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Carrying out the repair work at petroleum refineries

Annotation. *The development of the oil refinery is directly related to the peculiarities of the socio-economic environment, which is determined largely by the favorable conditions of activity of all branches of economy of the Republic of Kazakhstan, a stable regulatory processes of all normative-legal framework of implementation of market reforms and efficiency of making management and innovative solutions in the oil refining industry of the Republic of Kazakhstan. Currently, a lot of efforts are being made to scale modernization of all production processes, as well as modernization of equipment of the oil refining complex of the country*

Keywords: *coking, repair, oil refining industry, operation, reactor, oil, tubular furnaces, heat exchangers*

Introduction. The leading direction of the economic strategy of the Republic of Kazakhstan remains the improvement of production efficiency and the quality of oil products. These tasks solve by the development and implementation of a set of measures to improve product quality and economic efficiency of oil refineries.

A comprehensive solution to improving product quality and production efficiency requires cost optimization. One of the most important components is working machines and technological equipment used in production.

The dominant factor in ensuring the quality of products and the efficiency of petrochemical production is the quality of work of technological equipment, which is ensured by maintenance and repair.

The quality of maintenance and repair of equipment depends on:

– quality standards and normative and technical documentation;

– quality of operational and repair and instrumental equipment;

– quality of spare parts and materials;

– quality of work of persons performing maintenance and repair of equipment.

Therefore, the quality of the repaired equipment is determined by two factors: the quality of the equipment itself, intended for repair and the quality of equipment repair.

To ensure the quality of the repaired equipment at the production associations should be organized:

– incoming inspection of equipment, spare parts and materials supplied to the enterprise;

– development and application in the processes of maintenance and repair of high-quality operational, repair, technological and design specifications and estimates with the mandatory conduct of their examination, technological control and control standards;

– inspection of the equipment used for technological accuracy, equipment and timely verification of measuring instruments necessary in the processes of maintenance and repair.

– work quality control of persons operating and repairing equipment, with registration of warranty obligations for reliable operation of equipment after repair and maintenance during the period of after-sales guaranteed running hours [1].

Materials and methods. In addition, maintenance and repair of equipment should be organized and carried out in order to ensure the equipment is in good condition and ready for work on the basis of timely and high-quality maintenance and repair at the lowest relative cost of their implementation, as well as to improve the equipment through its modernization.

Achievement of these goals is ensured by:

– the selection and ordering of equipment having a higher level of maintainability, manufacturability during maintenance and repair;

– improving the organization of maintenance and repair based on the creation of specialized repair organizations, industries, workshops, sections and crews;

– increasing the concentration and specialization of repair work based on the expansion of cooperation in the repair of equipment and the manufacture of spare parts;

– maximum use in the repair of spare parts of equipment manufacturing plants;

– increasing the level of mechanization and equipment of the processes of maintenance and repair based on the rational organization of the instrumental economy, maintenance in good working order of the operational, repair and technological equipment and tools;

– improving the logistics of the processes of maintenance and repair based on the creation of a working assets of replaceable equipment, spare parts and materials;

– an increase in the level of performance standards during maintenance and repair, equipped on the basis of the development and implementation of technically sound labor standards, consumption rates for materials and spare parts, as well as the introduction of a defect-free system and a brigade form of organization and stimulation of labor.

The system of maintenance and repair of technological equipment is based on the mandatory planning, organization and conduct, with a given sequence and frequency, of the relevant types of maintenance and repair, as well as on the mandatory control, accounting and reporting, standardization of indicators of durability and maintainability of equipment.

It should be noted that the systematic increase in the capacity of oil refineries, increased requirements for the quality of produced oil products and raw materials for petrochemical synthesis are invariably accompanied by an increase in the equipment fleet while improving structures and improving the operational characteristics of machines and instruments.

Currently the supplied equipment in most cases meets modern requirements and ensures reliable operation of technological plants. At the same time, the effective use of each type of equipment, lengthening its service life, maximum duration of working runs and reducing downtime for repairs and revisions depend not only on the design and technological features, but also on the correct, technically competent operation of the complex of machines, instruments and transport means with which the technological installation is equipped [5].

The concept of “operation” is important, which includes not only maintenance and repair, but all stages of the life cycle of the equipment at which the production is carried out. Also, the operation process characterizes the intended use of the equipment, its transportation and storage conditions. Operation is divided into two components: the use of machines for their intended purpose and technical operation.

Intended use is the use of a product (machine) for the purposes stipulated by the technical conditions and instructions approved by the supplier.

Technical operation includes transportation, storage, maintenance and repair of the machine.

General management of the operation of the equipment is carried out by the oil refining company, on whose balance sheet the equipment is located. The equipment is directly operated by the territorial production enterprises that are part of this company or its branches. The quality of the operation system is manifested during its operation. The process of equipment operation can be provided as a sequential change in the various stages of operation through which the equipment passes. The whole range of equipment repair operations can be classified into two groups:

1) Scheduled preventive maintenance;

2) Defect detection work [6].

