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DEAD CORES FOR PARABOLIC REACTION-DIFFUSION PROBLEMS

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Abstract. In this article sufficient conditions are derived for the existence and the nonexistence of a dead core for at least one of the solutions (u, v) of a nonlinear parabolic reaction-diffusion system with Robin boundary conditions. Simplifying assumptions on the diffusion coefficients allow one to decouple the system and to use super and subsolution methods to guarantee or to exclude the existence of a dead core.
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1 Introduction

In chemical engineering, one studies reaction-diffusion equations which have the form of the coupled system

$$\frac{\partial u}{\partial t} - \mu \Delta u = -u^m \, e^{v/(1+\varepsilon v)}, \tag{1.1}$$

$$\nu \frac{\partial v}{\partial t} - \Delta v = \beta u^m \, e^{v/(1+\varepsilon v)}, \tag{1.2}$$

where $\mu, \nu, \varepsilon > 0$ are physical constants, $m = 1, 2, 3, \cdots$, and β is positive, zero or negative depending on whether the reaction is exothermic, isothermic or endothermic [11]. Depending on the specific chemical applications, various boundary conditions are imposed. The function $e^{v/(1+\varepsilon v)}$ can be replaced by e.g. $e^{-\gamma/v}$ for some $\gamma > 0$ [10].

In this article we consider the following initial-boundary value problem