Exploring Sustainable Strategies for the Conversion of Anaerobic Digestate into Value-added Electroactive Materials

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The urgent shift towards a circular economy emphasizes the vital importance of effective waste management strategies, with a specific emphasis on the pivotal role played by anaerobic digestion (AD) technology. This approach not only tackles the escalating waste crisis but also harnesses sustainable energy sources. Particularly, the application of AD for generating biogas and bio-hydrogen from organic waste materials emerges as a commendable solution. However, it is crucial to recognize that this process yields digestate, a residual byproduct, the management of which assumes paramount importance within the circular economy framework. The valorization and responsible treatment of digestate constitute integral components in ensuring a comprehensive and sustainable approach to waste management, thereby reinforcing the broader objectives of the circular economy.

In this context, our research endeavors to explore solutions to emerging environmental and energy challenges through integrating biological and electrochemical (Ech) technologies. The primary aim is to revalorize residual herbaceous plants (RHP), generated at contaminated sites or in environmental phytoremediation processes, and urban sewage sludges for biogas production in enhanced anaerobic co-digestion (co-AD) processes. Subsequently, we intend to utilize the digestate from this process for synthesizing electroactive materials (EAMs) through hydrothermal carbonization (HTC), which will be employed in Ech processes of energy (hydrogen) and environmental (electrochemical advanced oxidation processes, EAOPs) interest. This research line is part of a national project which basic approach is schematized in Figure 1.

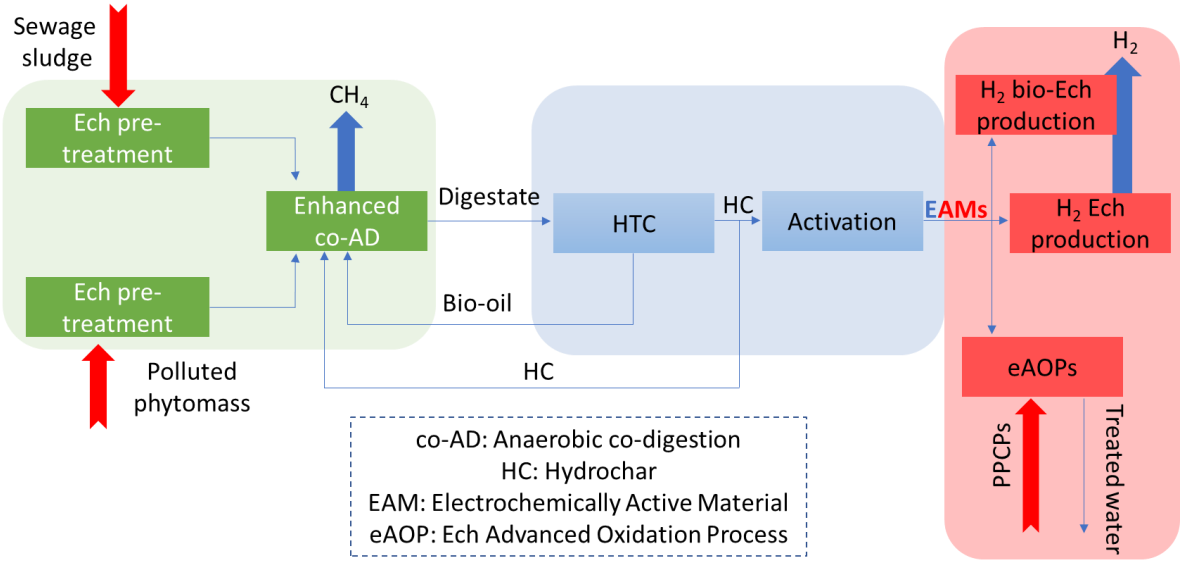

Figure 1. Schematic representation of the project.

Within our study, we will assess the viability of utilizing RHP as feedstock for co-AD processes, explore innovative electro-hydrolysis techniques, and investigate the impact of adding HTC products on biogas generation. Additionally, we propose to valorize co-AD digestate to produce electroactive materials (EAMs) via HTC, adapting the conditions and activation process to enhance its electrocatalytic properties. These materials will undergo testing for H_2 production and in designing eAOPs for wastewater treatment.

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