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PRODUCTION AND RESEARCH OF CORROSION INHIBITORS FOR THE OIL AND GAS INDUSTRY.

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Keywords. Corrosion, oil, gas, condensate, nitrogen, sulfur.
Abstract. This article provides information on corrosion in metal structures in the oil and gas industry, measures to prevent it, and analysis methods.

ПРОИЗВОДСТВО И ИССЛЕДОВАНИЕ ИНГИБИТОРОВ КОРРОЗИИ ДЛЯ НЕФТЕГАЗОВОЙ ПРОМЫШЛЕННОСТИ.

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Ключевые слова. Коррозия, нефть, газ, конденсат, азот, сера.
Аннотация. В статье приведены сведения о коррозии металлических конструкций в нефтегазовой отрасли, мерах по ее предотвращению и методах анализа.

Oil is the largest source of energy consumed by the world's population, surpassing other energy resources such as natural gas, coal, nuclear energy and renewable energy. 90% of the world's energy consumption comes from petroleum products [1].

The total consumption of motor fuels in the world is 1.75 billion tons per year, including the need for motor gasoline is more than 800 million tons per year [2].

After the 20th century, the demand for energy has increased dramatically due to the rapid industrialization of the world, accelerating economic growth, improving living standards, modern transportation system, technology and the energy sector, which depends only on limited oil reserves. By 2050, energy consumption will be completely replaced by biofuels. Oil is the world's most important source of life and chemicals, with consumption currently estimated at 12 million tonnes per day (84 million barrels per day) and projected to increase to 16 million tonnes per day (116 million barrels per day) by 2030 [3].

Motor gasoline is the main product of the petrochemical industry. About 25% of the world's oil is refined into gasoline, the primary fuel for automobiles.

Research Method and Processes. There are currently over 1 billion cars in the world. Every year, their number exceeds 100 million. The world leader in automobile production is China, with a production share of 26.76% (Figure 1). The total volume of automobile production in the United States, Germany, and Japan is equal to that of China:

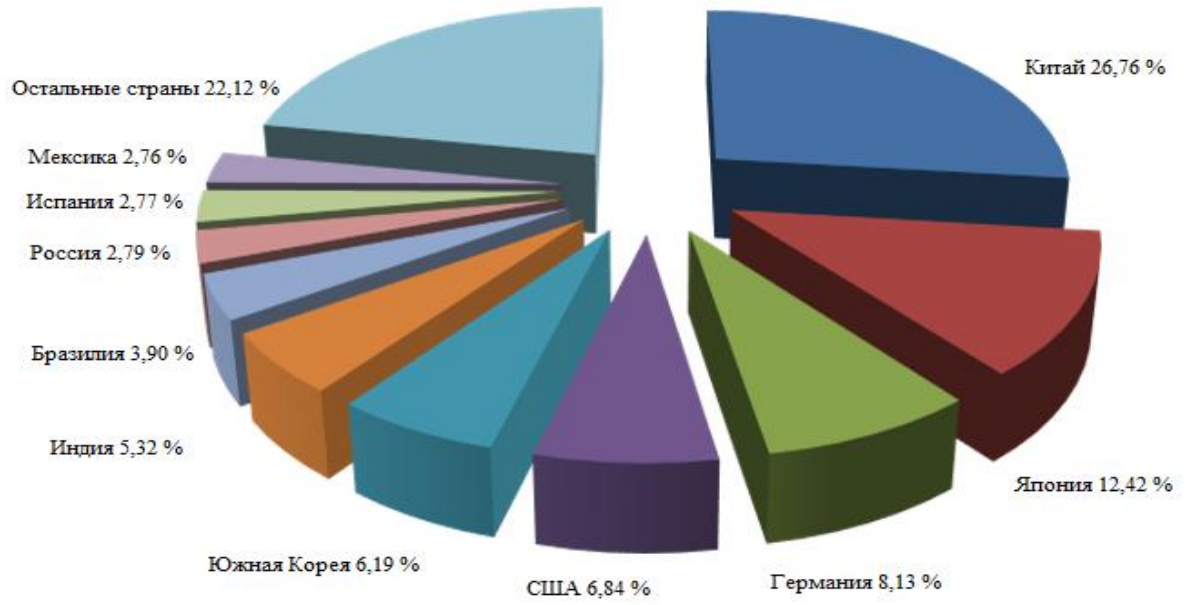

Figure 1 – Major car producing countries.