Revision of technological pipelines “on-line” is relevant in oil refining. The results of the audit serve as the basis for assessing the condition of pipelines and the possibility of its further operation. The most used equipment is ultrasonic thickness gauges. These innovative instruments are ideal for almost any type of measurement and are fully compatible with all transducers. They have a wide range of applications: from measuring the compaction of pipe walls to high-frequency measuring the thickness of thin or multilayer materials using transducers. Range data converters are listed in the Table 1 [2]

Their advantages are that production shutdown is not required; it is possible to plan equipment repairs in advance, to identify defective areas in a timely manner.

Table 1 – Measured temperature range from – 20 c to +500 c

Converter	Frequency (MHz)	Connector	Diameter (mm)	Temperature range °C	Steel range (mm)	Cable
D 790	5,0	straight	11,00	from -20 to 500	from 1 to 500	integrated
D 790-CM	5,0	straight	11,00	from -20 to 500	from 1 to 500	integrated
D 790-RL	5,0	90	11,00	from -20 to 500	from 1 to 500	integrated
D 790-SL	5,0	straight	11,00	from -20 to 500	from 1 to 500	integrated
D 791	5,0	90	11,00	from -20 to 500	from 1 to 500	integrated
D 791-RM	5,0	90	11,00	from -20 to 400	from 1 to 500	integrated
D 792	10,0	straight	7,20	from 0 to 50	from 0,5 to 25	integrated
D 793	10,0	90	7,20	from 0 to 50	from 0,5 to 25	integrated
D 794	5,0	straight	7,20	from 0 to 50	from 0,75 to 50	integrated
D 797	2,0	90	22,90	from -20 to 400	from 3,8 to 635	integrated

Continuation table 1

D 797-SM	2,0	straight	22,90	from -20 to 400	from 3,8 to 635	integrated
D 7226	7,5	90	8,90	from -20 to 150	from 0,71 to 100	integrated
D 798-LF	7,5	9090	8,90	from -20 to 150	from 0,71 to 100	integrated
D 798	7,5	straight	7,20	from -20 to 150	from 0,71 to 100	integrated
D 798-SM	7,5	straight	7,20	from -20 to 150	from 0,71 to 100	integrated
D 799	5,0	90	11,00	from -20 to 150	from 1 to 500	integrated
MTD 705	5,0	90	5,10	from 0 to 50	from 1 to 19	integrated
D 7906-SM	5,0	straight	11,00	from 0 to 50	from 1 to 50	integrated
D 7906-RM	5,0	90	11,00	from 0 to 50	from 1 to 50	integrated
D 7908	7,5	90	7,20	from 0 to 50	from 1 to 37	integrated

Also, the processing of heavy residual raw materials affects the maintenance and repair of equipment, the main of which is coking, which remains an economically successful technology for processing oil residues.

The world's leading coking companies are Conoco Philips (now it is a part of the company BECHTEL), Foster Wheeler (both develop delayed coking technology) and Exxonmobil (continuous coking technology). The experience of these companies in the design and operation of plants will significantly improve the economy, reliability and flexibility of the process.

Coking allows not only to obtain a valuable product - coke, which is in demand in many industries, but also to implement a number of technologies that guarantee the extensive use of this process in the production of motor fuel, improving the environmental situation and sanitary conditions of oil refinery plant). The coking process is a powerful “nurse” at the oil refinery plant [3].

The main units of the delayed coking unit are tube furnaces, reactors, heat exchangers.

The main apparatus of the DC (delayed coking unit) is the reactor (hollow coke drum). To reduce DC duty cycle time, the reactor cooling process is accelerated before coke unloading. However, the faster the cooling and heating of the reactor, the shorter its service life, the higher the likelihood of occurrence of deformation, swelling, cracks and breaks on the body. These defects usually occur at welded joint sites. The best option was the proposal to minimize the length of the most vulnerable, susceptible to cracks and splits annular seams.

It is known that DC heat exchangers (delayed coking unit), which preheat viscous raw materials with high coking properties, quickly clog up. It is possible to suspend its pollution, as well as extend the life by 3-4 times by turning the segments of the tube sheets so that they are located in the spiral itself [4].

Results. Modern remote-controlled hydraulic tools from Ruhrpumpen, as well as special remote-controlled valves of Delta Velve, Sulzer, which are already used on domestic DC (delayed coking unit), help accelerate coke unloading, increase safety and improve working conditions for personnel. B Recently, a closed coke unloading and intra-coke processing system has been proposed - Close Coke Slurry System, TRIPLAN license. This system can significantly reduce both the coke processing time and the number of staff. All this not only increases the efficiency of delayed coking, but also improves the ecology and working conditions of staff. In a number of delayed coking plants, the method of layer-by-layer coke unloading is used: a mechanical drill with a rotating hydrocutter is periodically moved from the top to the base of the layer and back. In this case, the coke is cut in the direction from the center to the walls of the chamber. This method reduces the cutting time, gives less coke particles and eliminates the problem of jamming of the drill.

