Study of Extracellular Polymeric Substances (EPS) during biological treatment of diluted real molasses wastewater and co-treatment with Light-Emitting Diode (LED) light.

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Abstract

Extracellular Polymeric Substances (EPS) constitute the main compounds of activated sludge matrix and are mainly composed of proteins and carbohydrates. Their role is crucial for the physicochemical and biological properties of biofilms. They can be classified into soluble EPS (sEPS) and bound EPS (Loosely Bound EPS-LBEPS and Tightly Bound EPS-TBEPS). Industrial wastewaters may affect the presence and the composition of EPS: molasses wastewater is a highly strength wastewater, with a considerable amount of biorefractory compounds; in addition, molasses wastewater usually presents high EPS concentration and especially proteins. The treatment of molasses wastewater by biological processes is not efficient and therefore, alternative methods or practices are required to enhance the performance of the biocommunities. Light-Emitting Diode (LED) lamps were used in this project, as a method to stimulate the activated sludge process. It is considered that the introduction of LEDs in an activated sludge reactor could favour the photosynthetic activity of microalgae resulting in increased removal of nutrients and organic substances. However, microalgae might synthesize EPS and especially proteins. In this work, the treatment of a mixture of molasses-municipal wastewater in a volume ratio of 10% was examined in two lab scale Sequencing Batch Reactors (SBR), implementing a 12 h cycle treatment (feed, anoxic phase, aeration, sedimentation, flow). One reactor was used for control while the second one was irradiated by LED light immersed into the activated sludge system. Samples were collected from influent, effluent and reactor mixed liquor and were analyzed for the determination of EPS; proteins were measured by the modified Lowry method and polysaccharides by the Dubois method.

The results obtained by the three months operation of the reactors showed that all EPS fractions presented a time variation, most probably following the life cycle of microalgae. Initially, EPS content in the reactor with the LED irradiation were higher than the control reactor; however, during the following period, EPS concentration became almost similar with the corresponding content in the control reactor. The maximum value of proteins for soluble EPS (being detected in greater concentrations than LBEPS and TBEPS) was 210 mg/g VSS while the corresponding value in the control reactor was 130 mg/g VSS. During the same period, soluble polysaccharides concentration was 18 mg/g VSS while in the control reactor their concentration was 4 mg/g VSS. It was concluded that the introduction of LEDs enhanced the process efficiency, due to the growth of photosynthetic organisms, contributing to an increase of EPS content.

Keywords: Extracellular Polymeric Substances (EPS), Light-Emitting Diode (LED) light, molasses wastewater, biological treatment.