



Singular Reaction-Diffusion System Arising from Quenching

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Abstract: In this paper, we study a singular parabolic reaction-diffusion system with positive Dirichlet boundary conditions. It is shown that certain conditions are sufficient to guarantee finite-time quenching and global existence of solutions. This system appears in the modeling of the quenching phenomena.

Keywords: *reaction-diffusion system; quenching; singular parabolic equations.*

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1 Introduction

Quenching refers to the process of rapidly cooling a material from a high temperature to a lower temperature. This is done to alter the material's physical or mechanical properties such as hardness or strength. The rapid cooling prevents the material from undergoing a gradual cooling process, which would allow the material to form larger crystals that could weaken the material's structure. Quenching can be accomplished using different methods, including immersion in water, oil, or air, depending on the desired outcome. The study of this important phenomenon began in 1975 with a paper by Kawarada [5], where he studied a model in one space dimension. That paper was an introduction to the large-scale studies of the quenching problem by many researchers in several scientific fields. For a detailed survey, we refer to Chan [3], Levine [7], Rouabah et al. [13], Zouaoui et al. [20].

By using reaction-diffusion models, researchers can simulate the behavior of quenching processes and predict the resulting microstructure and mechanical properties of the metal. This can help in the design of new quenching techniques and in the optimization of

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