MSc. Thesis/ Internship

Developing the next generation of UV-based advanced oxidation process using a dual wavelength approach: UV_{254nm}/H_2O_2 and VUV_{185nm}/H_2O

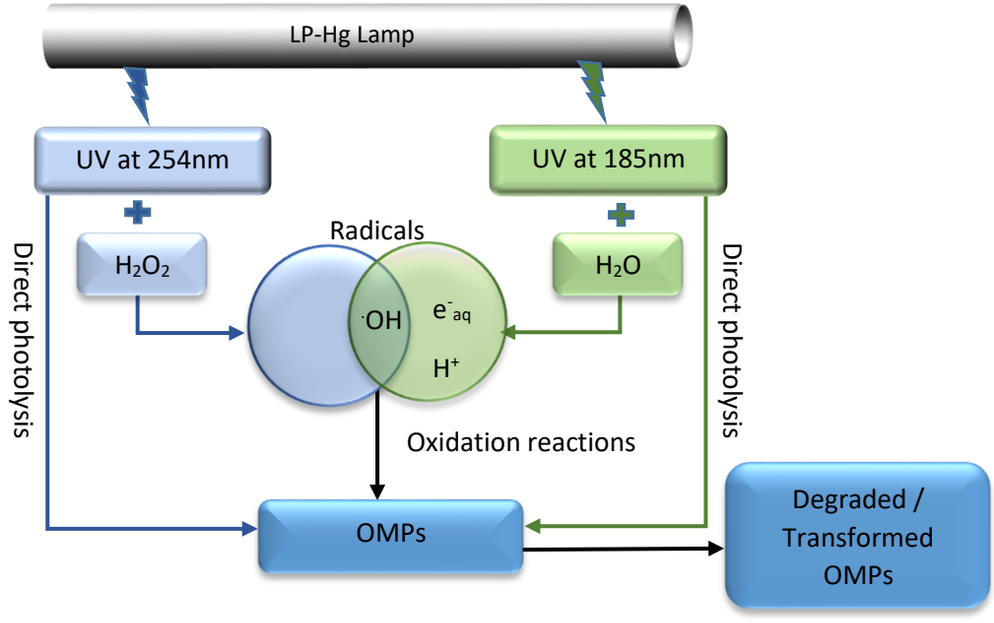
Areas of research:	Drinking Water treatment; Chemical reaction engineering;(Photo)chemistry
Duration and allowance:	min.3 months (start April 2019) and 350€/month

Background

Organic micro-pollutants (OMP's) are simply the chemical residuals of the pharmaceuticals, pesticides and the personal care products that we use on a daily basis. They are toxic, persistent and bio accumulative and thus may pose a negative impact on both aquatic and human life. Such OMPs are now increasingly found in the water sources and we are committed to reduce the health impact it may cause. One of the most popular approach is to have an Advanced Oxidation Process (AOP) so as to transform these OMPs to less harmful compounds. AOPs are water treatment processes that uses the hydroxyl radicals ($^{\cdot}OH$), one of the strongest, highly reactive and non-selective oxidant, for oxidation (and thus transformation or degradation) of OMPs. One of the most widely used AOP being the UV_{254nm}/H_2O_2 where the UV radiation at 254nm (UV_{254nm}) photo-chemically splits the hydrogen peroxide (H_2O_2) molecule to produce $^{\cdot}OH$.

Project description

The UV_{254nm}/H_2O_2 process requires H_2O_2 to be added as an external oxidant, for the production of $^{\cdot}OH$, complicating the logistics of the entire process and increasing the cost of the process since any unused H_2O_2 has to be quenched out of the system at the end of the process. Therefore, in this project, we try to combine the Vacuum UV radiation at 185nm (VUV_{185nm}) that can directly split the H_2O molecule with the UV_{254nm}/H_2O_2 process (see the graphical abstract) in an effort to reduce the amount of H_2O_2 used. As an added advantage the VUV_{185nm}/H_2O produces more like the solvated electrons (e^-_{aq}) and the protons (H^+) eventually helping to degrade a wider range of OMPs. Also, since the lamp that produces UV_{254nm} is also capable to produce VUV_{185nm}, no extra energy input is needed to realize this combination of processes.



Graphical abstract of the process

Objective of the MSc. Thesis/Internship

Your part in this project would be to conduct photochemical degradation experiments using this dual wavelength using a collimated beam setup (that houses the lamp producing the radiation) on selected micro-pollutants and study the effect of the following on the degradation kinetics:

1. pH
2. Temperature
3. Scavenger (organic matrix)
4. Inorganic matrix

Requirements

1. Motivated, enthusiastic, team-spirted and independent
2. Experience in laboratory
3. Proficiency in English

Application

Did this project instil interest in you? Do you want to know more to make a decision? Or do you want to apply right away? Contact me at nimmy.kovoor@wetsus.nl (to apply, please attach a motivation letter of 1 page and a CV of not more than 2 pages). To know more about the topic, please go through the reference papers.

References

1. Gonzalez, M., Oliveros, E., Worner, M. and Braun, A. (2004). Vacuum-ultraviolet photolysis of aqueous reaction systems. Journal of Photochemistry and Photobiology C: Photochemistry Reviews, 5(3), pp.225-246.
2. Zoschke, K., Börnick, H. and Worch, E. (2014). Vacuum-UV radiation at 185 nm in water treatment – A review. *Water Research*, 52, pp.131-145.