Zoulkifli Amadou Yacouba

Supervisors: Stéphan Brosillon, Julie Mendret, Geoffroy Lesage

Zero-discharge advanced treatment for a safe and sustainable urban wastewater reuse

Nowadays, water scarcity and quality are big challenges facing humanity in many places around the world. To solve this problem, municipal wastewater (WW) is thus considered to be an alternative water source for various applications after proper treatment. Nonetheless, urban WWs are increasingly contaminated with organic micropollutants. In addition, human and veterinary antibiotics have been found widespread in different environmental compartments due to their persistence and low degradability. As a consequence, the presence of antibiotic resistance genes (ARGs) is increasing in the environment. These toxic compounds have become a major issue for the Water Utilities (REACH 2006, WFD 2000 and 2012) and legislations in European Union in the coming years will be tightened with regard to OMPS in municipal WW and to their discharge. These evolutions are driving the WW treatment to come up with advanced technologies.

In this view, membrane processes are widely used but they are only a separation step, they must be coupled with techniques for the efficient destruction of pollutants and then provide new hybrid processes as a posttreatment step. With this aim in mind, ozonation (O_3) and peroxone processes (O_3 + H_2O_2) are also investigated, as they generate highly active species, hydroxyl radicals. Coupling of membrane processes and Advanced Oxydation Processes (AOP) could thus be a promising treatment for WW reuse.

The main scientific objectives of this study are to monitor the fate of six priority and representative substances in a new treatment process coupling membrane bioreactor (MBR), nanofiltration (NF) using organic and innovative inorganic material and ozonation (O_3) for a safe and affordable WW reuse, to propose the best design of such combined process and to verify the processes efficiency using a smart combination of analytical techniques, toxicity assessments within an holistic evaluation.