Development of combined pulsed corona discharge plasma with peroxocompounds oxidation technology for efficient application in different aqueous media matrices

Summary

The doctoral study aims to reveal chemical reaction kinetics, reaction products and, thus, reaction paths in respect of contaminants of emerging concern (CECs) in various matrices, such as water and waste activated sludge, treated with gas-phase pulsed corona discharge plasma combined with peroxocompounds oxidation processes. Accordingly, oxidation reaction pathways of the selected CECs to be established and characterized from the kinetic, stoichiometry and product safety standpoints in application of plasma-peroxocompounds oxidation systems. The novelty of study is based on the use of the most energetically advanced oxidation technology in a very promising combination with hydrogen peroxide and persulfate.

Research field:	Chemical, materials and energy technology
Supervisors:	Niina Dulova Sergei Preis
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between June 01, 2020 00:00 and July 03, 2020 23:59 (Europe/Zurich)

Description

The goal of this doctoral study is the development of combined pulsed corona discharge (PCD) plasma with peroxocompounds oxidation technology for efficient application in different matrices, such as water and waste activated sludge (WAS). While biological wastewater treatment is inefficient in degradation of the majority of contaminants of emerging concern (CECs), and adsorption simply transfers the pollutants to solid phase in a more concentrated form, oxidation, especially the advanced oxidation technologies (AOTs) are able to effectively degrade CECs, such as pharmaceuticals and personal care products. However, the main drawback of many AOTs is high consumption of energy and materials, and, as a consequence, high treatment cost. In turn, the plasma method provides a cost-effective alternative to most oxidation methods, and in combination with peroxocompounds can provide excellent treatment efficacy; therefore, fundamental research is required to establish the performance of the process and the limitations of efficiency with respect to contaminants of emerging concern (CECs) in different matrices.

The doctoral study aims to reveal chemical reaction kinetics, reaction products and, thus, reaction paths in respect of CECs in various matrices, such as water and WAS, treated with gas-phase PCD plasma combined with peroxocompounds oxidation processes. A tentative list of CECs to be studied includes pharmaceuticals and other personal care products frequently detected in local and European water streams and WAS, such as anti-inflammatory, antibiotic, and hormonal drugs. Thus, oxidation reaction pathways of the selected CECs to be established and characterized from the kinetic, stoichiometry and product safety standpoints in application of plasma-peroxocompounds oxidation systems.

This research project will make a highly significant contribution to solving one of the most urgent problems facing mankind, the accumulation of highly potent, toxic, carcinogenic, endocrine disrupting non-biodegradable compounds in the environment, by laying the foundation for an affordable and effective technological response, the energy-efficient plasma treatment in combination with peroxycompounds oxidation. The novelty of study is based on the use of the most energetically advanced AOT in a very promising combination with hydrogen peroxide and persulfate. The research results in obvious collection of data and conclusions resolve possible doubts in the method's upscaling.

Responsibilities and tasks

The applicant is responsible for planning and performing experimental and analytical work, analyzing data and writing scientific articles independently and with the help of co-authors.

Qualifications

MSc in Environmental Technology/Engineering, Chemical Engineering or Materials Technology

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The applicants should fulfill the following requirements:

- Language skills: English (speaking, reading and writing: good/excellent), Estonian (beneficial)
- Previous experience with AOTs application (highly beneficial)

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