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REDUCTION OF CORROSION RATE AT THE CIRCULATING WATER SUPPLY UNIT OF THE PAVLODAR OIL CHEMISTRY REFINERY

One of the key tasks facing the international community of oil refineries is the development of complex approaches to improving the reliability of equipment and protecting materials from aggressive influences.

The water circulation supply system at petrochemical and gas processing enterprises is one of the main elements of the technological process.

In the water circulation systems of oil refining and petrochemical industries, there is a constant deposition of hardness salts from the cooling water on the surfaces of equipment and pipelines, the deposited salts, being a substrate, as a result of the vital activity of sulfate-reducing bacteria, aerobic and other microorganisms, become overgrown with biological deposits. Such deposits destroy the protective (inhibitory, oxide film) metal film, as a result of which the underclam corrosion progresses, due to of deposition. Therefore, the development of modern methods of corrosion protection of water circulation systems of petrochemical enterprises is one of the most important problems of the industry.

This article presents an analysis of the possibility of reducing the corrosion rate on the recycled water supply unit by optimizing the reagent treatment program, reducing the loss of recycled water for non-technological needs, and dismantling the bridges between the systems.

Keywords: corrosion, methods of corrosion protection, corrosion control, oil refining equipment, reagent regime, corrosion rate.

Introduction

Metal equipment and structures in refineries and petrochemical plants come into contact with crude oil, petroleum products and fuels, solvents, water, atmosphere and soil. All processes involving aggressive substances take place in metal equipment at temperatures from minus 196 °C to plus 1400 °C and pressure from vacuum to 1000 bar. Refineries and petrochemical plants are a high-risk industry because the media are flammable, explosive, toxic to human health, or harmful to the environment. The combination of many factors makes refinery equipment very vulnerable to various corrosion phenomena that can lead to serious accidents [1].

Despite many studies and advances in the field of corrosion control and monitoring in the petrochemical refinery, corrosion problems have increased over the past 20 years. This is due to the introduction of new technological processes, materials, stringent requirements for fuel quality, etc.

Currently, the main methods of corrosion control at refineries include:

- selection of corrosion-resistant or suitable materials;
- correct design;
- use of anti-corrosion chemicals;
- control of technological parameters;
- use of coatings;
- cathodic protection;
- as well as verification and control at all stages of the application of these actions [2, 3].

Corrosion of metal equipment and structures in refineries occurs in various media and phases in a very wide range of conditions in refineries and oil chemical plants can be divided into 5 groups.

1) Low temperature (temperature below 100 °C) corrosion in the presence of electrolytes (usually water and aqueous electrolyte solutions such as dissolved corrosive gases (e.g., HCl, H_2S, NH_3) or dissolved salts (e.g. NaCl, Na_2 SO_4).

2) High-temperature (temperature above 200 °C) corrosion caused by non-electrolytes (usually gaseous H_2S and H_2; naphthenic acid corrosion; hot room corrosion; oxygen oxidation in furnaces).

3) Corrosion at intermediate temperatures (from 100 °C to 200 °C), which can occur in the presence of electrolytes (for example, amines) or non-electrolytes (SO, SO_3) depending on the substances and conditions.

4) Corrosion in natural environments: in the atmosphere, in soil and natural waters.

5) Specific corrosion phenomena: dew point corrosion; corrosion under thermal insulation; boiler feed water corrosion and steam condensate corrosion [4].

Materials and methods

The water circulation system in petrochemical enterprises is one of the main elements of the technological process, circulating water is used as a refrigerant for all refrigeration and pumping equipment, which makes up most of the equipment in oil refineries. In the water circulation systems of oil refining and petrochemical industries, hardness salts are constantly deposited from the cooling water on the surfaces of equipment and pipelines. The settled salts, being a substrate, are overgrown with biological deposits as a result of the vital activity of sulfate-reducing bacteria, aerobic and other microorganisms. Such deposits destroy the protective film of the metal, as a result of which under-sludge corrosion progresses due to precipitation [5].

According to the nature of pollution, wastewater from the POCR is divided into industrial wastewater and wastewater from an electric desalination plant. There are two separate sewerage systems for wastewater collection at the POCR [6].

Neutral effluents contaminated with oil products and mechanical impurities from the LK-6U plants, the KT-1 complex, the hydrogen production unit, the sulfur production unit, the bitumen production unit, the washing and steaming station, commodity parks, and the cooling water purge line are sent to the sewerage system I, as well as storm sewage from the plant.

Wastewater from the oil treatment unit (electric desalination plant) of the LK-6U unit, sulphurous alkaline effluents from the alkalizing units of the KT-1 complex, drainage effluents from POCR sites, wastewater after flushing from loading racks, wastewater after a washing and steaming station, and process condensate [7, 8] are directed to the II (II, IIa) sewage system.

