BASIC PRINCIPLES OF CREATING COMPLEX METHODS OF EFFICIENCY EVALUATION AND OPTIMIZATION OF HEAT-UTILIZATION SYSTEMS

Stepanova A., Fialko N., Navrodskaya R.
Institute of Engineering Thermophysics, NAS of Ukraine,
Kiev, st. Zhelyabova 2a, tel. 380444532858, nmfialko@ukr.net

Objective. Improving the efficiency of heat-recovery systems of power plants based on the development and application of integrated methods of efficiency analysis and optimization.

The results. As a necessary general stage for the development of these techniques, new criteria for evaluating the efficiency have been proposed, which are highly sensitive to changes in the parameters of heat recovery systems and serve as optimization functions. For simple thermodynamic systems, techniques have been developed, including the determination of the functional dependencies of selected performance criteria on the main system parameters using balance methods of exergy analysis and statistical methods for experiment planning. For complex heat recovery systems, complex techniques have been developed, based on the basic principles of structural variant methods, multi-level optimization methods, the theory of linear systems, and the thermodynamics of irreversible processes. The main stage of the methodology, based on the principles of structural-variant methods, is to optimize the elements of the heat-recovery system, the change in the losses of exergy power in which most significantly affects the change in the efficiency of the system as a whole. The developed methodology, based on the principles of multi-level optimization, as the main stage includes the reduction of complex multi-criteria and multi-parameter optimization tasks for heat recovery systems to the simpler local mutually agreed optimization problems of each level. The main stage of the methodology, based on the principles of the theory of linear systems, consists in recording the mass balances, energy and exergy of the installation under study in a matrix form. Techniques based on a combination of exergy methods and methods of thermodynamics of irreversible processes include obtaining the differential equation of exergy and, on its basis, obtaining formulas for calculating exergy power losses due to the movement of heat carriers and non-equilibrium heat exchange between them.

Findings. Developed a comprehensive methodology for analyzing the effectiveness and optimization of heat recovery systems. It was established that a reasonable choice of methodology increases the effectiveness of optimization of the heat-recovery system, which, in turn, increases its efficiency by 3-4%.