11th Conference on Dynamical Systems Applied to Biology and Natural Sciences DSABNS 2020 Trento, Italy, February 4-7, 2020

AN OPTIMAL CONTROL PROBLEM FOR DEGRADATION OF WASTE IN LANDFILLS UNDER ANAEROBIC CONDITIONS

Marzia Bisi, Maria Groppi, Giorgio Martaló and Romina Travaglini*

Department of Mathematical, Physical and Computer Sciences, University of Parma, Italy

marzia.bisi@unipr.it, maria.groppi@unipr.it, giorgio.martalo@unipr.it, romina.travaglini@unipr.it (*corresponding author)

We propose a recent mathematical model [1] for the degradation of the organic fraction of solid waste in a batch bioreactor by means of an anaerobic bacterial population. The time variation of a two components substrate (soluble and insoluble) and a bacterial population (biomass) is governed by a system of ordinary differential equations describing: anaerobic digestion, hydrolysis, i.e. solubilization of the insoluble substrate, and biomass decay. The evolution of the system is monitored by controlling the effects of leachate recirculation that can stimulate or inhibit the hydrolytic process. The main aim is to find the best strategies optimizing an objective functional, that balances the minimization of leachate recirculation cost, modeled by a linear or quadratic function, and the minimization of substrate components at the final time. The minimization problem can be reformulated by typical tools of Pontryagins theory and solved numerically by a classical descent gradient method. Results show the occurrence of different optimal strategies: constant (*bang*), piecewise constant (*bang-bang*) or *singular* controls. A sensitivity analysis for varying parameters and different initial configurations will be presented.

References

[1] M. Bisi, M. Groppi, G. Martal, R. Travaglini. *Optimal control of lechate recirculation for anaerobic processes in landfills* (submitted).