Chae Jeong and Benjamin Davis

Economic and Environmental Evaluation of Olive Mill Wastewater Treatment Methods for a Self-Supplied American Olive Oil Mill

AIChE Annual Meeting 2017
Abstract

Session: **Advances in Life Cycle Optimization for Process Development**
Environmental Division

Olive oil is a highly versatile and popular consumer product, sold as food product and used in other products such as cosmetics and pharmaceuticals. Consequently, there is a large global market for olive oil with a production estimate of 3.225 million metric tons in the 2015-16 season. While olive oil production in the United States (U.S.) occurs at a small scale, with about 14,000 metric tons produced yearly (against 1.3 million metric tons produced in Spain which is almost 100 times more). Yet, Americans consume an average of 80 million gallons of olive oil annually, coming in as the second largest consumer in the world outside of Europe. Thus, major olive oil producers in the U.S. have recently started operating at larger scale. With increased olive oil production comes the increase production of olive mill wastewater (OMW). OMW has a very high organic load (COD: >220,000 ppm) [Borja, et al. *Grasa Y Aceites*, **57.1**, 34-46, 2006] and consequently it is phytotoxic and inhibits growth of soil and marine bacteria, posing a threat to ecosystems upon exposure.

Polyphenols and phenol derivatives are the primary cause of toxicity of OMW [Borja, *ibid*] and any waste treatment methods should be effective in removing these compounds. The phenolic content of OMW can range from 500 mg/L to 24,000 mg/L [Borja, *ibid*] depending on the type of olives used, degree of ripeness, and growth conditions. The permissible concentration of phenols for release to freshwater aquatic systems is 3.4 mg/L according to the EPA; therefore, treatment methods should be robust enough to handle and remove large quantities of phenols.

The current literature details various methods of OMW treatment but fails to consider the economic viability of the proposed methods. Still yet to consider is the overall environmental impact of the olive oil production process with treatment methods in place, taking into account the overall usage of energy and water. We will present a model for a continuous olive oil production process that optimizes the operating revenue of a self-supplied American extra virgin olive oil mill. This model gives insight on the economics of wastewater treatment methods as well as detail the amount of wastewater needed to be treated. Treatment methods will then be evaluated against the expected operating revenue and the environmental impact of the full process will be assessed using a cradle-to-gate LCA.