The existing complex of treatment facilities consists of two mechanical treatment systems, two biological treatment systems and a common oil sludge treatment system.

The systems I, II, IIa were put into operation together with the start of operation of the plant.

Since 2018, these systems have been treated with the following reagents: bactericide, technical sodium hypochlorite, corrosion inhibitor, dispersant , two types of iron dispersant , non-oxidizing biocide , sodium caustic technical . The company that supplied the reagents, including the maintenance of the reagent processing program, issued recommendations on the effective use of reagents.

In order to carry out operational control over the water-chemical regime and determine the actual corrosion rate, flow coils equipped with slots for installing corrosion witness samples (coupons) were mounted. Corrosion coupons are exhibited for 60 days in the coil and in the cooling tower bowl to control the corrosion rate of the circulating water coming from the plants and sent to them [8, 9].

To optimize the reagent treatment program, a number of measures were taken based on the recommendations of the supplier company. As well as:

- reduction of losses of recycled water at the plant's units for non-technological needs;
- dismantling of jumpers between systems I, II and IIa [9].

Results and discussion

When monitoring the corrosion rate, the following results were obtained.

Figure 1 shows that the corrosion rate for the 1st system more than halved from 0.4 mm/year to 0.19 mm/year: for the 2nd system – more than 5 times from 0.39 mm/year year, up to 0.07 mm/year; according to the IIa system more than 2 times – from 0.13 mm/year to 0.05 mm/year [10].

The system IIa before the introduction of the reagent treatment program was a clean system with a corrosion rate of about 0.1 mm/year, since it was used mainly for cooling jackets of pumping and compressor equipment, and after the introduction of the program, the corrosion rate was 0.05 mm/year, which is significantly below the norm.

Figures 2, 3 present data on corrosion rate monitoring in systems I and II [10].

As can be seen from Figure 3, starting from March 2020, the corrosion rate did not exceed the norm.

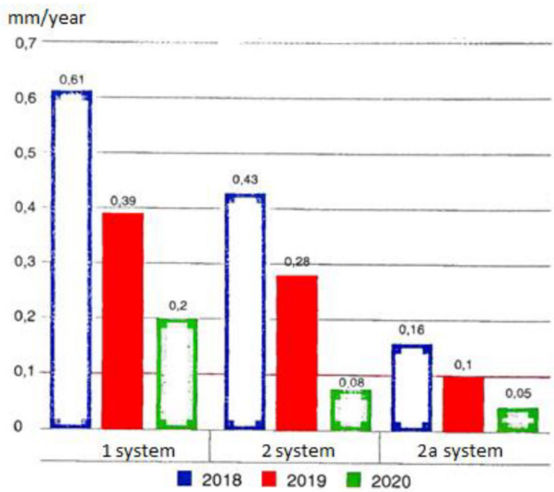

Figure 1 – Average corrosion rate by years

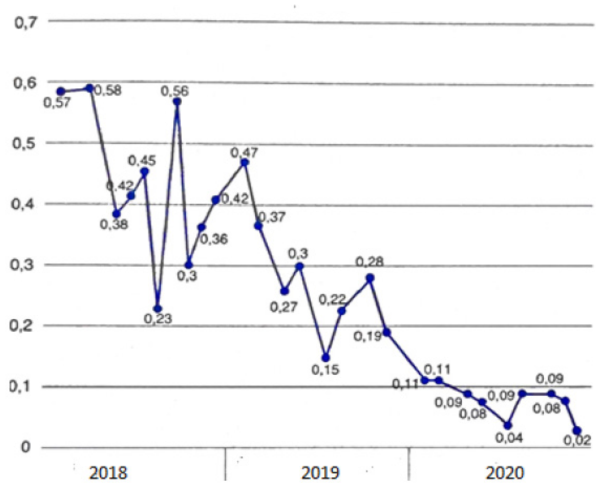

Figure 2 – Corrosion rate monitoring graph in system II
(for coupons made of steel 20)

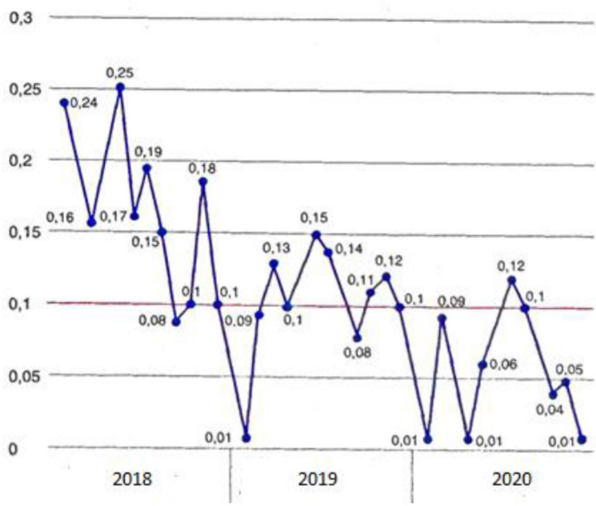

Figure 3 – Corrosion rate monitoring graph in system I
(for coupons made of steel 20)

