

There is no “away”: The CO₂ invoice when using non-conventional media or water in biocatalysis.

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Biocatalysis has emerged as a sustainable alternative for many synthetic processes.^[1] To sustain the greenness of enzymatic procedures the simple qualitative use of the Green Chemistry Principles is oftentimes employed. This has created the misleading perception that biocatalysis is green *per se*, regardless of other important aspects of the reaction (e.g. substrate loadings, the downstream unit, etc.). To validate the greenness of the reactions, the need of incorporating quantitative green chemistry metrics appears mandatory.^[2]

This is particularly relevant when the reaction media is considered. Biocatalytic processes can be performed in water or in non-conventional media. Once the synthesis is terminated, two main waste streams are generated: i) a wastewater effluent if reactions are performed in water as reaction system; ii) and an organic fraction, coming from enzymatic reactions in non-aqueous media, and from the downstream processing. The fate of the wastewater treatment can be the Wastewater Treatment Plant (WWTP), whereas incineration is commonly applied for the organic fractions and water-based recalcitrant effluents. Both approaches generate CO₂, what can be used as the common metric to compare (bio)catalytic reactions (kg CO₂ · kg product⁻¹).^[3,4]

This presentation will discuss how biocatalysis can become a green and efficient alternative for chemical processes when environmental metrics – in particular, the CO₂ production –, are measured in relation to the fates of the wastewater and the organic fraction. Several scenarios will be presented, emphasizing the need of setting recycling loops and intensified processes to reach decent sustainable metrics. In particular, a forward-discussion on the fate of Deep Eutectic Solvents (DES) and their environmental impact will be provided.^[5]

References.

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