

## Modelling chlorine decay in reclaimed water distribution systems

### Summary

The increasing water needs for multiple applications and the decreasing availability of water, aggravated by the effects of climate change, with episodic of water scarcity and droughts and unforeseen events of intense rainfalls, urge the use of alternative water sources to guarantee the preservation of water and ecosystems, and to enable the sustainability of economic and social activities. Wastewater is a renewable resource from which water, nutrients and energy can be recovered, following the circular economy concept, and promoting the transition of wastewater treatment plants (WWTP) into water resource recovery facilities (WRRF). The use of treated wastewater - reclaimed water - has been implemented and regulated around the world. Nevertheless, concerns were raised about the requirements to ensure suitable disinfection of reclaimed water from the wastewater treatment plant to the point of application. Based on studies on the topic of drinking water chlorination, research was carried out on the maintenance of a chlorine residual in reclaimed water, to promote reclaimed water quality control and the efficient operation of reclaimed water distribution systems.

A chlorine decay model for reclaimed water was developed, incorporating properties related to the inorganic and organic matrix, where monochloramine auto-decomposition reactions were coupled to a parallel second-order mechanism, characterized by the reactions of monochloramine with two fractions of organic matter: those reacting faster and slower with monochloramine. The correlation of chlorine decay models' parameters with reclaimed water quality parameters was studied, and a water-quality based model was developed to predict chlorine decay. A methodology for the implementation of a chlorine decay model in reclaimed water distribution systems, including chlorine wall decay reactions, was developed and tested in real systems.

The results demonstrate the applicability and reliability of the hydraulic and water quality models, contributing to the prediction and control of residual disinfectant requirements in reclaimed water distribution systems.

### Keywords

Reclaimed water distribution systems, chlorine decay modelling, monochloramine, reclaimed water quality, EPANET-MSX.



Reclaimed water – an alternative water resource identified by purple color.



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