ZAŁĄCZNIK NR 4

do Wniosku o wszczęcie postępowania w sprawie nadania stopnia doktora

Abstract

The subject of the present work is the analysis and optimization of the natural gas liquefaction system using the waste exergy available in the natural gas transmission and distribution system. The scope of the research covers both the analysis of measurement data of real objects and the identification of waste energy sources, construction and simulations of natural gas liquefaction models as well as the optimization of the unit.

Firstly, an analysis of the measurement data of fourteen facilities was carried out, i.e. two reduction stations supplying fuel gas for compressor stations, two gas compressor stations, and ten reduction stations supplying city areas.

Based on the performed analysis, potential sources of waste energy were estimated and the key source used to create a model of a reduction-liquefaction unit with zero energy consumption was indicated. A model of an integrated reduction station and a natural gas liquefaction unit with a 'black box' integration and a full, deep integration, which connects the reduction station facility and the natural gas liquefaction line into one facility, was developed. The design of the reduction-liquefaction station system was prepared, the work of the proposed system was analyzed and thermodynamic indicators such as efficiency and energy consumption of the process were estimated.

Optimization of the operating parameters of the reduction-liquefaction unit in order to increase the exergy efficiency, reduce the thermo-ecological cost and the energy consumption of the system was performed. On the basis of the obtained results, a highly efficient, zero energy-consuming system of a reduction-liquefaction unit was proposed.

During the thesis development, the exergy efficiency of natural gas liquefaction units was increased from a reference level of approximately 30% to a level of 90% after system optimization. Each stage of the work was associated with increasing the efficiency of the system.