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Modeling of transport processes in the presence of substance-locking effects. (English)

Zbl 0938.35099

SIAM J. Appl. Math. 59, No. 2, 743-776 (1999).

After an initial discussion of various simplified models of chemical mass transport processes induced by external fields in one space dimension and some of the mathematical problems involved the authors first focus on the discussion of a system of the form

$$\partial_0 c + \partial_1 i(c, \mu, a) = 0, \quad \partial_0 \mu = 0,$$

where the concentration c is a scalar function and μ, a may be vector-valued. The parameter vector a is linked to μ, c by an additional equation $h(c, \mu, a) = 0$. The flux density i is a known scalar function of its variables with $i(0, \mu, a) = 0$. The initial data are prescribed as particular piece-wise constant function in the space variable (as for a Riemann problem) of the form $c = c_0 \chi_{[0, x_0]}$, $\mu = \mu_1 \chi_{[0, x_0]} + \mu_2 (1 - \chi_{[0, x_0]})$, where $\chi_{[0, x_0]}$ denotes the characteristic function of the interval $[0, x_0]$, $x_0 > 0$. Mass conservation and the Rankine-Hugoniot conditions are assumed. By elimination of a, μ the problem reduces to a generalized Riemann problem for the concentration c . In addition, stationary lines of discontinuity $[0, \infty[\times\{0\}$ and $[0, \infty[\times\{x_0\}$ are assumed. The solutions and their properties are then discussed in detail. Eventually the effect of an additional diffusion term (proportional to $\partial_1^2 c$ and $\partial_1^2 \mu$) in the original system is considered. The problem with diffusion is approached numerically to show the effect of substance trapping between the strong singularities $[0, \infty[\times\{0\}$ and $[0, \infty[\times\{x_0\}$ previously observed by the authors in experiments.

Reviewer: [R.Picard \(Dresden\)](#)

MSC:

[35L65](#) Hyperbolic conservation laws

[65M06](#) Finite difference methods for initial value and initial-boundary value problems involving PDEs

[35B35](#) Stability in context of PDEs

Keywords:

[hyperbolic conservation laws with algebraic restrictions](#); [stationary discontinuity](#); [contact discontinuity](#); [Riemann problem](#); [finite-difference schemes](#)

Full Text: [DOI](#)