

Title: Blow-up in a Medium with Anomalous Diffusion Properties and Advection

Abstract:

Blow-up due to a localized high energy source within a medium exhibiting anomalous diffusion effects and undergoing advection is considered. This problem is studied within the framework of a fractional diffusion equation. For the case of subdiffusion, spatial domains of infinite extent in one, two, and three dimensions are considered. It is shown that a blow-up always occurs, independent of spatial dimension, thermal properties of the material, or advection speed. Results also suggest that increasing the advection speed will delay the time to blow-up, even though it does not prevent a blow-up. These results are in distinct contrast with the analogous classical diffusion problem, in which blow-up can be avoided by sufficiently increasing the advection speed. For the case of superdiffusion, it is shown that there exists a critical advection speed above which blow-up is avoided and below which blow-up is guaranteed.