

Solar-Activated Chlorine Process for Efficient Degradation of Brominated Aromatic Pollutants

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INTRODUCTION

2,4,6-Tribromophenol (TBP) and its transformation product, 2,4,6-tribromoanisole (TBA), are characteristic brominated aromatic compounds frequently detected in various aquatic systems [1,2]. TBP and TBA have odour threshold concentrations (OTC) of 600 and 0.008-10 ng L⁻¹, respectively [3]. The simulated solar light(SSL)/chlorine process is a representative advanced oxidation process (AOP) that has been studied in recent years due to its potential applicability compared with other methods in this category. The aim of the present study is to investigate alternative methods for the removal of both compounds from different aqueous matrices.

RESULTS

- ❖ High removal percentages were observed for both compounds.
- ❖ Enhanced degradation rates of the SSL/chlorine process, in comparison to the chlorination and SSL photolysis.
- ❖ No statistically significant increase of the micronucleus frequencies in human lymphocytes was observed.
- ❖ An increase in the inhibition rate towards *Chlorococcum* sp. was observed at the early stages of the treatment, but this effect was attenuated after prolonged exposure.

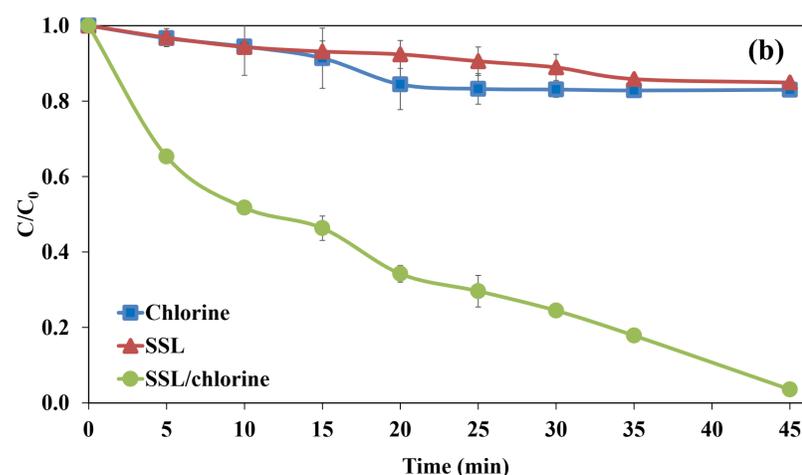
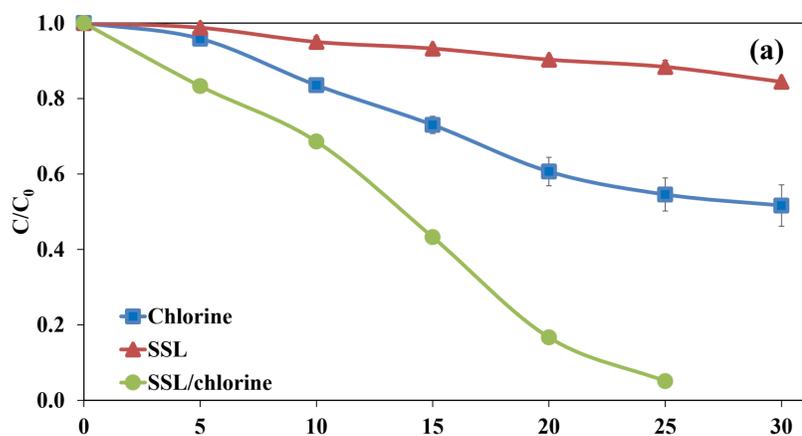


Figure 1: Degradation kinetics a) TBP and b) TBA mixture in ultrapure water, under chlorination, simulated solar light (SSL) photolysis and SSL/chlorination. [TBP]₀=[TBA]₀=[Cl]₀=1 mg L⁻¹

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METHODS

- Initial solutions containing 1 mg L⁻¹ of each target compound and chlorine were prepared and irradiated with SSL.
- Cytokinesis-block micronucleus assay (CBMN) was applied to study the potential cytotoxic and genotoxic effects throughout the SSL/chlorine process towards human cells.
- The potential toxic effects of the treated samples were studied in the freshwater microalgae *Chlorococcum* sp., using the Algae Growth Inhibition Test.

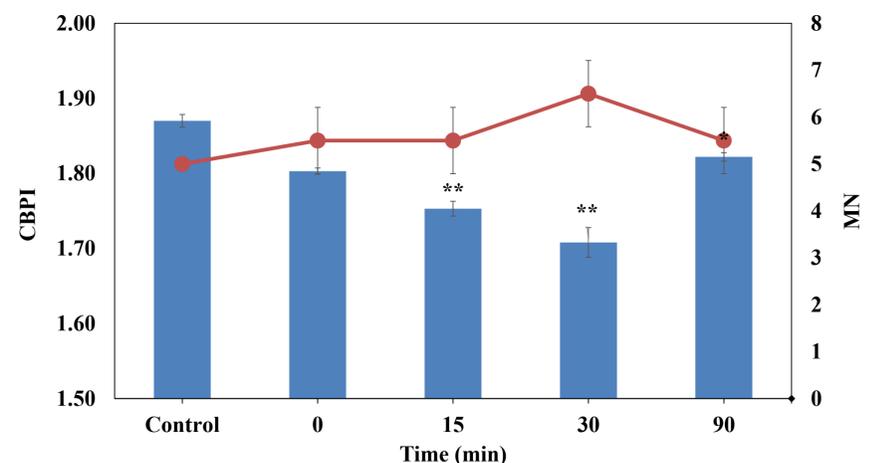


Figure 2: Mean values of CBPI and MN in human lymphocytes exposed to different treated samples of the SSL/chlorine process. **, **Significant difference compared to control at $p < 0.05$ and < 0.001 , respectively.

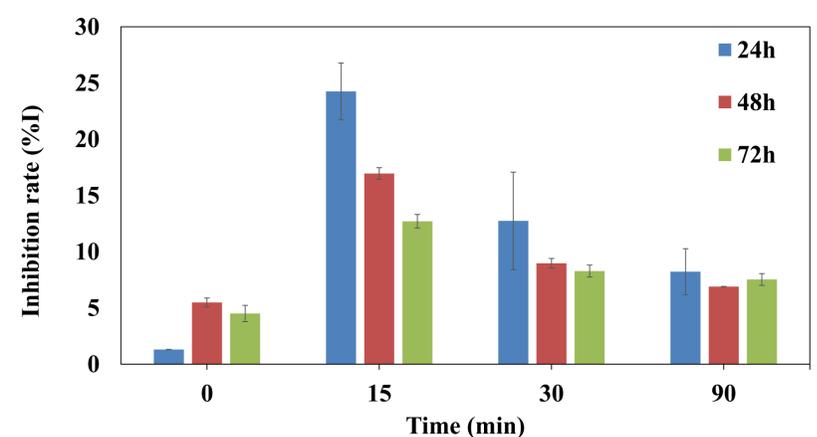


Figure 3: Inhibition rate of *Chlorococcum* sp. after 24, 48 and 72 h exposure to different treated samples of the SSL/chlorine process.

CONCLUSIONS

- ✓ SSL/chlorine process was found to be an effective method for the removal of TBP and TBA mixture.
- ✓ No evidence of genotoxic effects were present throughout the process.
- ✓ While the microalgae were affected during the early stages of exposure, their adaptive capacity allowed them to overcome this effect over time.

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