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СОВРЕМЕННЫЕ ТЕНДЕНЦИИ СОЗДАНИЯ ЭНЕРГО- И РЕСУРСОСБЕРЕГАЮЩЕГО ОБОРУДОВАНИЯ В ХИМИЧЕСКОЙ ПРОМЫШЛЕННОСТИ

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В настоящей статье представлен анализ тенденций развития энерго- и ресурсосберегающего оборудования в химической промышленности. Рассмотрены четыре основных направления создания энерго- и ресурсосберегающего оборудования: увеличение большой единичной мощности агрегатов на примере производства аммиака; разработка и внедрение оборудования комбинированного принципа действия; модернизация основных узлов оборудования и режимно-конструктивная оптимизация с целью существенной интенсификации протекающих в нем гидродинамических тепло- массообменных процессов; осуществление качественной технической диагностики и ремонта, позволяющих проводить модернизацию оборудования и повышать долговечность его работы. Сделан вывод о том, что при отсутствии модернизации оборудования с ненадлежащей организацией ремонтных работ затраты на техническое обслуживание и ремонт отдельных видов оборудования в период его эксплуатации в несколько раз превышают стоимость нового оборудования.

Ключевые слова: энергосбережение, ресурсосбережение, оборудование, оптимизация.

In the chemical industry in Russia and other developed countries, energy and resource-saving technologies are inconceivable without energy and resource-saving equipment. The decrease in the prime cost of the products of the chemical industry is usually achieved by increasing the capacity of apparatuses of large unit capacity while reducing the specific energy consumption (kWh / tonne of output) and maintaining the reliability of the equipment at a certain level.

An example of an increase in the unit capacity of chemical production can be the production of ammonia, when in the early 70s the first apparatuses had a capacity of 1360 tonne NH3 per day, but at the end of the last century - 1800 tonne NH3 per day. For example, in Kingisepp, the capacity of one unit and, accordingly, of the whole production, increased to 2,200 tonne NH3 per day. However, increasing the efficiency of a single unit operating under high pressure is not cost-effective, as increases the diameter of the apparatus and, consequently, the wall thickness increase. There are also problems of ensuring the reliability of the seals of the lids of units and ensuring the durability of the entire chain of apparatuses.

The solution to the problem of reducing the cost of production along the first path almost always faces a reduction in the durability of the equipment, especially if its design does not change. Increasing the efficiency of operating equipment without its modernization leads to an increase in the speed of movement of intermediates and

products, which, naturally, increases the abrasive and corrosive wear of the structural elements that contact the flows.

Increasing the efficiency of individual equipment and the rates of corrosive and abrasive wear sometimes leads to a significant decrease in the durability of the equipment, which is not always taken into account in calculating the economic efficiency of industrial production lines, while increasing their efficiency to the operating limits. The increase in the capacity of apparatuses of a large unit capacity without the reconstruction of equipment leads to a reduction of the between-repairs run of the main equipment and not always taken into account the reduction of the running time between of major repairs.

The second approach to reducing the cost of production is significantly less frequent: the development of a new technology for the manufacture of products, or with the reduction of a number of intermediate stages, or with the combination of several processes in one unit of equipment, when several mutually intensifying processes take place in parallel or one after another. Capital expenses connected with lower prices of the equipment.

The practice of the last years of development and implementation of energy and resource saving technologies and equipment shows that the greatest economic effect from their introduction into production is observed in cases when one research and design institute undertakes to develop these technologies and the new equipment to be put into the project and it also participates in the process of launching the projected facilities. Responsibility for new developments is increasing and the result of the project implementation is good.

An example of such work "from project to object" is the work done by the Research and design institute of carbamide in Dzerzhinsk. For example, for PJSC "Metafrax" from 2016 to the present, a project of complexes connected with each other producing "Ammonia-Carbamide-Melanin" is being implemented. The project documentation for the complex is being implemented (ISBL / OSBL objects); OSBL "turnkey" objects are built (working documentation, delivery of all equipment, execution of construction, installation and commissioning works).

For Ammonia OJSC, Mendeleevsk, Tatarstan (2010-2015), the “Ammonia-Methanol-Carbamide” complex is being implemented jointly with the Japanese company “Mitsubishi”. Scope of work: project documentation for the complex; construction of OSBL objects "turnkey" (working documentation, equipment supply, construction and installation and commissioning works). During commissioning, in addition to NIIK's commissioning and commissioning specialists, there is a GUI for this project, which already corrects the small project shortcomings at the production site, which allows to significantly shorten the commissioning and start-up time and quickly reach the design efficiency.

