NATIONAL INSTITUTE OF RESEARCH AND DEVELOPMENT FOR INDUSTRIAL ECOLOGY

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EXCELLENCE IN RESEARCH AND ENVIRONMENTAL SERVICES

INTERNATIONAL SYMPOSIUM „THE ENVIRONMENT AND THE INDUSTRY" SIMI 2020

SIMULATION OF BIOCIDE EFFECT ON BACTERIAL MODEL IN AQUATIC SYSTEMS

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Introduction

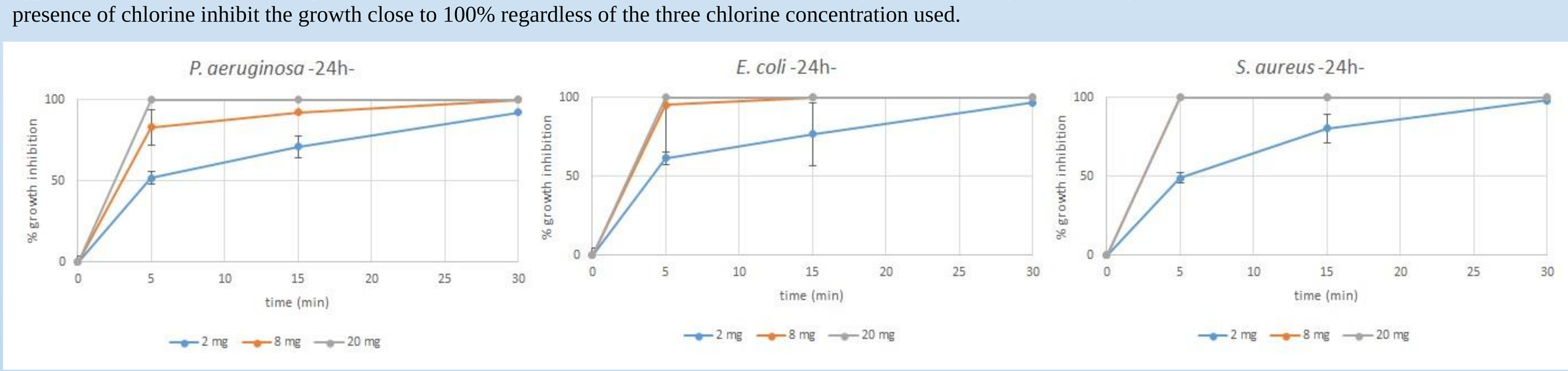
In recent years, the increasing use of biocides has lead to concerns about development and emergence of biocide resistant microorganisms, due to their adaptation mechanisms. Various biocide technologies have been used successfully in water treatment applications, but their constantly increased production and excessive usage had turned to generate considerable environmental and economic impact. Water is an essential element to preserve life but, at the same time, it is a perfect environment to spread harmful chemical compounds and pathogens. The aquatic systems could be the source of pathogenic microorganisms responsible for an epidemiological risk such as *Escherichia coli, Pseudomonas aeruginosa* and *Staphylococcus aureus*. The chemical agencies has approved biocides such as chlorine based product or active oxygen based on their different molecular targets and efficiency against microorganisms.
This study described the differences in the response of tested microorganisms to biocides chlorine based product or active oxygen at various concentrations (2 ÷ 50 mg/L) and incubation time from 5 minutes and up to 30 minutes.

Materials and Methods

The *in vitro* biocidal effect of two types of antimicrobial products, chlorine and active oxygen based was assessed using the standard method EN 1276 on *Ps. aeruginosa* ATCC 15442, *E. coli* ATCC 10536 and *S. aureus* ATCC 6538. According to the standard technique, the biocides effects were tested at three different contact times (5 min, 15 min and 30 min) and three different concentrations: 2 mg/L, 8 mg/L and 20 mg/L for chlorine and 5 mg/L, 20 mg/L and 50 mg/L for active oxygen. The bacterial viability was analyzed, after the incubation with biocides, by counting the colony forming units (CFU) per mL developed after 24 hours of incubation at 37°C with a help of a Scan 500 system (Interscience, FR).

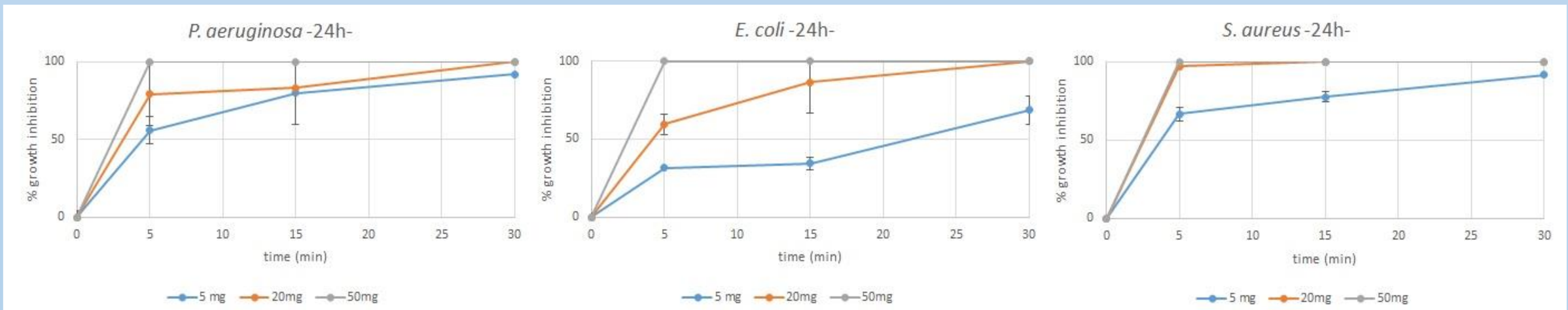
Results and Discussion

The biocide toxic effect of chlorine (figure 1) was very potent on all bacterial strains even after 5 min incubation where 2 mg/L chlorine decreased the bacterial growth up to 50%. The concentration of 8 mg/L chlorine decreased *Ps. aeruginosa* density up to 70% after 5 minutes and up to 90% after 30 minutes. The same growth inhibition pattern applied to *S. aureus* and *E. coli* up to 100% inhibition after 15 minutes bacterial incubation in presence of 8 mg/L and 20 mg/L chlorine. 30min bacterial incubation in the presence of chlorine inhibit the growth close to 100% regardless of the three chlorine concentration used.



Growth inhibition of bacterial density under effect of three different concentrations and contact time of a chlorine based product for disinfection

The density of *Ps. aeruginosa* indicated a constant decrease of bacterial viability by about 50% at the concentration of 5 mg/L active oxygen (figure 2) up to 70% at 20 mg/L. *E. coli* seemed to be less sensitive to oxygen at the 5 mg/L up to 15 minutes.



Growth inhibition of bacterial density under effect of three different concentrations and contact time of active oxygen based product for disinfection

Conclusions

- The bactericidal effect of active oxygen was very potent on *S. aureus* but the action over a long time of exposure can obtained in the application of minim concentration (5 mg/L).
- The results indicated that both chlorine and active oxygen biocides at middle range concentrations (7-20 mg/L) had a bactericidal affect after contact.
- Bacterial densities decreased indirect proportion with the increase of the exposure time to biocides.
- A higher biocide concentration than middle (8 mg/mL for chlorine product and 20 mg/mL for active oxygen) on induced a rapid inhibitory effect in a short period.

ACKNOWLEDGEMENTS. This work was realized with the support of Nucleu Program, Project no.PN 18-05 02 01.