

# CONTROL OF AN IDEAL ACTIVATED SLUDGE PROCESS IN WASTEWATER TREATMENT VIA AN ODE-PDE MODEL

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**ABSTRACT.** The activated sludge process (ASP), found in most wastewater treatment plants, consists basically of a biological reactor followed by a sedimentation tank, which has one inlet and two outlets. The purpose of the ASP is to reduce organic material and dissolved nutrients (substrate) in the incoming wastewater by means of activated sludge (microorganisms), also called biomass. The major part of the discharged flow through the bottom outlet of the sedimentation tank is recirculated to the reactor, so that the biomass is reused. In this work, only two components are considered; the soluble substrate and the particulate biomass. The biological reactions are modelled by two nonlinear ordinary differential equations (ODEs) and the continuous sedimentation process by two nonlinear hyperbolic partial differential equations (PDEs), which have coefficients that are discontinuous functions in space due to the inlet and outlets. In contrast to previously published modelling-control aspects of the ASP, the theory for such PDEs is utilized. In [1], the authors have classified all steady states for this model. The most desired steady-state solutions constitute only a small subset of all steady states, namely when there exists a discontinuity, called sludge blanket, in the sedimentation tank. In the present work [2], it is proved that the most desired steady-state solutions can be parameterized by a natural control variable; the ratio of the recirculating volumetric flow to the input flow. This knowledge is a key ingredient in a two-variable regulator, with which the effluent dissolved nutrients concentration and the concentration profile in the sedimentation tank are controlled. Numerical simulation with and without the regulator are presented.

**Keywords:** conservation law; discontinuous coefficient; clarifier-thickener; biological reactor; continuous sedimentation

**Mathematics Subject Classifications (2000):** 35B37, 35L65, 93A30

## REFERENCES

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- [2] S. Diehl and S. Farås. Control of an ideal activated sludge process in wastewater treatment via an ODE-PDE model. Submitted. [www.maths.lth.se/matematiklth/personal/diehl/Diehl\\_Faraas.pdf](http://www.maths.lth.se/matematiklth/personal/diehl/Diehl_Faraas.pdf)

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