ASSESSMENTS OF OPPORTUNITIES OF NUMERICAL METHODS OF GRIDS FOR SOLVING THE TIME-DEPENDENT THERMAL CONDUCTION PROBLEMS OF CERAMIC NUCLEAR FUEL

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Thermal conduction processes have significantly influence on the operability of ceramic nuclear fuel and as a result they are significantly limiting capabilities of the exploitation modes choices and technical and economical characteristics of nuclear power plants units. To justify the operability of ceramic nuclear fuel for different exploitation modes it is necessary to research all possible processes of time-dependent thermal conduction, what can be in general accomplished by numerical methods using only. Thus, it is very actual the proposed theme about assessments of opportunities of numerical methods of grids for solving the time-dependent thermal conduction problems of ceramic nuclear fuel.

To estimate the assessments of numerical methods of grids for solving of time-dependent thermal conduction problem of ceramic nuclear fuel we considered the model problem about finding the temperature fields in the initial uniformly heated rod made from uranium dioxide with one thermally isolated edge after the thermal impact in its other edge. Method of separation of variables gives us an opportunity to obtain the exact analytical solution for this formulated problem and by comparing numerically obtained solutions with that exact analytical solution we can to assessment the qualification of corresponding numerical methods. The solution of the proposed model problem was obtained using classical scheme of the method of grids with time and coordinate grids in which results are significantly depended on the agreement between time and spatial grid's steps. That agreement can be established for some partial formulations of the problem but it can be significantly difficult in general formulations. Therefore, as alternative we considered the numerical solutions obtained using the semi-discretisation method which leads to the first-order ordinal differential equations with initial conditions to finding values of temperature in pre-defined nodes of a spatial grid. To integrate these obtained ordinal differential equations with initial conditions we used Merson's method and we showed that automatic choice of the on time integration step in this method give us the opportunity to obtain results with higher accuracy on shorter compute time. It can be to imagine that the automatic choice of the on time integration steps in Merson's method provides the agreement between time and spatial grids steps.

Results of assessments of numerical methods of grids leaded us to the conclusion that the semi-discretisation scheme with Merson's method for ordinal differential equations with initial conditions solving is suitable to use in researches of time-depended thermal conduction of ceramic nuclear fuel. We will use semi-discretisation scheme only in further researches of time-dependent thermal conduction of ceramic nuclear fuel.