From the point of view of convenience in obtaining solutions to boundary value problems with differential equations, it is advisable to use approximate computing methods to solve boundary value problems on a computer using mathematical programs. This means that the mathematical model is specified in a form that can be implemented on a computer. The solution obtained in this way will be approximate and will take the form of a series of values of the objective function, but the values of individual system parameters will not be considered.

Despite the above advantages of approximate computing methods over analytical ones, the values of the objective function obtained afterwards should be analyzed for their relevance to the process under study. Thus, to improve the accuracy of the implementation of calculation and optimization mathematical models, it is more expedient to use analytical methods rather than approximate computing methods.

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MATHEMATICAL MODELS, AS A TOOL FOR OPTIMIZING TECHNOLOGICAL PROCESSES

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To improve the quality of the technological process of thermal impact on a technical system, the paper proposes mathematical models, computational methods for calculating and optimizing the technical parameters of emitters. This made it possible to develop an algorithm for controlling the consumption of resources in many technical and biotechnological systems that contain concentrated, discrete, moving sources of thermal load.

To optimize the parameters of technical systems that contain sources of physical

fields, it is necessary to propose methods from interdisciplinary research. This is primarily due to the fact that boundary value problems with partial differential equations are used to analyze the state of these systems. The boundary conditions are set in accordance with the technical characteristics of the load sources, considering the expert assessment of the system parameters. Since the boundary value problems with differential equations describe not one physical phenomenon but several physical processes in the modeled systems, the dimension of the space of the desired parameters is quite significant and in general, it depends on the number of load sources and the dimension of the area where they are located.

Quite often, it is necessary to optimize the parameters of technical systems to improve the quality of technological processes of thermal impact on the material by, for example, minimizing the deviation of the temperature field in a given area of the material from its predefined permissible value. Limitations imposed on the limits of change in the technical parameters of radiators are generally nonlinear and their number depends on the number of parameters to be changed. In general, due to the non-standard shape of the objects under study under the influence of thermal load sources, the domain of admissible solutions is multi-connected. The analysis of processes occurring in modeled systems is possible only after obtaining solutions to boundary value problems with differential equations. Optimization of the technical parameters of systems is possible only after obtaining the values of the objective function and is ensured through a repeated iterative process of searching for its local extremes, which is achieved through the repeated implementation of a series of boundary value problems in the process of mathematical modeling. In addition, to solve boundary value problems and obtain the values of the objective function, it may be necessary to use not one but several computational methods [1, 2]. This will increase the accuracy of the implementation of boundary value problems, but will also complicate applied optimization mathematical models for finding and searching for local extremes of the temperature field.

Since analytical (approximate-analytical) solutions exist only for classical domains, in order to improve the accuracy of optimization and control over resource consumption in technical systems, it is necessary to prove the correctness of boundary value problems, applied optimization mathematical models for finding local extrema of the objective function and the general problem of improving the quality of thermal effects on a technical system by taking into account the constraints on the resulting temperature field of the material. In [3], to find and substantiate the conditions for the correctness of boundary value problems with differential equations of heat conduction and applied optimization mathematical models for biotechnological systems, it is proposed to apply the theory of pseudo-differential operators over the field of specialized functions. Improving the detail of the modeled systems, increasing the number of technological process features considered in the implementation of boundary value problems and applied optimization mathematical models, made it possible to improve the accuracy of calculation and optimization of technical parameters of the modeled systems, and also increased the accuracy of solving the general problem of controlling the consumption of resources of technical systems.

The use of the above approach for calculating and optimizing parameters in

technical systems has made it possible to develop an algorithm for controlling resource consumption in many technical and biotechnological systems that contain concentrated, discrete, moving sources of thermal load. The specificity of the mathematical models and computational methods proposed in this paper is that they should be used to solve not specific, partial tasks, but to solve the general problem of resource consumption control in these systems. As the object of study changes, boundary value problems, methods for solving them, and searching for local extremes of the temperature field will change, but the proposed algorithm will remain unchanged. This indicates the interdisciplinarity of the above studies and their wide application to control resource consumption in many systems with distributed parameters.

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OPTIMAL DESIGN FOR TWO-DIMENSIONAL COMPOSITE STRUCTURES

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The problem of optimal design of structures made of composite materials is considered. The optimal design of laminated plates and shells subject to constraints on strength, stiffness, bending loads and fundamental natural frequencies is proposed.

Composite materials are now widely used in the mechanical and aerospace industries because they enable designers to achieve significant weight savings [1, 2]. Another advantage is that more complex shapes can be produced due to the manufacturing techniques used, and the total number of parts can be significantly