PiCO₂buddies: Advancing Microalgal Bioprocessing for Diclofenac Detoxification Using Cellulose-Based Biofilms

Speaker

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PiCO₂buddies: Advancing Microalgal Bioprocessing for Diclofenac Detoxification Using Cellulose-Based Biofilms Diclofenac (DFC), a widely used pharmaceutical, persists through conventional wastewater treatment and poses increasing ecological risks. Addressing this challenge requires innovative biological solutions that ensure pollutant breakdown under realistic, fluctuating process conditions. In this context, PiCO₂buddies introduces a novel approach to support microalgal degradation of DFC through the development of cellulose-based biofilms designed for environmental shielding and process stability.

Our strategy leverages bacterial cellulose (BC) as a robust, porous matrix to physically embed and protect microalgal cells from grazing, washout, and adverse conditions commonly encountered in wastewater environments. A thermodynamically guided formulation of a minimal growth medium was developed to optimize gas solubility and maintain pH within biologically favorable ranges. This medium enables stable growth and DFC removal even under light-limited and variable salinity conditions.

Initial results demonstrate that the microalgae, when embedded in the BC matrix, retain activity in synthetic wastewater containing high DFC loads, achieving up to 85% removal in 5 days. Experimental evaluations of DFC diffusion and partitioning within the cellulose scaffold support the design of a scalable photo-biofilm reactor. A techno-economic projection further indicates competitive viability in future wastewater treatment markets.

This work lays the foundation for biofilm-integrated photobioreactors that are both chemically and physically optimized for micropollutant detoxification. We are actively seeking collaborators with expertise in modeling, reactor design, membrane technologies, or process integration to advance this technology toward real-world deployment.

Dr. Manuel Vicente Ibañez *is a postdoctoral researcher at the Technical University of Munich (TUM), Campus Straubing. His expertise lies in bioprocess and biochemical engineering, with a focus on thermodynamic modeling, bioprocess optimization, and the development of sustainable technologies. He leads the PiCO2buddies project on microalgae-based water detoxification and contributes to scaling up bioprocesses and designing novel bioreactor systems. His work integrates experimental and modeling approaches for environmental remediation and advanced biotechnological applications.*

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