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BIO-OIL AS FEEDSTOCK FOR THE PRODUCTION OF BIOPOLYMERS BY AEROBIC MIXED CULTURES

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Abstract

Biomass, as an alternative energy source to fossil fuels, gained importance trough the last years due to its significant environmental advantages. Wood and other forms of biomass including energy crops and agricultural and forestry wastes are some of the main renewable energy resources available. Most processes that convert biomass into liquid fuels begin with pyrolysis, a thermal decomposition that occurs in the absence of oxygen. Bio-oils resulting from the fast pyrolysis of biomass can be converted into fuels with similar properties to the petroleum-derived ones. Several chemicals can also be extracted or derived from the bio-oil including food flavourings, specialities, resins, agro-chemicals, fertilisers and emissions control agents. Alternatively, fermentation of the bio-oil as a post-processing biological approach can be applied. Bio-oil can be use as carbon source for microbial conversion into high value products, such as bioplastics. Polyhydroxyalkanoates (PHAs) are biodegradable polyesters with promising alternatives to conventional plastics. However the significant cost difference between PHAs and petrochemical-derived plastics presents the major barrier for them to gain market share (9% among bioplastics). In order to develop more cost effective processes, low cost substrates and mixed microbial cultures have been applied for PHA production. Mixed cultures are selected by the operational conditions imposed to the biological system, allowing for savings in energy and equipment cost.

Bio-oil resulting from the fast pyrolysis of chicken beds was used for the production of PHA. Selection of PHA accumulating bacteria was performed in a sequencing batch reactor operated under "feast and famine" aerobic condition. The reactor was inoculated with activated sludge from a wastewater treatment plant and fed with 60 C-mmol/day of easily biodegradable carbon contained in bio-oil. Due to the carbon complexity of the bio-oil, the effect of different carbon sources and feeding strategies in the PHA accumulation organisms selected was observed through several kinetic studies using bio-oil, or model substrates as acetate and glucose. In order to follow the culture acclimatization to this carbon source and to better understand the operating system, molecular techniques like FISH and DGGE were used. These techniques allowed observing the enrichment of PHA accumulating organisms during the acclimatization period, resulting in increased of the intracellular PHA content.