S$

It is an antibiotic that belongs to the beta-lactams group and it is often used for bacterial infection treatments

World Health Data Platform / GHO / Indicator Metadata Registry List

Essential Medicines List includes paediatric Amoxicillin syrup

Introduction



ELSEVIER

Journal of Environmental Management

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Review

Removal of caffeine, nicotine and amoxicillin from (waste)waters by various adsorbents. A review

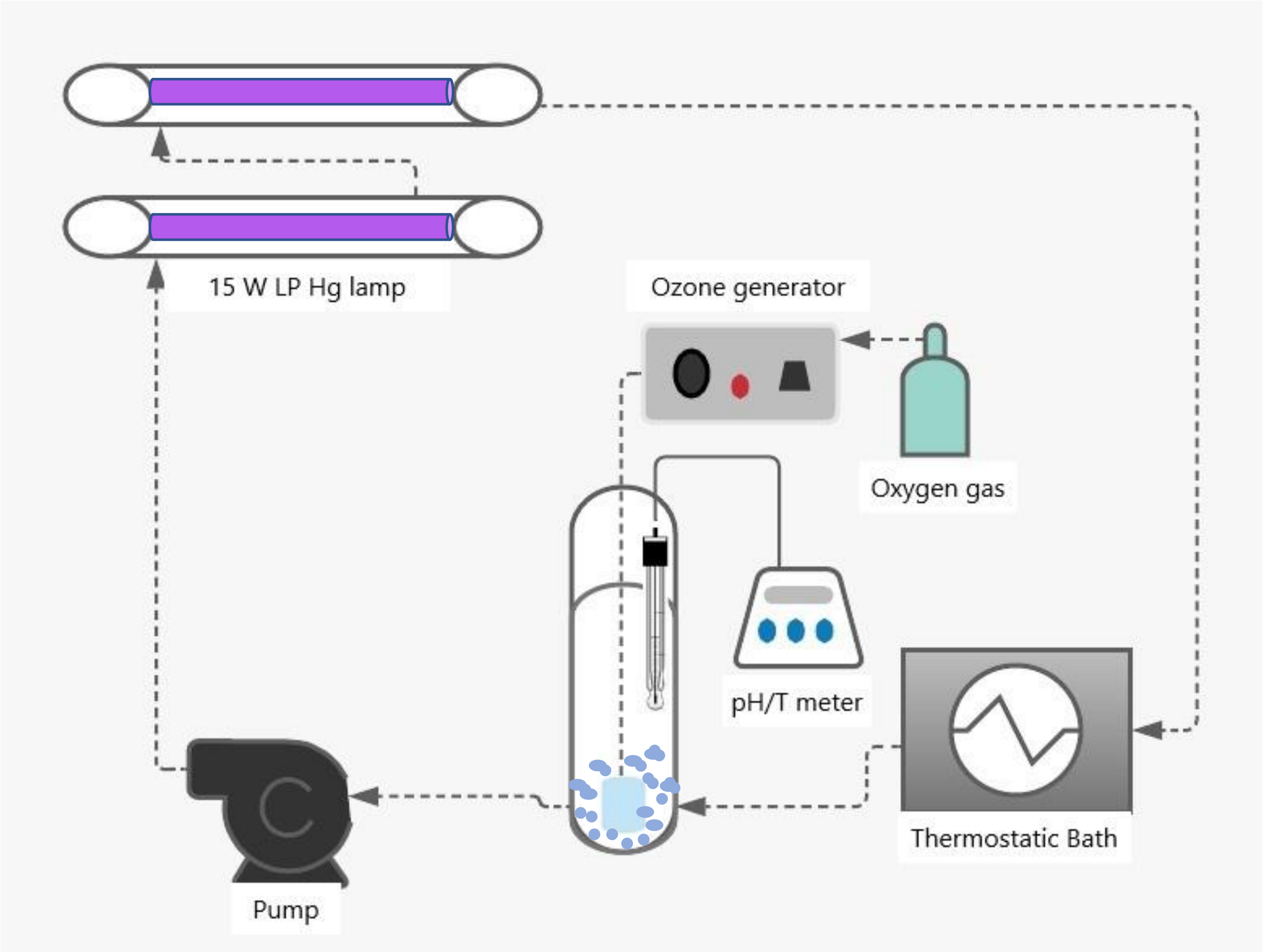
Ioannis Anastopoulos [a], Ioannis Pashalidis [a], Alexios G. Orfanos [b], Ioannis D. Manariotis [b], Tetiana Tatarchuk [c, h], Lotfi Sellaoui [d], Adrián Bonilla-Petriciolet [e], Alok Mittal [f], Avelino Núñez-Delgado [g]

