A SYSTEM OF CONVECTION-DIFFUSION-REACTION PDES MODELLING CONTINUOUS SEDIMENTATION WITH REACTIONS

RAIMUND BÜRGER, STEFAN DIEHL, AND CAMILO MEJÍAS

Abstract. The continuous sedimentation process in secondary settling tanks (SSTs) in wastewater treatment plants has previously been modelled by a scalar nonlinear degenerate parabolic conservation law. Robust and reliable numerical simulations can be obtained [2, 3] and the phenomena modelled include hindered settling and compression at high concentrations, but no reactions. The settling particulate material is flocculated activated sludge (biomass), which is fed into the SST from preceding biological reactors, where several biochemical reactions take place – the biomass decomposes nutrients dissolved in the water. There exist well-established activated sludge models (ASMs) for these reactions in terms of ODEs [5]. It is known that some of these reactions occur also in the SST to the extent that they have a substantial impact on the overall behaviour of the plant. The authors have recently studied a reduced ASM during batch sedimentation in which the movement of the dissolved substrates is modelled by an ad hoc diffusion term [1]. Here we present the full system of convection-diffusion-reaction PDEs for the movements of both particulate and liquid phases through the SST. The formulation of method-of-lines equations is based on the idea of [4] for multi-component particles. Explicit and linearly implicit numerical schemes are suggested and tested for a reduced ASM.

Keywords: continuous sedimentation; convection-diffusion-reaction PDE system; secondary clarifier; linearly implicit time discretization; thickener; wastewater treatment

Mathematics Subject Classifications (2010): 35K65, 35L65, 35Q35, 35Q70, 65M20

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CI^{2}MA and Departamento de Ingeniería Matemática, Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción, Casilla 160-C, Concepción, Chile
E-mail address: rburger@ing-mat.udec.cl

Centre for Mathematical Sciences, Lund University, P.O. Box 118, S-221 00 Lund, Sweden
E-mail address: diehl@maths.lth.se

CI^{2}MA and Departamento de Ingeniería Matemática, Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción, Casilla 160-C, Concepción, Chile
E-mail address: cmejias@ing-mat.udec.cl