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A numerical method for a doubly degenerate diffusion-reaction model describing biofilm processes

Some biofilm systems and processes can be described by quasilinear parabolic equations with two non-Fickian diffusion effects: (i) degeneracy of the diffusion coefficients for vanishing biomass density, and (ii) a super-diffusion singularity when the maximum biomass density is reached. Phenomenon (i) guarantees a well defined interface between the biofilm and the surrounding aqueous phase that moves at finite speed, phenomenon (ii) ensures that the maximum biomass density is not exceeded. In numerical simulations both these aspects are not easy to deal with. We discuss a simple, yet relatively robust numerical method. We show that under this numerical realisation the effects of (i) and (ii) are maintained, we give a stability result, show convergence numerically by grid refinement, and discuss the parallel speed-up gained on OpenMP platforms.