Fig. 2. Number of publications on EC.

Objectives

- **Evaluate the potential application of ozone-based technologies in the removal of amoxicillin (AMX).**
- Evaluate the effects of the operational factors UV dose, pH, O_3 dose on AMX degradation and mineralization.
- Determine the reaction kinetics of AMX degradation using ozone-based technologies (O_3 and O_3/UV).
- Study mechanisms of AMX degradation.
- Evaluate the influence of 1-propanol and 2-propanol (possible •OH scavenger).

Materials and Methods



- pH = 9.0; 11.0; and 13.0 ± 0.5
- Temperature = 20.0 ± 0.5 °C
- Volumetric flow-rate: 0.5 and 1.0 L min^{-1}
- Ozone mass-rate: 8.13; 15.00; and 25 mg min^{-1}
- Low-pressure mercury vapor lamps

Fig. 3. Reaction system diagram.

Materials and Methods

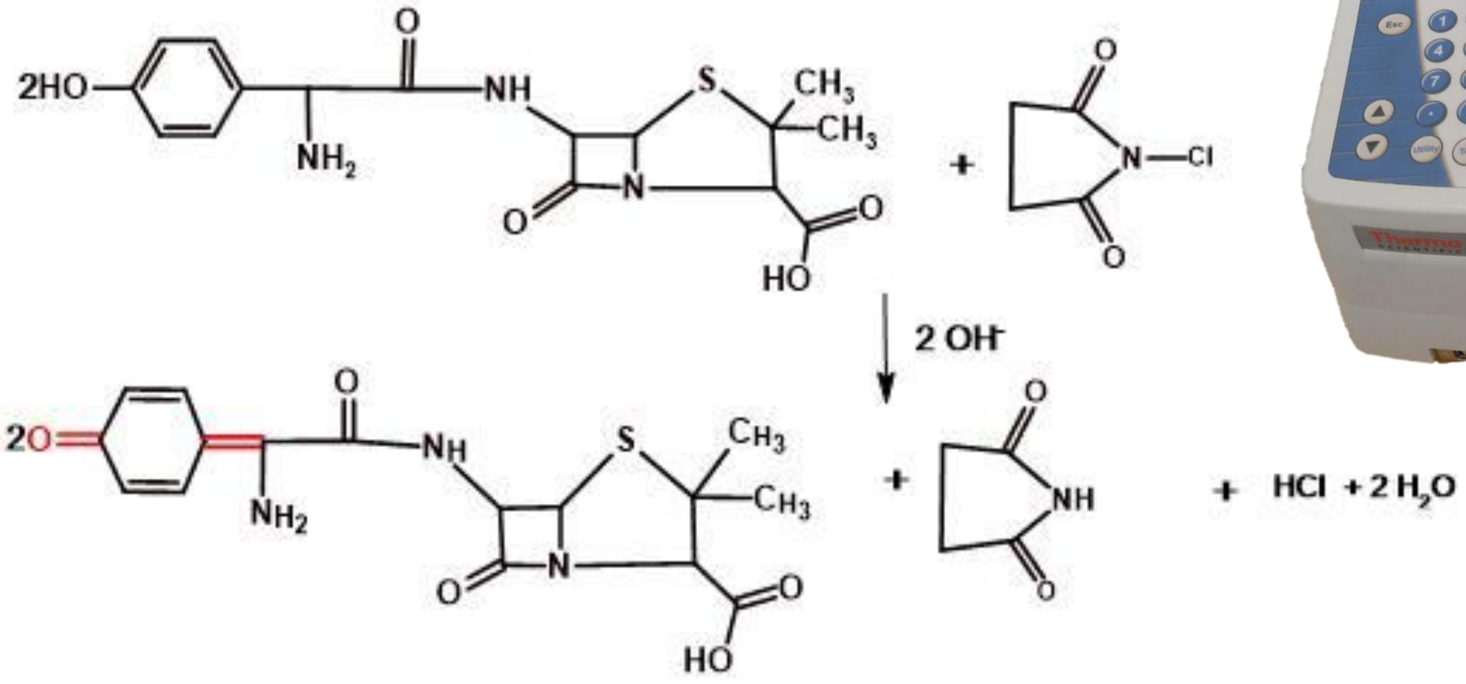


Fig. 4. NCS method mechanism.

λ = 395 nm

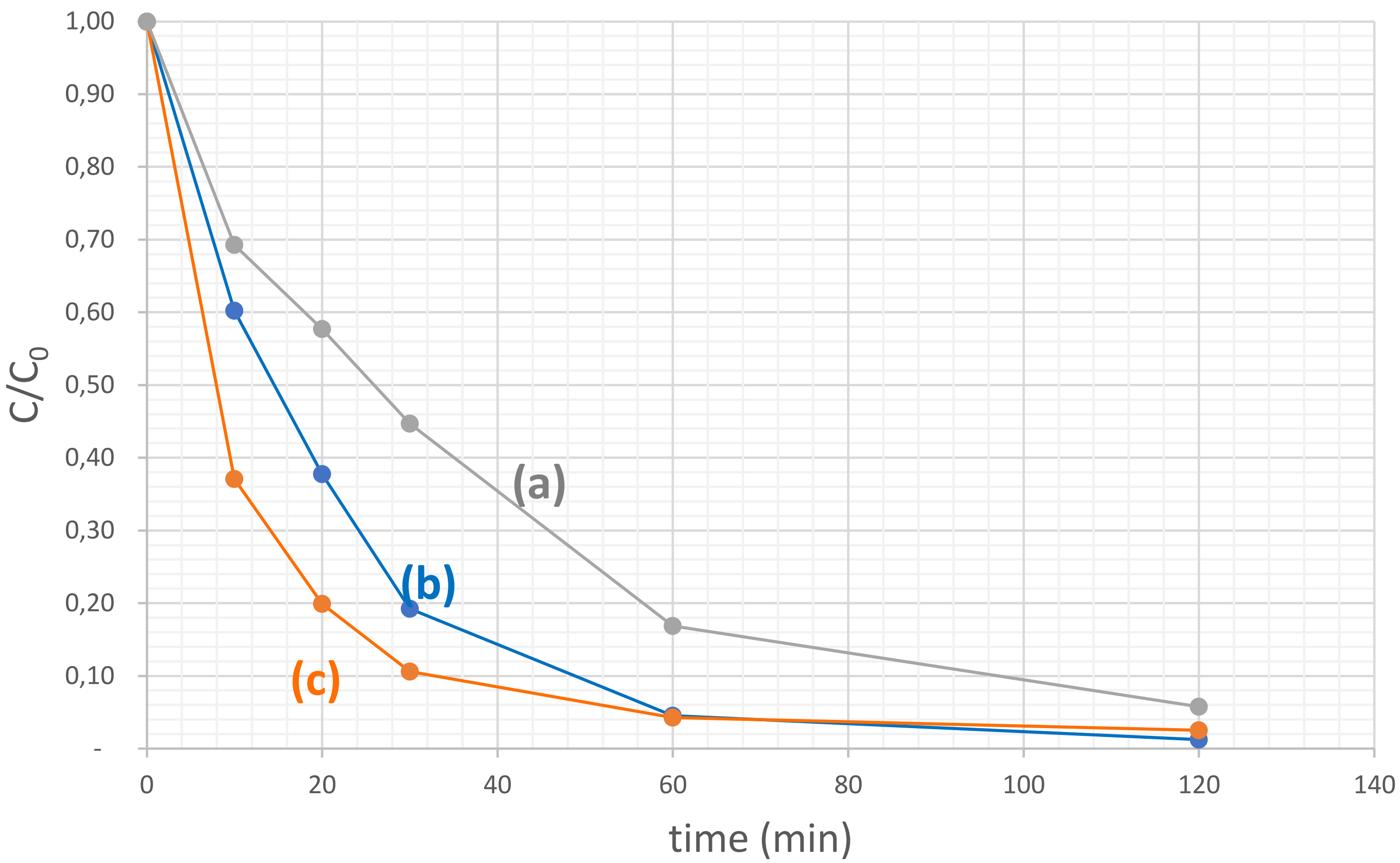
Spectrophotometer
Thermo Scientific
Model Genesys 10S UV-Vis

