Characterization of Scavenging Potential in Diverse Water Sources for Advanced Oxidation Processes

External Study Project with Xylem Water Solutions GmbH

About us

Xylem is a global water technology provider helping our customers solve the world's toughest water challenges across utility, industrial, commercial, and residential markets worldwide.

Over the last 100+ years, our unique combination of innovative products and services, proven expertise, and unmatched customer support have been helping to create a more water-secure and resilient world.

Across the water cycle, our innovative solutions use less energy, reduce operating expenses, and support sustainability efforts. By working together, we can ensure water is accessible, affordable, and safe for all.

Topic

Advanced oxidation processes (AOPs) are essential treatment steps in water reuse applications or for the removal of Trace Organic Chemicals (TOrCs) in general. Common AOPs include the irradiation of hydrogen peroxide (H_2O_2) or hypochlorous acid (HOCl) with UV light to generate hydroxyl (•OH) and/or chlorine (•Cl) radicals. These radicals possess high oxidative power and react rapidly with compounds present in the water. While effective in degrading TOrCs, these radicals also react unintentionally with other constituents in the water matrix—such as dissolved organic carbon (DOC), bicarbonate (HCO_3^-), bromide (Br^-), and nitrite (NO_2^-)—in a phenomenon known as scavenging. Although the reaction rates of radicals with HCO_3^-, Br^-, and NO_2^- are well-characterized, the reaction with DOC is unique to each water source and, depending on its concentration, can represent the major scavenging fraction.

Understanding the scavenging capacity is crucial when designing new AOP systems. For existing water treatment plants being upgraded with AOP systems, the scavenging capacity can be evaluated through laboratory testing. However, for new treatment facilities where feed water is not yet available, AOP system design must rely on modeling.

The aim of this study is to collect a range of water samples and assess their scavenging capacity using an established methylene blue test for hydroxyl radicals. Additionally, the literature should be reviewed to identify a suitable test for quantifying the scavenging potential of chlorine radicals. If a viable method is found, it shall be applied as well. The results of the scavenging tests will then be compared to an existing chemical model.

Tasks

- Conduct a literature review on radical scavenging by various water matrix components and available scavenging test methods
- Collect feedwater samples of varying quality (e.g., wastewater treatment plant effluent, surface water, RO permeate, groundwater)
- Evaluate the scavenging potential of the collected waters using a collimated beam apparatus
- Compare the experimental scavenging results with a numerical model

Requirements

- Urban Water Engineering as field of study
- High interest and basic knowledge of water treatment and water reuse applications
- Lecture of advanced water treatment and hydrochemistry lab

Time range

The work is designed for a period of 6 months and should be started as soon as possible (beginning of July 2025 the latest)

Contact

Dr. Philipp Sperle
Senior Pilot Process Engineer
Xylem Water Solutions Herford GmbH
Boschstr. 4-14, 32051 Herford, Germany
mobile: +49 174 200 69 80
mail: philipp.sperle@xylem.com