# METHODOLOGY FOR ASSESSING THE ENERGY EFFICIENCY OF HEAT-TECHNOLOGICAL EQUIPMENT FOR OIL AND GAS PROCESSING INDUSTRIES

**[1]Nodirbek Rustambekovich Yusupbekov, [2]Shukhrat Manapovich Gulyamov, [3]Nasiba Djumabayevna Xodjiyeva, [4]Yusuf Shodiyevich Avazov, [5]Bakhodir Akilovich Sharipov**

Tashkent State Technical University named after Islam Karimov Address: 2, University str., 100095, Tashkent, Uzbekistan[1,2,4], Tashkent University of Information Technology named after Muhammad Al-Khorazmi Address: 108, Amir Temur Avenue, 100200, Tashkent, Uzbekistan[3,5]

yusufbek_avazov@mail.ru,yusuf.avazov@tdtu.uz, nhojieva8@gmail.com, bahodir.61@mail.ru

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## ABSTRACT

Based on the analysis of the current state of the theory and practice of deep processing of hydrocarbon raw materials, the relevance and relevance of developing a methodology for assessing the energy and resource efficiency of heat-technological devices and installations with the introduction of the efficiency coefficient Ke, which allows taking into account not only the thermodynamic characteristics of the heat-technological system, but also the design characteristics of the studied technological structure, is shown. It is shown that the use of the considered technique in the development of optimal energy-saving systems can significantly reduce energy consumption.

***Keywords: energy and resource saving, heat technology equipment, methodology for assessing the energy efficiency of heat technology systems.***

***Аннотация:*** На основе анализа соверменного состояния теории и практики глубокой переработки углеводородного сырья показана актуальность и востребованность разработки методики оценки энерго- и ресурсоэффективности теплотехнологических аппаратов и установок с введением коэффициента эффективности $К_э$, позволяющего учитывать не только термодинамические характеристики теплотехнологической системы, но и конструктивные характеристики исследуемой технологической структуры. Показано, что использование рассматриваемой методики при разработке оптимальных энергосберегающих систем позволяет существенно сократить энергопотребление.

***Ключевые слова:*** энерго- и ресурсосбережение, теплотехнологическая аппаратура, методика оценки энергоэффективности теплотехнологических систем.

***Аннотация***: Углеводородли хомашёларни чуқур қайта ишлаш назарияси ва амалиётининг замонавий ҳолатини таҳлил қилиш асосида иссиқлик-технологик тизимларнинг нафақат термодинамик хоссаларини, балки тадқиқ этилаётган технологик структураларнинг конструктив тавсифларини ҳам ҳисобга олиш имконини берадиган самарадорлик коэффициенти $К_с$ ни киритиш орқали иссиқлик-технологик аппаратлар ва қурилмаларнинг энергия ва ресурс самарадорлигини баҳолаш услубиятини ишлаб чиқишнинг долзарблиги ва аҳамияти кўрсатиб берилган. Кўриб чиқилаётган услубиятдан оптимал энергиятежамкор тизимларни ишлаб чиқишда фойдаланиш энергия истеъмолини сезиларли даражада камайтириши кўрсатилган.

***Таянч сўзлар:*** энергия ва ресурсларни тежаш, иссиқлик-технологик қурилмалар, иссиқлик-технологик тизимларнинг энергия самарадорлигини баҳолаш услубияти.

## INTRODUCTION

One of the priority areas for improving the efficiency of energy and resource efficiency of hydrocarbon processing processes is to increase the use of secondary fuel and energy resources, maximize the use of heat recovery and optimize the technological modes of operation of technological complexes and installations [1].

In a number of cases, the technological equipment of oil and gas processing industries does not provide the necessary regulatory parameters even after optimization. Therefore, it is economically feasible to implement and introduce highly efficient resource-saving equipment. Along with increasing the thermal efficiency of such process equipment, it often becomes necessary to solve the problems of improving the operational reliability, metal consumption and maintainability of process equipment [2].

**Determination of the energy efficiency of the functioning of heat technology equipment**

Let us turn to the problem of determining the economic efficiency of the operation of heat-technological equipment using the example of installing an atmospheric-vacuum tube (AVT) of an oil refinery, all the technological equipment of which is interconnected. To determine the effectiveness of such equipment, initial data are needed to fully display the technological processes occurring in the apparatus. These necessary initial data are obtained through experimental studies.

Let us consider the issues of studying the thermodynamic characteristics of the heating unit of the primary oil refining unit and creating optimal energy-saving heat exchange systems that reduce the use of secondary energy resources, maximize the use of recuperated heat and optimize the operating modes of heat technological installations. In our case, the evaluation of the efficiency of the systems under study is carried out according to the quality criterion or the efficiency criterion, the search for which for specific industrial conditions is a rather difficult task [3].