Conclusions

Therefore, it can be concluded that the introduction of a reagent program, as well as a reduction in the use of recycled water for non-technological needs, due to the use of water from the return of treated wastewater, a decrease in the consumption of make-up water and the dismantling of jumpers between systems, made it possible to significantly reduce the corrosion rate of the 1st, but so far it does not reach the norm of 0.1 mm/year.

This is because the 1st system has the largest volume, and, consequently, it involves a large amount of equipment and, as a result, a greater probability of black oil leakage and system contamination. According to the 2nd system, the corrosion rate decreased by more than five times.

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ПАВЛОДАР МҰНАЙ-ХИМИЯ ЗАУЫТЫНЫҢ АЙНАЛМАЛЫ СУМЕН ЖАБДЫҚТАУ БЛОГЫНДА КОРРОЗИЯ ЖЫЛДАМДЫҒЫН ТӨМЕНДЕТУ

Мұнай өңдеу кәсіпорындарының халықаралық қауымдастығының алдында тұрған негізгі міндеттердің бірі – жабдықтың сенімділігін арттыру және материалдарды агрессивті әсерден қорғау мәселелеріне күрделі тәсілдерді әзірлеу.

Мұнай-химия және газ өңдеу кәсіпорындарындағы сумен жабдықтау жүйесі технологиялық процестің негізгі элементтерінің бірі болып табылады.

Мұнай өңдеу және мұнай-химия өндірістерінің су айналым жүйелерінде жабдықтар мен құбырлардың беттеріндегі салқындатқыш Судан тұрақты тұнба пайда болады, сульфатты төмендететін бактериялардың, аэробты және басқа микроорганизмдердің тіршілік әрекеті нәтижесінде шөгінділер биологиялық шөгінділермен толып кетеді. Мұндай шөгінділер *металдың қорғаныш (ингибиторлық, оксидтік үлдірін) үлдірін бұзады, соның салдарынан тұнба коррозиясы өршиді. Сондықтан мұнай-химия кәсіпорындарының су айналымы жүйелерін коррозиядан қорғаудың заманауи әдістерін әзірлеу саланың маңызды мәселелерінің бірі болып табылады.*

Бұл мақалада реагентті өңдеу бағдарламасын оңтайландыру, технологиялық емес қажеттіліктерге арналған судың шығынын азайту, сондай-ақ жүйелер арасындағы секіргіштерді бөлшектеу арқылы айналмалы сумен жабдықтау блогындағы коррозия жылдамдығын төмендету мүмкіндігі туралы талдау келтірілген.

Кілтті сөздер: коррозия, коррозиядан қорғау әдістері, коррозияны бақылау, мұнай өңдеу жабдықтары, реагент режимі, коррозия жылдамдығы.

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СНИЖЕНИЕ СКОРОСТИ КОРРОЗИИ НА БЛОКЕ ОБОРОТНОГО ВОДОСНАБЖЕНИЯ ПАВЛОДАРСКОГО НЕФТЕХИМИЧЕСКОГО ЗАВОДА

Одна из ключевых задач, стоящих перед международным сообществом нефтеперерабатывающих предприятий – разработка сложных подходов к вопросам повышения надежности оборудования и защите материалов от агрессивного воздействия.

Система водооборотного снабжения на нефтехимических и газоперерабатывающих предприятиях является одним из главных элементов технологического процесса.

В водооборотных системах нефтеперерабатывающих и нефтехимических производств происходит постоянное осаждение из охлаждающей воды солей жесткости на поверхностях оборудования и трубопроводов. Осевшие соли, являясь субстратом, в результате жизнедеятельности сульфатредуцирующих бактерий, аэробных и других микроорганизмов обрастают биологическими отложениями. Подобные отложения разрушают защитную (ингибиторная, оксидная пленка) пленку металла, в результате чего прогрессирует подшламовая коррозия, вследствие осаждения. Поэтому разработка *современных методов защиты от коррозии водооборотных систем нефтехимических предприятий является одной из важнейших проблем отрасли.*

В данной статье представлен анализ по возможности снижения скорости коррозии на блоке оборотного водоснабжения за счет оптимизации программы реагентной обработки, сокращения потерь оборотной воды на нетехнологические нужды, а также выполнен демонтаж перемычек между системами.

Ключевые слова: коррозия, методы защиты от коррозии, контроль коррозии, нефтеперерабатывающее оборудование, реагентный режим, скорость коррозии.

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