Studio della produzione di biopolimeri dal trattamento di depurazione dei reflui agrumari di processo

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Bioplastic production

Concept

The research topic is the production of biopolymers from citrus industry waste and, in particular, from wastewater, through the implementation of advanced technology biological processes. The production of bioplastics from wastewater is based on the selection of some bacterial strains specialized in the conversion of organic substrates into biopolymers, such as polyhydroxyalkanoate (PHA) or polyhydroxybutyrate (PHB). To date, the production of bioplastics at industrial level involves the use of pure bacterial cultures, however, due to the high costs of the process (sterile environments and valuable organic substrates), research is moving towards the use of mixed bacterial cultures (sludge active) that allow the use of less valuable substrates such as wastewater or waste by-products, while ensuring processes that are economically sustainable. The innovation introduced in the research project is to implement the biological synthesis processes of biopolymers through membrane bioreactors (MBR). These systems make it possible to select biomass more effectively than conventional systems, as they base the selection exclusively on metabolic and kinetic principles, rather than on the ability of the biomass itself to aggregate into sedimentable flakes.

Scientific approach

The research activity is divided into 4 phases:
1) optimization of the fermentation process of citrus wastewater, aimed at maximizing and characterizing the production of volatile fatty acids (VFA) necessary for the subsequent stages of the process; 2) optimization of the wastewater treatment process and biomass selection, operating in different process conditions; this activity will be carried out in laboratory-scale plants in which innovative plant solutions and plant schemes will be implemented, such as membrane bioreactors (MBR) and conventional ones, such as sequential activated sludge processes (SBR); 3) optimization of the biopolymer accumulation process, to be implemented in a secondary process line, in which the effects on the biomass storage capacity of different operating conditions will be studied, such as the volumetric organic load, the ratio between nutrients (C: N: P) and the pH; Different accumulation tests will be performed, in each of which the effect of the process parameter investigated on the production and characteristics of the biopolymer produced will be tested; 4) identification of the plant layout and the ideal process conditions to be implemented in a pilot plant to be put into operation at a production plant.

Research objectives

The activity will focus on the construction and operation of laboratory and pilot scale plants, on which the effects of different operating conditions will be studied, with the aim of identifying those that allow the highest rate of conversion of organic matter into biopolymers to be obtained. In particular, the research aims to identify the optimal process conditions to biologically select bacteria capable of producing biopolymers, as well as those necessary to maximise their accumulation within the bacterial cells during the cultivation phase.