The regime-constructive optimization of equipment with the use of modern means of automation and reliable maintenance, allows in a number of cases to increase efficiency by 25-30% and significantly reduce the specific energy consumption. Another direction of significant reduction of energy and resource costs due to operating equipment in the chemical industry is the increase in the durability of apparatuses of large unit capacity due to the regular examination of wall thicknesses by methods of nondestructive testing, the use of additional means of protection against corrosion, the conduct of qualitative repairs of the main equipment units undergoing major repair.

With that end in view, for example, in a city Great Novgorod the specialised repair organisation "Akron-repair" having qualified workers for repair of the equipment and necessary control and measuring equipment for an estimation of its durability and reliability has been created.

The increase in the longevity of the equipment is parallel in two directions:

a) improving the quality of the assessment of the repairability of the main equipment units;

b) increasing durability due to the protection of wear parts from abrasive and corrosive wear of equipment while using new materials.

The most promising in terms of increasing the durability and economy of production is the use of new materials during major overhaul. One of the ways to increase the productivity of existing equipment and, accordingly, the reduction of specific energy inputs is the development of new design solutions for the main units of machines and devices that allow changing the hydrodynamic conditions and significantly improve heat and mass transfer processes, which, in turn, allows to increase efficiency of machines and devices at the same dimensions of the equipment.

Unfortunately, such solutions during capital repairs, which simultaneously allow increasing the longevity of the operation of the main equipment with increasing its efficiency, are extremely rare, due to the long period of agreement on changes in the equipment design with the firms that manufacture this equipment.

A significant increase in the durability of industrial equipment in most cases operating at elevated pressures of 32 MPa or more, temperatures from 100 to 15000C in super-corrosive mixtures (mixtures of several acids) is the implementation of competent technical diagnostics. Technical diagnostics, conducted at certain intervals, determines the technical condition of the equipment.

It is one of the most important elements of increasing the durability of equipment and the system of industrial safety management. The purpose of technical diagnostics is to maintain the established level of reliability, to ensure the safety requirements and the efficiency of the use of equipment.

The main task of technical diagnostics is to recognize the state of equipment in conditions of limited information, but with the use of modern monitoring devices, for example, wall thicknesses that allow not only to determine the minimum average wall thickness, but also to find zones of local corrosion and abrasive wear. Based on the results of such a qualified diagnosis, recommendations are given to the repair services of enterprises to eliminate local wear zones in order to increase the durability of industrial equipment.

Competent organization of not only technical diagnostics, but also, first of all, repair works, are the most important factors for increasing the durability of machines and devices of the chemical industry and, accordingly, energy and resource saving. In the absence of modernization of equipment, with improper organization of repair work, the costs of maintenance and repair of certain types of equipment during its operation are several times higher than the cost of new equipment.

Decrease in expenses for maintenance service and major repairs, which heads of some the large chemical enterprises now have, finally leads not positive, and to negative economic balance because of loss of qualified personnel, impossibility of acquisition as spare parts, and modern means of restoration and modernization of the worn out details.

Long-term work of the repair services of large chemical plants indicates that modern methods of restoring parts can restore parts with virtually any defects of natural wear, while ensuring their high reliability and greater durability compared to the new ones. The cost of restoring parts on average is no more than 30-50% of the cost of manufacturing new ones, and the basic details - much less.

In this connection, it is completely economically inexpedient to reduce the repair service at large enterprises, but on the contrary, it is necessary to allocate addition-

al funds to them for the purchase of modern devices for determining reliability, durability of the main equipment and devices for restoring parts that can significantly increase the durability of its wear parts.

Therefore, the issues of rational use of equipment, the prevention of losses in production due to faults and accidents, the reduction of operating costs, the carrying out of qualitative repairs with the modernization of the main equipment components, increasing the hydrodynamic, heat and mass transfer characteristics thereof, while increasing the longevity, is one of the main factors of the increase energy and resource saving of operating equipment.

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MODERN TRENDS IN THE CREATION OF ENERGY AND RESOURCE-SAVING EQUIPMENT IN THE CHEMICAL INDUSTRY

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In this paper the analysis of the trends in the development of energy and resource-saving equipment in the chemical industry is provided. Four basic directions of creation the power- and resource-saving equipment are considered: increase in the big individual capacity of units at an example of manufacture of ammonia; working out and introduction of the equipment of the combined principle of action; modernization of the basic knots of the equipment and regime-constructive optimization for the purpose of an essential intensification proceeding in it hydrodynamic warmly – mass transfer processes, realization of qualitative technical diagnostics and the repair, allowing to spend modernization of the equipment and to raise durability of its work. The conclusion that is drawn, in the absence of modernization of equipment with improper organization of repair work, the costs of maintenance and repair of certain types of equipment during its operation are several times higher than the cost of new equipment.

Key words: energy saving, resource saving, equipment, optimization.