To optimize the operation of the existing scheme of the heating block, it is proposed to use the following optimality criterion - the efficiency factor of the $K_E$

$$K_E = \frac{K_s \sum_{i=1}^{n} F_{act}}{\sum_{i=1}^{n} F_{ins}} = \frac{(1,15 \div 1,2) \sum_{i=1}^{n} F_{act}}{\sum_{i=1}^{n} F_{ins}}$$

where $\sum_{i=1}^{n} F_{act}$ – actual required area of the heat transfer surface of the heat exchange system, m$^2$; $\sum_{i=1}^{n} F_{ins}$ – installed area of the heat transfer surface of the heat exchange system, m$^2$; $K_s$ – safety factor of heat exchange surface.

When optimizing the heating block, the $K_E$ coefficient should tend to unity, as follows:

$K_E \rightarrow 1$, when $\sum_{i=1}^{n} F_{act} \rightarrow \sum_{i=1}^{n} F_{ins}$.

The use of the $K_E$ coefficient in the development of optimal energy-saving heat exchange systems makes it possible to take into account not only the thermodynamic characteristics of the heat exchange system, such as the amount of heat transferred (heat flow), flow rates, the coefficient of contamination of the heat exchange surface, but also the design characteristics of the heat exchanger. The selected efficiency factor also allows you to judge how useful the heat exchange surface of the apparatus is used. Inefficient use of the heat exchange surface actually leads to equipment downtime, and, therefore, to excessive capital costs and depreciation charges.

Using the selected criterion as an example, the circuits of heating blocks of the AVT of the Chinaz Oil Refinery were optimized. The degree of heat recovery at these plants is 37.105%, after optimization, the calculated degree of heat recovery of waste process streams is 42.613%.

The influence of the degree of heat recovery in the heating block on the operation of process furnaces of primary oil refining units, in which additional heating of desalted oil after the heating block takes place before it is fed into the distillation column, is determined. As a result, the consumption of fuel gas increases and there is a shortage of dry gas. In this case, crude gas of primary processing is sent to the furnace, the calorific value of which is more than 35% higher than dry gas. In addition, their combustion temperatures differ by 600 °C. Periodic replacement of one type of gas with another negatively affects the operation of tubular furnace coils. With insufficient heat recovery of process flows in heat exchangers for heating oil, these flows enter refrigerators with an elevated temperature. This leads not only to the loss of heat, which can be additionally used in the heating unit and reduce fuel consumption, but also to the hard work of the refrigerators themselves. The required temperature of the flows at the outlet of the refrigerators is not provided. Technological products are sent to the park with increased temperature. The temperature of the circulating water at the outlet of the submersibles increases. This leads to losses of the latter from evaporation and requires additional costs for cooling. Experiments on refrigerators of primary oil refining units confirm the above [4].

## CONCLUSION

Oil refineries are the largest consumer of fuel and energy resources, including fuel, heat and electricity. Efficiency The rationality of their use in oil refining processes is largely determined by the efficiency of the process equipment of the enterprise.

To meet today's requirements, existing installations must be redesigned, when investment in new equipment must be kept to a minimum by making full use of existing equipment. Optimization of equipment operation is necessary for another reason. Existing plants were designed and built in times of much cheaper energy than now, so it is urgent to provide measures to save it.

A feature of the processing of hydrocarbon raw materials is that the technological processes themselves are not perfect. Thus, the processes of primary oil refining consume 1.91 tons of reference fuel. for processing 100 tons of oil with a theoretically required 1.016. At the same time, at oil refineries and petrochemical plants, only 30-35% of the received thermal energy is used, and the rest (with low-potential thermal energy) becomes non-recuperative-capable. For example, about 36% of the energy entering the plant leaves with cooling water or air, up to 16% is released into the atmosphere together with the flue gases of process furnaces, 12-14% of the energy is dissipated into the environment in the form of heat given off by the hot surfaces of the equipment.

At present, the task of increasing the thermal efficiency of heat-technological equipment of oil refineries is in demand. For this, it is necessary to experimentally determine the degree of energy efficiency of the operation of heat-processing equipment of oil refining industrial productions and the development of energy-saving heat exchange systems that would allow the use of heat exchangers already involved in the technological chain with minimization of capital costs.

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***Information about authors:***

*1. Nadirbek Rustambekovich Yusupbekov Academician, Doctor of Technical Sciences, Professor of Department “Automation of Production Processes”, TSTU, dodabek@mail.ru*

*2. Shuxrat Manapovich Gulyamov Doctor of Technical Sciences, Professor of Department “Automation of Production Processes”, TSTU, shukhrat.gulyamov@mail.ru*

*3. Nasiba Djumabayevna Xodjiyeva PhD, Department of "System and Applied Programming" Tashkent University of Information Technologies, Tel.:(+99894) 683-38-37 , nhojieva8@gmail.com*

*4. Yusuf Shodiyevich Avazov PhD, Associate Professor, Doctoral Candidate of the Department “Automation of Production Processes”, TSTU, yusufbek_avazov@mail.ru*

*5. Bakhodir Akilovich Sharipov. Applicant of the Department "System and Applied Programming" Tashkent University of Information Technologies bahodir.61@mail.ru*