

CEE 595AG Seminar Environmental Engineering and Science Program Seminar

Destruction of Cyanotoxins in Water Using Homogeneous and Heterogeneous Advanced Oxidation Technologies and Nanotechnologies

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The enormous diversity of toxic and organic pollutants of different chemical composition eliminates the possibility of using a universal treatment method and has led to the development of special treatment methods for water decontamination. The so-called Advanced Oxidation Technologies (AOTs) and Nanotechnologies (AONs) are among the most promising emerging chemical oxidation processes and are anticipated to play a crucial role in water treatment as stand-alone processes or in combination with conventional technologies. Among heterogeneous AONs, TiO₂ photocatalysis is of particular interest because of its environmentally friendly features. TiO₂ photocatalysis is characterized by a specific oxidation pathway, which includes the formation of hydroxyl radicals ($\bullet\text{OH}$) and other oxidizing species such as the superoxide anion radical. The hydroxyl radical is extremely reactive and readily attacks most organic contaminants. As a result, the organic contaminants are sequentially transformed to simpler organic molecules that are eventually mineralized to CO₂, H₂O, and mineral species (i.e., chloride, nitrate). In general, due to rapid hydroxyl-radical-based oxidation reactions, AONs are characterized by high reaction rates and short treatment times. Among homogeneous AOTs, UV/H₂O₂ processes have recently experienced tremendous growth in both commercial and research applications because of their applicability and effectiveness. UV/H₂O₂, which are also based on the generation of hydroxyl radicals ($\bullet\text{OH}$) radicals, are currently used in various water treatment trains as effective technologies to destroy micro-pollutants and other emerging contaminants, such as pharmaceuticals and compounds found in personal care products. AOTs based on sulfate radicals (SO₄ \bullet^-), such as UV/persulfate (PS) and UV/peroxymonosulfate (PMS), are also gaining popularity.

Dr. Dionysiou will discuss some general aspects of AOTs and Environmental Nanotechnology (fundamentals, synthesis of nanomaterials, applications, and experience in his group). He will provide specific examples of the destruction of organic contaminants using hydroxyl radicals as well as TiO₂-based AONs and UV/H₂O₂, UV/PS, and UV/PMS processes for the treatment and purification of water in general and in particular for the destruction of cyanobacterial toxins and specific contaminant of emerging concern (i.e., pharmaceutical compounds). He will also discuss the development of TiO₂ photocatalysts using wet chemistry procedures. Results will be presented on the synthesis of TiO₂ catalyst in the form on films, membranes, visible light-activated non-metal doped TiO₂, and other composite materials. Dr. Dionysiou will also present recent findings from his group on the reaction pathways of the breakdown of cyanotoxins with hydroxyl radicals and sulfate radicals.

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12:00 – 1:00 p.m.

2311 Newmark

Everyone Welcome

Refreshments immediately following in the lobby area