Fig. 5. Spectrophotometer.

Pale-Yellow Collor

Fig. 6. AMX determination.

Results and Discussion



$$O_3 + OH^- \rightarrow HO_2^- + O_2$$

$$HO_2^- + O_3 \rightarrow {}^{\bullet}O_2^- + HO_2^{\bullet}$$

$$HO_2^{\bullet} \rightarrow {}^{\bullet}O_2^- + H^+$$

$$^{\bullet}O_2^- + O_3 \rightarrow {}^{\bullet}O_3^- + O_2$$

$$^{\bullet}O_3^- + H_2O \rightarrow HO^{\bullet} + O_2 + OH^-$$

Fig. 7. Normalized AMX concentration abatement kinetics for ozonation of pharmaceutical formulation effluent at pH=13 (a), pH=9 (b), and pH=11 (c).

Results and Discussion

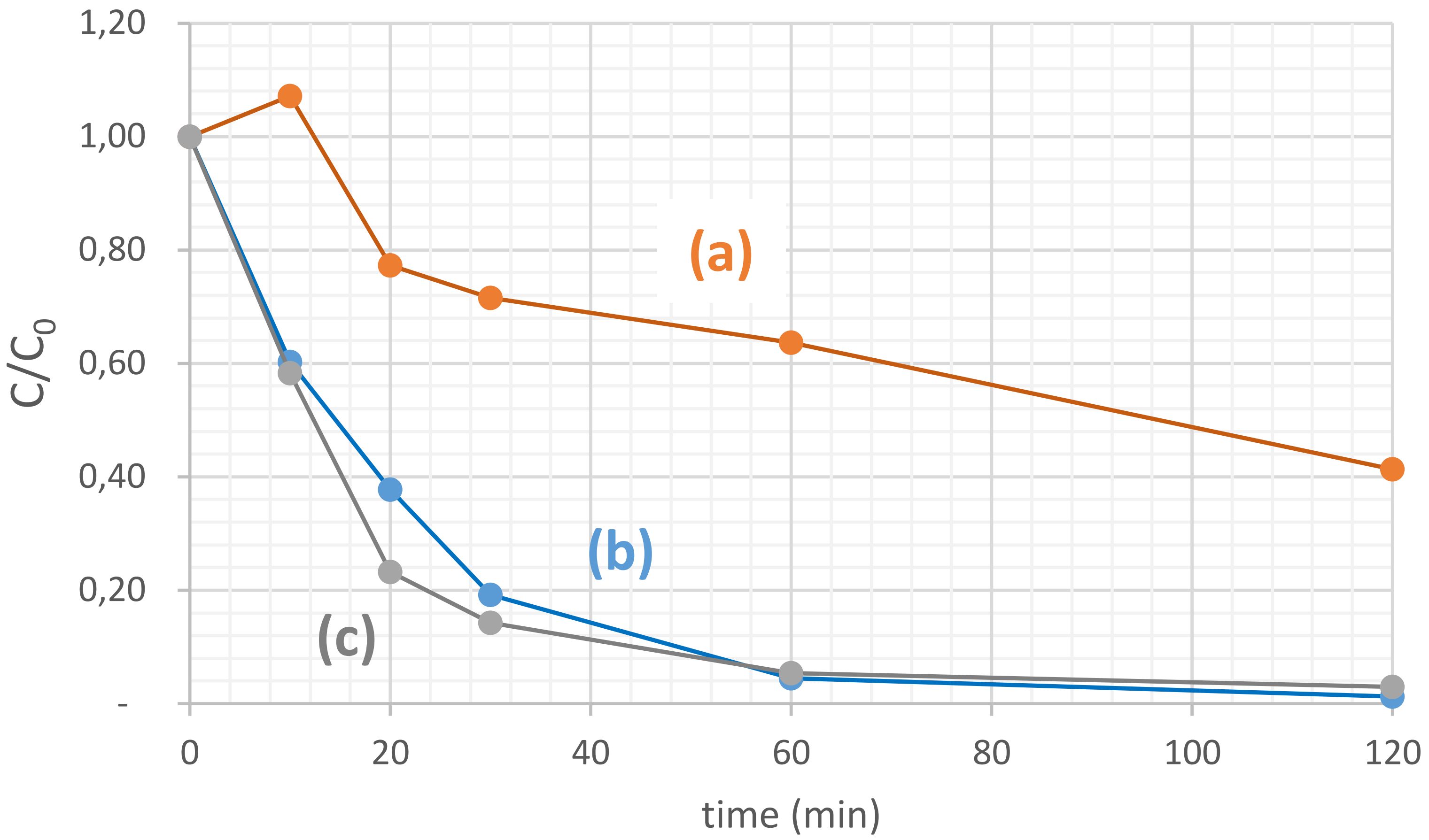


Fig. 8. Normalized AMX concentration abatement kinetics for ozonation of pharmaceutical formulation effluent at pH=9: (a) O_3 at 8.13 mg min^{-1} + UV; (b) O_3 at 15 mg min^{-1}; and (c) O_3 at 15 mg min^{-1} + UV.

