PhD Candidate Profile

Name:
Can Burak ÖZKAL

Research Group:
Nanotechnology Research group

Research Centre:

Department/School(s):
Environmental Engineering / Namık Kemal University

College:
Kocaeli University / İstanbul Technical University

Supervisor(s):
Prof. Dr. Süreyya MERİÇ PAGANO

Funding body:
N/A

Area (field) of study:
Thin-film Photocatalysis

Thesis Title:
Modelling Antibiotics and Escherichia Coli removal by Thin Film Photocatalysis from Urban Wastewater Treatment Plant Effluents

Abstract:
Recent studies show that observed concentrations for pollutants that partially or non-treated forms of pharmaceuticals and related micropollutants that are in partially or non-treated forms, at receiving environmental and aquatic bodies are of primary concern and give rise to severe pollution in river, lake, sea and estuary systems. Most of the studies on wastewater and surface water re-use, are built on water quality assesment based on conventional parameters, which are determinants to better define treatment needs. Due to low rates of bio-transformation of antibiotics in biological treatment advanced oxidation processes have become widespread for the effluent quality improvement. Compatible to be run with solar energy and and a promising green energy application, there is growing interest on photocatalysis processes. Nanoparticle

technology capable of utilizing different mechanisms to avoid/prevent microbial activity mainly prevail resistant bacteria via multiple mechanism that run concurrently. Research on natural and wastewater flows evidently highlight the AOPs are capable of efficient and instant removal/reduction of recalitrant persistent organic pollutants and micropollutants. In this study, based on evaluation in the Tekirdag preliminary assesment study data, antibiotic groups mainly known to originate from urban and hospital usage and reaching the receiving environment are pre-determined. Defining and optimizing the removal efficieny of the related resistance developing bacteria experimentally will be the priority targets of the study. Toxiciology assesment will be carried out in this way correlating toxicology behaviour of the process effluent with the transformation by-products formed during the process will be easier and more significant.

Principally for the immobilized system it is defined as a priority to determine a suitable ratio between catalyst surface area and total reactor volume. Within this scope, proper design of a reactor/system is critical since the interaction between the catalyst, target pollutant and light will be directly influenced by flow regime and reactor operation conditions

Moreover the longevity and non easily deactivating surface photocatalytic activities make immobilized systems superior compared to suspended system photocatalysis applications To ensure that larger scale applications/reactors become widespread, there are many aspects of the study that are under investigation, but inevitable among all is mass transfer limitations and stability of the film on the applied surface. With intent to actualize development and maintenance of a continous flow photocatalysis system, factors effective on process efficiency and continuity of the photocatalytic activity (photocatalyst inactivation) (depending on the mode of catalyst existence in the system- heterogenous suspended system or immobilized on surface) must be considered and investigated in accordance with the requirements of the process in subject

To that end, as well as advances in the material production and development (in line with the objective of obtaining photocatalysts with higher activity) development of mathematical equations and kinetic models defining the process with reactions and effective paremeters (catalyst, flow conditions, light, mass transfer limitations) is a big necessity and must be considered for larger scale applications become possible

Unlike the heterogenous (suspended system) system configurations, that were under scope of many scientific groups or individuals with the aspects of obtaining kinetics, building mathematical empirical models or model fitting studies for varying target pollutants, thin-film photocatalysis systems are reported to have promising potential to be run efficiently under varying conditions and target pollutants, with no substantial necessity of replacement or a total regeneration reported so far. Thin-film photocatalysis will be mathematically modeled and the model will be supported with mechanistical equations that will make the use of final model as a guideline for larger scale application design.It will be a pioonering approach in the field is to build models that are valid in a wide range of operational conditions and type of target pollutants.

Collaborations:

University of Patras , COST MP1106 – Short Term Scientific Misson between 21th September – 20 October 2015, Chemical Engineering Department under advisory of Prof.Dr. Dionissios MANTZAVINOS

Publications:

Saraçoğlu G. Göçmez, S., Özkal, C.B. Ekmekyapar, F., Meriç, S. (2014) “Occurence of Antibiotics and Antibiotic Resistant Bacteria: A Risk Assessment Study in Tekirdağ City, Turkey”, Global Journal on Advances Pure and Applied Sciences, v.4.

Özkal, C.B., Koruyucu, A., Meriç, S. (2015) "pH and Incident Photon Flux Dependency of Ampiciline Removal in A Suspended Photocatalytic System", Desalination and Water Treatment. (under review).

Özkal, C.B., Meriç, S. (2015) "Antibiyotik ve antibiyotiklere dirençli bakterilerin fotokataliz prosesi ile gideriminin değerlendirilmesi" (a review study) Nigde Üniversitesi, Mühendislik Bilimleri Dergisi, (in Turkish, under review)

Meriç, S., Özkal, C.B. (2015) "Escherichia coli in Urban Water", Urban Water Reuse – Handbook, Chapter VII, Cat/ISBN: K22608 / 9781482229141

Presentations:

Saracoglu, G., Meriç, S., Ekmekyapar, F., Özkal C.B., Göçmez, S., Koruyucu, A., (2015) "Monitoring of Antibiotics in Urban Wastewater in Tekirdag City: a comparison with predicted environmental concentrations", ICOCEE Symposium, International Conference on Civil and Environmental Engineering, Nevsehir, Turkey.

Lofrano, G., Özkal, C.B., Carotenuto, M., Meriç, S., (2014) "Photocatalytic Removal of Vancomycin B by TiO2 and ZnO Based Suspended System: Toxicity Based Assesment and Evaluation of By-product Formation" International Symposium, Recycle & Reuse, 2014 June.

Özkal, C.B., Meriç, S., Mantzavinos, D., (2015) "Optimization of TTIP thin-films for removal of methylene blue and ampicilline and inactivation of E. coli bacteria" 4th European Conference on Environmental Applications of Advanced Oxidation Processes, October 2015. (Extended abstract accepted for oral presentation)

Meriç, S., Rizzo, L., Özkal, C.B., Marotta, M., (2015) "An ecotoxicity based lab-scale optimization for removal of three antibiotics in a suspended photocatalytic reactor", 4th European Conference on Environmental Applications of Advanced Oxidation Processes, October 2015 (Extended abstract accepted for poster presentation)

Özkal, C.B., Kizek, O., Meriç, S. (2014) Optimization of Homogenous and Thin-film Photocatalytic Degradation of Ampicillin by Means of NOM Effect and Toxicity, ECOstp2014 ECO Technologies for Wastewater Treatment. (printed in abstracts book)