Optimal planning and optimization system gasoline blending formulations

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Abstract

The relevance of the work. Gasoline compounding is the process of intensive blending of gasoline components and a small amount of high-octane additives to maintain the required quality parameters of commercial gasoline, such as octane numbers according to research and engine methods, saturated vapor pressure according to Reid, etc. Gasoline blending process is one of the important and final stages in the process chain of units at refineries, which determines the quality of commercial gasoline and, as a consequence, the efficiency of production in general. From a set of possible formulations of blending components that meet the specification of commercial gasoline, one is selected, in accordance with the selected optimality criterion, which ensures the efficiency of gasoline compounding. The efficiency of the process is achieved by reducing the cost of expensive gasoline components, minimizing costs through optimal scheduling of the blending process. Thus, the task of improving the efficiency and optimization of gasoline production processes is highly relevant both from the point of view of improving product quality and from the economic point of view.

The aim of the work. The purpose of the dissertation work is the problem statement, development of mathematical models, algorithms and software package of optimal planning and optimization of blending formulations of gasoline and fuel oil production.

Tasks solved in the dissertation work are:

1. Analysis of existing in practice systems of preparation and optimization of compounding processes of commercial gasoline;
2. Development of a mathematical model of gasoline blending taking into account the nonlinear dependence of a number of quality indicators of gasoline blends (octane numbers, Reid saturated vapor pressure) and fuel oil (viscosity);
3. Development and implementation of online optimization models and algorithms under conditions of parametric uncertainty as a tool for solving the problem of gasoline blending process efficiency.

4. Development of a software complex of optimal planning and optimization of blending formulations of gasoline and fuel oil production.

Scientific novelty.

Scientific novelty consists in the following:

1. The mathematical model of gasoline and fuel oil blending taking into account nonlinearity of fuel mixture quality indicators and uncertainty of technological mode parameters has been developed;
2. The system of optimal control of gasoline blending under conditions of parametric uncertainty is developed;
3. An algorithm for an intelligent system for monitoring and controlling the blending process in gasoline production in real time to reduce the impact of perturbations on the compounding process has been developed;
4. Developed a combined algorithm of auto-associative neural network and optimal formulation planning and optimization software system for modeling and controlling gasoline blending process;
5. Mathematical models and algorithms for optimization of scheduling operations of gasoline production process have been developed.

Practical significance.

1. Criteria for optimization of gasoline and fuel oil blending formulations from the point of view of maximum production of commercial gasoline are formulated;
2. A model and algorithm for online monitoring of the measuring system elements using auto-associative neural networks and statistical data analysis apparatus for grouping them according to their belonging to technological modes and self-correction of erroneous measurements for each of these groups are proposed;
3. A database and a software package for solving the problems of optimal planning and optimization of blending recipes for gasoline and fuel oil production have been developed.

The main provisions for the defense:

1. Methods for development of mathematical models and control systems in off/online modes and optimization of gasoline blending formulations;

2. Mathematical model and results of calculation of gasoline and fuel oil blending formulations;

3. An intelligent system for real-time control of gasoline blending under conditions of parametric uncertainty;

4. Software system and results of optimal planning and optimization of gasoline blending formulations.