Results and Discussion

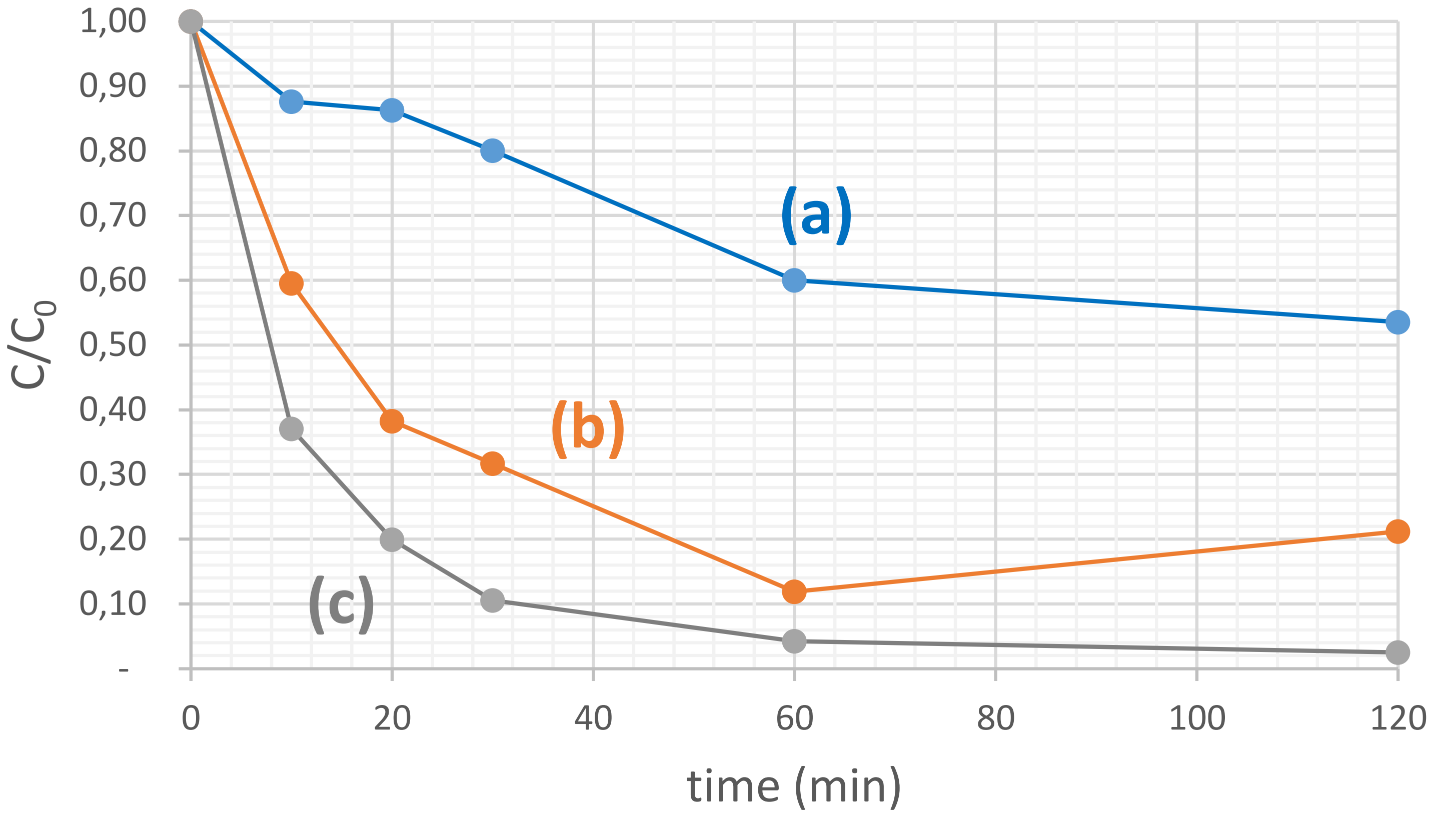


Fig. 9. Normalized AMX concentration abatement kinetics for ozonation of pharmaceutical formulation effluent at pH=11: (a) O_3 at 8.13 mg min^{-1} + UV; (b) O_3 at 15 mg min^{-1} + UV; and (c) O_3 at 15 mg min^{-1}.

