152e Poop to Plastic: Commercial Production of Polyhydroxyalkanoates in Municipal and Industrial Wastewater Treatment

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Biologically-derived polyesters known as polyhydroxyalkanoates (PHAs) represent a potentially ‘sustainable' replacement to fossil-fuel based thermoplastics. However, current commercial production practices that fermentatively produce PHA with pure microbial cultures grown on renewable, but refined, feedstocks (e.g. glucose) under sterile conditions, do not represent a sustainable replacement. Here we report on the commercial production of PHA with a mixed microbial consortium indigenous to an activated-sludge process on carbon present in industrial and municipal wastewaters in a unit-operation configuration completely congruent with wastewater treatment facilities. PHA production averaged 85, 10, and 53% (w/w) on pulp-and-paper mill foul condensate, biodiesel, and municipal wastewaters, respectively, with concurrent substantial reductions in soluble organic carbon and orthophosphate at specific percentages dependent on the type of wastewater. Given the proposed polymer production process arguably eliminates the energy and costs associated with feedstock production and bioreactor operation and further that wastewater treatment is mandated in most countries, results presented herein suggest environmentally benign production of biodegradable polymers is feasible. We further utilized the cell mass, without extraction or purification of PHA, to produce a natural fiber reinforced thermoplastic composite (NFRTC) that can be used to offset the cost of advanced wastewater treatment.