

Jet-loop reactor with cross-flow ultrafiltration membrane system for treatment of olive mill wastewater

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Abstract

Olive oil extraction is one of the ancient agricultural industries all over the Mediterranean area and even today it is of fundamental economic importance for many industries found over the whole Mediterranean. However, this industry generates large amounts of olive mill wastewater (OMW) and due to its physicochemical characteristics it causes severe environmental concerns and management problems in the Mediterranean area, which is facing water scarcity. Technologies to reuse this wastewater will have a high impact at the economic and environmental level. The work presented aims to improve the use of jet-loop reactors technology for the aerobic biotreatment of OMW. A jet-loop reactor (100 L) coupled with an ultrafiltration (UF) membrane (MBR) system (JACTO.MBR_100 L) were tested for the influence of hydraulic parameters on OMW degradation and scale-up to 1,000 L. Chemical oxygen demand and total phenols (TP) decreased notably (up to 85% and 80% removal efficiency, respectively) after the biological treatment. The treated OMW (UF permeate) was evaluated as a source for irrigation and its impact on the soil and plant growth and their quality parameters.

Key words: cross-flow ultrafiltration membrane, jet-loop reactor, olive mill wastewater

INTRODUCTION

The olive oil industry is very important in Mediterranean countries, both in terms of wealth and tradition and it is considered to be as one of the driving sectors of the agricultural economy of the Mediterranean basin (Agapiou *et al.* 2016). Every year, worldwide olive oil production generates in a short period (from October to March) more than 30 million m³ of olive mill wastewater (OMW) (Belaqziz *et al.* 2016) causing disposal problems with great negative environmental impact. The major concerns associated with OMW disposal are mainly its high organic content in terms of chemical oxygen demand (80–200 g·L⁻¹, COD), high content of polyphenols (3–12 g·L⁻¹), and acidic pH.

Currently in Jordan, direct OMW disposal is not allowed to avoid contamination of the soil and water resources nor even to discharge it to the municipal wastewater treatment plants (Rusan *et al.* 2015). Instead, untreated OMW is disposed in dumping sites (Rusan & Malkawi 2016). The reuse of treated OMW should be considered as an additional water source and an important solution from an economical and environmental point of view. The need for appropriate management and treatment of OMW remains the largest single environmental problem in Mediterranean olive oil extraction countries and the development of effective approaches for the treatment of OMW is thus of crucial importance.

Aerobic biological treatment systems could become an interesting alternative due to their fast process kinetics and high removal rates. The use of systems with air jet in the biological treatment of