

# Production of polymers by cyanobacteria grown in wastewater treatment systems

Dulce María Arias, Enrica Uggetti, María Jesus García-Galán, Joan García

GEMMA – Group of Environmental Engineering and Microbiology, Department of Civil and Environmental Engineering, Universitat Politècnica de Catalunya-BarcelonaTech, c/ Jordi Girona 1-3, Building D1, E-08034, Barcelona, Spain (enrica.uggetti@upc.edu)

During the last decades, increasing attention has been paid to the production of bioplastics and biofuels due to their potential to replace petroleum-based products, with all their known drawbacks. Polyhydroxyalkanoates (PHAs) and polyglucose (glycogen) are polymers synthesized and internally accumulated by certain microorganisms, with a high potential for bioplastics and biodiesel production respectively. As many prokaryotic microorganisms, cyanobacteria are able to accumulate both PHAs and glycogen as an intracellular storage products. Studies related to the cultivation of cyanobacteria and their metabolites are generally based on the utilization of pure microbial or genetically modified cultures. This results in high production costs, where the final product is significantly more expensive than traditional petroleum-based products. From a biorefinery concept, an alternative approach for biomass and by-products generation could be the use of wastewater-borne cyanobacteria cultures, using waste-streams as substrate. Wastewater treatment technologies are probably the most promising sustainable strategy to reduce additional production costs in biomass production. In this study, we explore different strategies for PHA and glycogen production from cyanobacteria, using wastewater as feedstock.

First, a description on how a culture mostly dominated by cyanobacteria can be obtained and maintained in the long term, using waste-streams as feedstock, will be put forward. To this aim, experimental results will be presented, based on a pilot scale closed-photobioreactor (30 L) which was fed with treated municipal wastewater and digestate from an anaerobic digester (mixed 50:1, treated wastewater:digestate). After one year of operation, cultivated cyanobacteria reached a biomass production average of 0.08 g VSS L<sup>-1</sup>d<sup>-1</sup>. Secondly, strategies on the metabolites accumulation will be described. We will show results from lab-scale accumulation tests under different nutritional and light regimes. PHA accumulation up to 5-10% (dry cell weight) and 50% (dcw) of glycogen content were obtained under nutrients starvation and unlimited carbon conditions. Finally, an analysis on how all this information can be integrated in a biorefinery concept based on the use of waste-streams will be proposed.