In modern conditions, the domestic version of deep oil refining, taking into account the rational use of heavy feedstocks, should include various coking technologies in production schemes of oil refining plants to produce coke not only as a target product, but also as an inexpensive energy carrier.

Pavlodar Petrochemical Plant has become an innovator – the first enterprise among the group of companies of the KazMunaiGas Refining and Marketing JSC, introducing an effective preparation system for major repairs as part of the transition to an extended interrepair cycle.

TMP (theoretically maximum performance) – is a planning method that is aimed at the final result, and its main goal is optimization of work.

Discussion. Thanks to this modernization of the oil refinery plant in Kazakhstan, the fuel shortage of concern to many people was resolved and its environmental friendliness increased. In 2018, Kazakhstan completed the modernization of three fairly large oil refineries: in Atyrau, Pavlodar and Shymkent. This was done in order to cover the fuel shortage in the domestic market. As a result, the main volume of oil refining increased from 14.17 to 17.6 million tons of oil, and the production of high-octane gasoline - from 2.7 and 5.427 million tons. An excess of gasoline and diesel appeared on this market, the environmental friendliness of the fuel itself improved to Euro-4 level. However, changes at the refineries are concluded not only in the volume of output, but also in the arrangement of the refineries: much more attention, for example, was paid to the automation of production processes, digital technologies are also being introduced everywhere.

Pavlodar Petrochemical Plant was launched in 1987. Accordingly, Russian oil is the raw material for it, because initially the enterprise was built to process raw materials from West Siberian fields. Its chemical and physical composition is different from our Kazakhstani oil, therefore it is strictly forbidden to use it at the refinery.

The design capacity of the plant is the processing of 6 million tons of crude oil per year. The product line includes automotive gasoline with diesel, liquefied gases, fuel oil with coke and bitumen with sulfur. Now they are joined by jet kerosene Jet A-1. They could master its production precisely thanks to the modernization.

Conclusion. The main manufacture of this plant is the LK-6U installation. The very same components of gasoline of the AI-92 and AI-95 brands, fuel for fast engines of the RT brand, diesel fuel, oil product and also household gases are directly manufactured here. It is worth to mention that for the first time they announced modernization in 2010, and it ended at the Petrochemical Plant (Pavlodar Petrochemical Plant) at the end of 2017. In addition to increasing output, the main effect is considered to be an increase in the depth of oil refining up to 85 %. Also, it is important that since 2017 two new technological complexes were commissioned at the plant: the isomerization complex and the naphtha splitter and the complex of sulfur production facilities. The reconstruction of already existing complexes of primary and deep oil refining and a delayed coking unit was completed. And now the AI-92 and AI-95 gasoline and diesel fuel produced here comply with the international environmental standards Euro-4, or K4 and K5 in the Customs Union. [4]

Thus, we believe that repair work and equipment operation at the country's oil refining enterprises should be interconnected with modernization and activation of activities in the field of stimulating innovative processes of the industry development in order to reduce overall costs, plan measures to reduce the likelihood of risk situations and to develop an expansion strategy for petroleum product sales. The transport infrastructure is gradually expanding, which has an impact on the development of oil refineries in the Republic of Kazakhstan.

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Мұнай өңдеу өнеркәсібі кәсіпорындарында жөндеу жұмыстарын жүргізу

Мұнай өңдеу өндірісін дамытуҚазақстан Республикасы экономикасының барлық салалары қызметінің қолайлы жағдайларымен, нарықтық өзгерістерді жүзеге асырудың барлық нормативтік-құқықтық негіздерін реттеудің тұрақты процестерімен, сондай-ақ Қазақстан Республикасы өнеркәсібінің мұнай өңдеу секторында басқарушылық және жаңашыл шешімдер қабылдаудың тиімділігімен елеулі дәрежеде айқындалатын әлеуметтік-экономикалық ортаның ерекшеліктерімен тікелей байланысты. Қазіргі уақытта барлық өндірістік үдерістерді ауқымды модернизациялауға, сондай-ақ елдің мұнай өңдеу кешенінің жабдықтарын модернизациялауға көп күш жұмсалып отыр.

Түйін сөздер: *коксту, жөндеу, мұнай өңдеу өнеркәсібі, эксплуатация, реактор, мұнай, құбырлы пештер, жылу алмастырғыштар.*

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Проведение ремонтных работ на предприятиях нефтеперерабатывающей промышленности

Развитие нефтеперерабатывающего производства напрямую связано с особенностями социально-экономического окружения, которое, по сути, определяется в значительной степени благоприятными условиями деятельности всех отраслей экономики Республики Казахстан, стабильными процессами регулирования всех этих нормативно-правовых основ осуществления рыночных преобразований, а также эффективностью принятия управленческих и новаторских решений в нефтеперерабатывающем секторе промышленности Республики Казахстан. В настоящее время много усилий прилагается к масштабной модернизации всех производственных процессов и оборудования нефтеперерабатывающего комплекса страны.

Ключевые слова: *коксование, ремонт, нефтеперерабатывающая промышленность, эксплуатация, реактор, нефть, трубчатые печи, теплообменники.*