Exposing a live cell to ionizing radiation can lead to cell inactivation. Oxygen and other chemical substances soluted in the internal environment of a cell participate in various chemical reactions during the chemical stage of the radiobiological process. The thesis is concerned with modelling diffusion and reaction processes of the chemical stage. A system of semilinear parabolic partial differential equations for concentrations of chemical substances involved is derived in three spatial dimensions, including weak formulation. Assuming spherical symmetry, the problem can be reduced to one dimension. Under further simplifications, existence of solution is proven via Galerkin method. The one-dimensional problem is solved numerically, using finite element discretization. Error estimates and computer implementation are presented.