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An Ohmic heating non-local diffusion-convection problem for the Heaviside function. (English summary)

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The authors study the behavior of the non-local parabolic equation $u_t = u_{xx} - u_x + \frac{\lambda f(u)}{(\int_0^1 f(x)dx)^2}$ with certain initial and boundary conditions where f is the Heaviside function. In the case where $f(u) = H(1-u)$, that is, for decreasing $f(u)$, comparison techniques can be applied. Two problems with different types of boundary conditions are studied. In both problems, there exist critical values λ_* and λ^*, such that for $0 < \lambda < \lambda_*$, there is a unique steady state solution which is asymptotically stable and the solution u is global in time. For $\lambda_* \leq \lambda \leq \lambda^*$, there exist two steady-states and the authors study their stability, while for $\lambda > \lambda^*$ there is no steady-state. It is also proved that for $\lambda > \lambda^*$ or for $\lambda_* \leq \lambda \leq \lambda^*$, and initial data sufficiently large, the solution u "blows up" (in some sense). Moreover, for increasing f and Neumann boundary conditions, u is an unbounded solution global in time.

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