Rational design and optimization of eco-friendly easily recoverable materials for olive mill wastewater treatment

Melissa Galloni[1,2,*], Vasilissa Nikonova[1], Ermelinda Falletta[1,2], Claudia Bianchi[1,2]

[1] *Dipartimento di Chimica, Università degli Studi di Milano, Via Golgi 19, 20133, Milano, Italy.*
[2] *Consorzio Interuniversitario Nazionale per la Scienza e Tecnologia dei Materiali (INSTM), Via Giusti 9, 50121, Firenze, Italy.*
[*] *melissa.galloni@unimi.it*

Olive oil production, one of Europe's most flourishing agricultural industries, generates olive oil and undesired products, i.e., pomace and olive mill wastewaters (OMWW). These latter are composed of *ca.* 80-83 wt.% water, 2 wt.% inorganic matter, and *ca.* 15-18 wt.% organic compounds (mainly polyphenols, phenols, and tannins). In this context, they require proper disposal treatments because of their complex composition.
In this view, developing efficient sustainable strategies is fundamental [1]. Among all the possibilities, photocatalysis is emerged due to its efficiency, high sustainability, and potential for integration into water purification systems. It can reduce polyphenols and reach high mineralization levels, thus being able to reintroduce water into the environment. Here, a captivating challenge is the rational design of efficient photocatalytic systems with wide light response able to tackle the new challenges in energy, economy, and environmental sustainability of industrial processes [1]. An ideal photocatalyst should be: *i)* active which means to be able to use sunlight energy to catalyse a chemical reaction; *ii)* selective, i.e., promoting the formation of desired products; *iii)* it should be characterized by good stability or durability and regeneration capability. According to these premises, further requirements are needed to obtain an ideal eco-friendly photocatalyst. An environmentally benign photocatalyst should also be easily handled and managed, from its creation to its disposal, non-toxic, biocompatible, and bioavailable [2]. This means that it should be obtained by easy and cheap preparation procedures from common, non-toxic, and safe precursors, or alternatively be extracted by natural sources, or better, biowastes, opening the possibility to recycle and consequently valorise materials at the end-of-life. Eventually, after its use, it should be discarded without causing adverse effects to the environment and human health, or, if possible, be exploited for other applications.
In this work, we present our results related to the rational design of advanced, easily recoverable materials based on bismuth oxybromide (BiOBr) supported onto sustainable materials (alginate, Fe_3O_4-alginate spheres) for the treatment of simple matrixes containing model polyphenols representatives of the OMWW fraction.
A critical insight into the potentialities and/or shortcomings related to the studies of advanced materials will be discussed. A targeted physico-chemical characterization and a proper evaluation of the abatement of different polyphenols in the dark and after exposure to solar or visible light irradiation will be described.
The encouraging obtained results deserve a deeper study, but already open the view towards the future use of these systems in real applications, particularly in applying sustainability principles to industrial processes.

References

[1] Galloni, M.G.; Ferrara, E.; Falletta, E.; Bianchi, C. L. *Catalysts* **2022**, *12(8)*, 923.
[2] Anastas, P.T.; Kirchhoff, M.M.; Williamson, T.C. *Applied Catalysis A: Gen.* **2001**, *221*, 3-13.