Results and Discussion

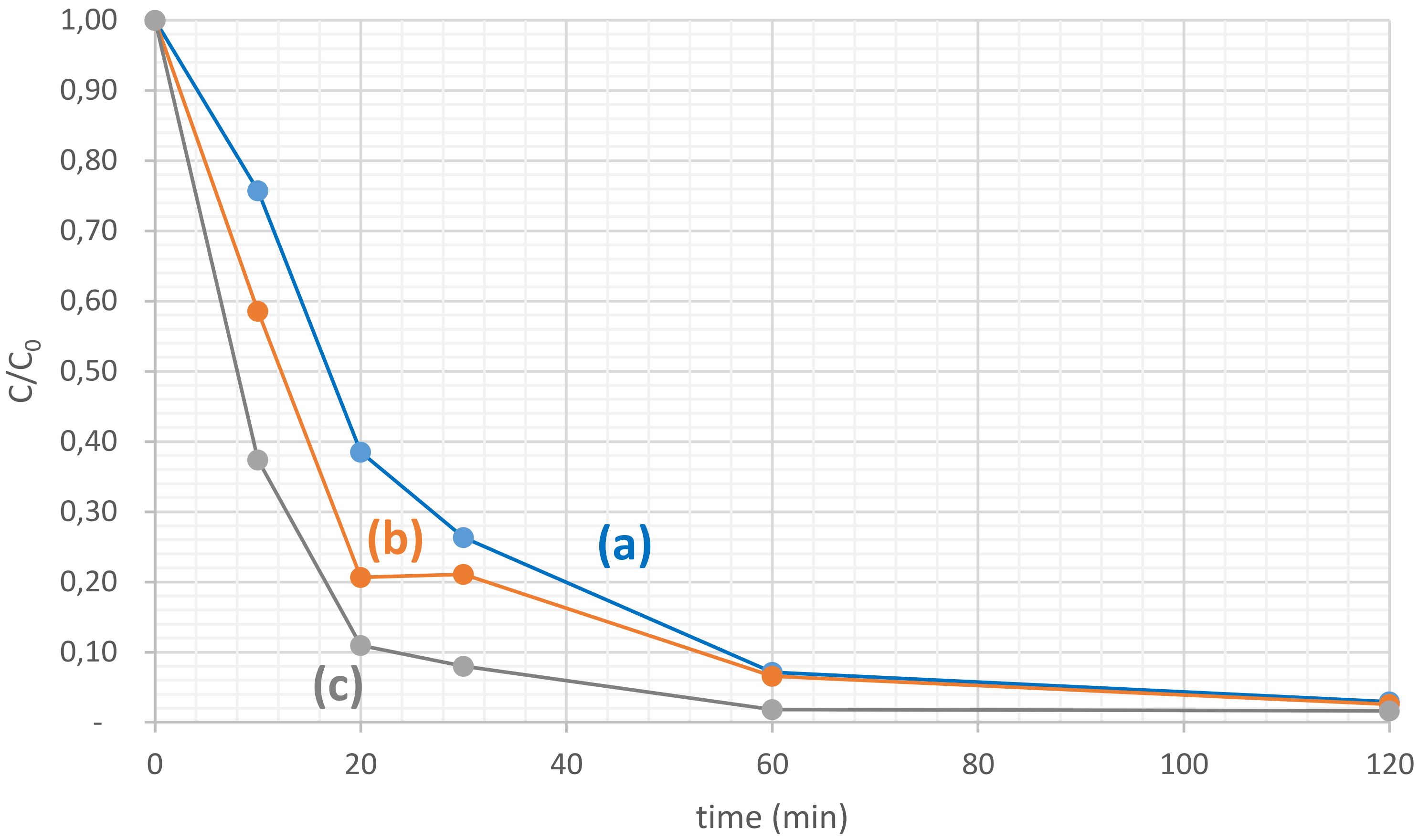


Fig. 10. Normalized AMX concentration abatement kinetics for ozonation of pharmaceutical formulation effluent at pH=13: (a) O_3 at 15 mg min^{-1}; (b) O_3 at 15 mg min^{-1} + UV; and (c) O_3 at 25 mg min^{-1} + UV.

