Implementation of different physicochemical techniques for the more efficient management of olive mill wastewater streams

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The olive oil extracting process is of paramount importance for the financial prosperity of the Mediterranean countries. Nevertheless, olive oil production is directly associated with the co-production of large quantities of wastewater, known as Olive Mill Wastewater (OMW). This by-product is characterized by the high organic and phenolic content rendering it responsible for many severe environmental phenomena. On the other hand, OMW is enriched in high added value constituents such as phenolic compounds and their isolation and recovery is related with the higher efficiency in the management and valorisation of the effluent. Many available treatment methods have been reported in the literature concerning the treatment of OMW in order to contribute to the confrontation of this serious environmental impact, however none of them can be considered as unique and affordable solution.

This work is associated with the development of a more efficient management process of the waste aiming to the commercial exploitation of phenolic compounds present in OMW. Specifically, the implementation of a combination of the membrane technology and the cooling crystallization process is proposed.

Nonetheless, the recovery of phenolic compounds in purified crystalline form from raw OMW is not feasible as their particular solubility point is far lower than their corresponding freezing point. As a result, for the onset of crystallization, it is imperative that the concentration of the phenolic compounds, in the effluent, is sufficiently increased. A proposed method for the more efficient treatment of OMW should include membrane technology for the fractionation of the high added value compounds in the concentrated streams of Nano-Filtration (NF) and Reverse Osmosis (RO). In addition, the enriched in phenolic fraction concentrated streams may be further treated through the application of cooling crystallization in order to investigate the possibility of recovering purified phenolic compounds based on their respective freezing point.

Recovering and purification of phenolic compounds from OMW was initiated by an extent literature research and followed by experiments with synthesized solutions of OMW. Glucose and the majority of polyphenols, contained in OMW (including tyrosol, caffeic acid and ferulic acid), were served as the model compounds for sugars and phenolic fraction, respectively. The implementation of membrane technology followed for the fractionation of monosaccharides and phenolics in the concentrated streams of nanofiltration and reverse osmosis. Finally, the application of cooling crystallization process took place for the investigation of recovering phenolic compounds in crystallized form from the treated solution.

The current work is a first step for the development of a satisfactory model for the recovery of phenolic compounds through cooling crystallization process, with an ultimate purpose of the industrial implementation of the process.

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