DEVELOPMENT OF PRE-TREATMENT TECHNOLOGIES FOR THE ENHANCEMENT OF BIOGAS PRODUCTION FROM OLIVE OIL RESIDUES

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The olive oil industrial sector produces solid residues (Solid Olive Mill Wastes, SOMW) and wastewater (Olive Mill Wastewater, OMW) that are currently considered an environmental problem to be targeted. Because of their high organic load such as carbohydrates, pectins and polyphenols –the last with non biodegradable nature-, they are difficult to be managed and treated through conventional management technologies.

Spain, together with Greece and Italy, covers 70% of world olive oil production. According to real data, a total amount of 2.5 millions tones of OMW and olive washing wastewater, 4.1 millions of tones of two-phase SOMW and 0.4 millions of tones of three-phase SOMW are yearly produced only in Spain.

This study investigates the application of different pre-treatment technologies for the enhancement of Anaerobic Digestion (AD) technology and the co-digestion of Solid Olive Mill Waste (SOMW) and Olive Mill Wastewater (OMW) at laboratory scale. Ozonation, Sonication and biological pre-treatment technologies are being developed and optimised for the enhancement of biogas production in the frame of Biogas2PEM-FC project (7FP Capacities, SME-2012-1), which aims to develop a novel and integrated solution for the efficient valorisation of both OMW and SOMW by integrating enhanced AD technology with further biogas reforming and proton exchange membrane fuel cells (PEM) technologies.

An optimal SOMW and OMW ratio has been selected after preliminary biogas experiments testing different SOMW:OMW ratios (defined according to original physic-chemical properties). From these results, total polyphenol was considered as one of the most important AD inhibitors conditioning biogas generation.

Operating parameters such as pH, ozone dosage and reaction time have been optimised for ozonation pre-treatment technology under optimal SOMW/OMW ratio. First optimisation tests demonstrated that 47% of phenolic concentration could be reduced after 30 minutes. Regarding sonication technology, total polyphenol reduction was comparable to that obtained by using ozonation technology while optimizing parameters such as frequency, energy and reaction time.

Finally, *T.versicolor* has been selected as a biological pre-treatment for its capacity to degradate polyphenol. Different dilutions of the optimum SOMW:OMW mixture have been plated as a nutrient source while the growing capacity of *T.versicolor* has been tested. It has been found that *T.versicolor* is able to grow under SOMW:OMW mixture at 50% or higher dilution with either cleanwater or pig manure (co-sustrate). The polyphenol concentration after pretreatment is currently being evaluated.

AD tests at laboratory scale for the co-digestion of SOMW and OMW after different pre-treatment technologies are demonstrating promising results. Mesophilic and thermophilic anaerobic digestion conditions are being compared. The use of additional co-substrates such as pig manure and additional specialised inoculates contributes to the C:N:P ratio balance and final biogas production yields, demonstrating its potential industrial viability. A feasible integration with further biogas reforming and PEM technologies is also foreseen.