MATHEMATICAL MODELLING OF THE PROCESSES IN THE REAL GASES

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In this work we are considering the approach for the mathematical modeling of interrelated thermo-dynamic and hydrodynamic processes in real gases. The specific feature of the approach, is the method of forming the equations of state during the construction of mathematical models for processes and the way to solve the model equations.

A numerical approach is proposed to generate the equations of state. This approach is based on the analysis of experimental data. Analyzed properties of substances belong to the regions of existence of liquid, steam and gas phases, with a first-order discontinuities at the interfaces.

The method comprises the following steps [1]:

1. Search of the experimental data. According to the conditions of the problem, for each individual substance that is involved in this process, the search of the table dependencies state parameters is conducted.

2. The processing of table relationships. Received tables are approximated by analytical functions. It is known that, at phase transitions, some thermodynamic characteristics such as density, viscosity, specific heat, undergo considerable abrupt changes. According to this, some difficulties with approximation of data characteristics in mathematical model is arised. Therefore, for each task, the most appropriate approximation algorithm is chosen (linear, cubic spline interpolation), which allows to use the values in this diapasons without large mistakes.

3. Construction of the mathematical model. The mathematical model includes the obtained approximation relationships, basic equations of thermodynamics and the laws of conservation of energy. Thus, the equation of state are replaced by approximations for the table values of thermodynamic parameters. Depending on the specific conditions, an additional equation may be present in the mathematical model. These equations consider the heat exchange with the structural elements, the working fluid leaks through the seals, phase changes, chemical reactions, and so forth.

4. The solution of model equations. The solution method is based on an analytical solutions of of linear differential equations system for the local temporal and spatial domains of intervals where processes are taking place. The solution is carried out iteratively; as a result, the required parameters of the working fluid and the energy-characteristics of current processes are determined.

References

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