NUMERICAL SOLUTION OF NONLINEAR HEAT AND MASS TRANSFER PROBLEM WITH DIFFUSION IN THE GASEOUS PHASE

A Thesis Submitted in Partial Fulfillment of the Requirements for the Master Degree in Mathematics

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ABSTRACT

In the present thesis we describe the method of numerical solution and give the results of investigation of nonlinear heat problem with moving boundary.

We assumed the spherical symmetry of the process and the uniformity of the pressure within the bubble. We derived the basic equations of our problem. We used the variable $y = \frac{t}{R}$ freeze the moving boundary of the bubble. After that, we used the non-dimensional parameters to obtain the numerical solution easily.

We transfer Rayleigh equation form the second order differential equation to a system of two first order differential equations by using the following substitution $\frac{dR}{dt} = w$.

We solved a mixed system containing ordinary and partial differential equations using finite-difference technique by dividing the whole system into spherical layers inside the bubble. We get a system with $n + 3$ ordinary differential equation to solve numerically, we used $n$ between 30 to 100, since this is the value that if we will make it double result will not change.

The results of numerical calculations presented as figures showing the behavior of radius and temperature distributions inside the bubble and their evolution during the time using the power of Mathematica 8 and Maple 15 program. We used Runge-Kutta numerical method with other numerical methods to solve the system.