Results and Discussion

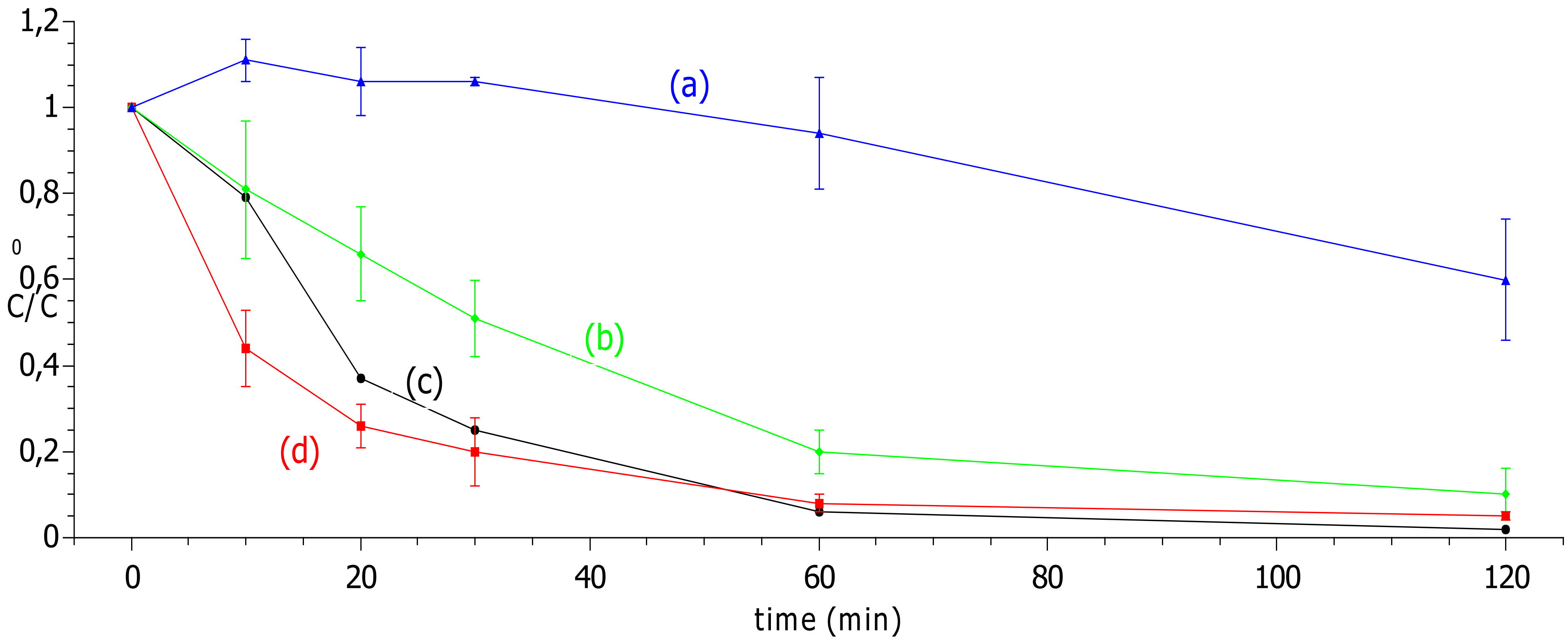


Fig. 11. Normalized AMX concentration abatement kinetics for ozonation of pharmaceutical formulation effluent at pH=13. (a) blank experiment with O_2 injection at 0.5 L min^{-1}; (b) ozonation process; (c) ozonation process with adition of 2-propanol 0.1 mol L^{-1}; (d) ozonation process with adition of 1-propanol 0.1 mol L^{-1}.

Conclusions

- Expiry AMX pharmaceutical effluent was successfully degraded by ozone technology in high pH value.

- The basic pH medium provided higher AMX solubility, which facilitates mass transfer in a direct/indirect ozone reaction.

- The ozonation semi-batch process was effective for one hour in all experimental conditions, producing recalcitrant transformation products to the oxidative process.

- UV light in hydroxyl radicals production is marginal. On the other hand, the ozone dose is the most important parameter so far.

Acknowledgments

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FAPESP

SÃO PAULO RESEARCH FOUNDATION

References

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SALEH, G.A.. Two selective spectrophotometric methods for the determination of amoxicillin and cefadroxil. The Analyst, v. 121, n. 5, p.641-645, 1996. Royal Society of Chemistry (RSC).

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THANKS FOR THE ATTENTION,

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