(share of total cars produced in the world)

Gasoline is a fuel intended for use in spark-ignition internal combustion engines. Gasoline is widely used in agriculture, aviation, as a solvent for paints and varnishes, and for other household purposes. The technological processes for obtaining gasoline fractions used as gasoline components include: primary oil refining, catalytic cracking, catalytic reforming, alkylation, isomerization, thermal cracking; visbreaking, pyrolysis, hydrocracking, hydrotreating. Automobile gasoline is a fuel that boils in the temperature range of 28-215°C and is intended for combustion in internal combustion engines. According to its intended purpose, gasolines are divided into automobile and aviation. The main indicators of gasoline are explosion resistance (octane number), saturated vapor pressure, fractional composition, chemical stability, and the amount of sulfur and aromatic compounds. In recent years, the tightening of environmental requirements for the quality of petroleum fuels has limited the amount of aromatic hydrocarbons and sulfur compounds in gasoline. Modern automobile gasolines, as petroleum products, are usually prepared by combining individual components in the form of fractions that can be obtained directly and by methods of catalytic cracking, reforming, hydrogenation processes - hydrotreatment, hydrocracking and petrochemical processes - alkylation. Gasoline is also obtained on the basis of polymerization, isomerization, as well as some other processes of thermal processing of oil and petroleum residues.

The IR spectrum of the PF-1 corrosion inhibitor we synthesized and used in the test was provided to investigate its composition and structure.

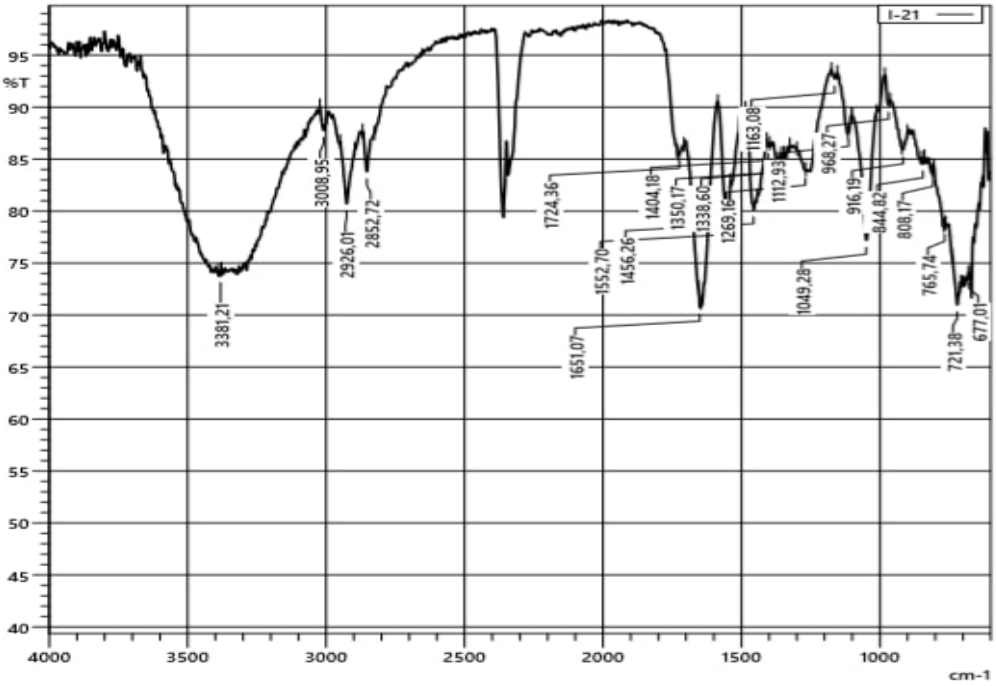

Figure 2. IR spectrum of PF-1 brand corrosion inhibitor

The composition and structure of the PF-1 corrosion inhibitor were studied using IR spectrometer technology (IK-Fure, SHIMADZU, Japan) in the range up to 4000 cm^{-1}. In the IR spectroscopy of the inhibitor used for corrosion protection of the PF-1 brand, asymmetric and symmetric valence vibrations of CH_2 groups were observed in the regions 2926-2852 cm^{-1}. In the region 1456 cm^{-1}, we can see asymmetric deformation vibrations of CH_2 groups. One of the most characteristic absorption regions for the product was the symmetric valence vibrations of (N-C) at 1112 cm^{-1}. Absorption lines corresponding to the valence vibrations of the C=O group are observed in the IR spectrum range 1650-1820 cm^{-1}. The intensity of the absorption line corresponding to this vibration is greater than that of the other absorption lines in the IR spectrum. According to the results of this analysis, the corrosion inhibitor we tested contains nitrogen, which indicates that it has anti-corrosion properties.

Taking into account these problems in the oil and gas industry, we conducted testing processes of the PF-1 brand corrosion inhibitors containing nitrogen in our synthesis at different temperatures and in different proportions and selected the proportions and temperatures that were acceptable for us and provided high levels of protection.

The protection levels, corrosion rates and surface coverage coefficients of our PF-1 brand corrosion inhibitor, which we synthesized based on the processing of organochlorine waste and synthesized using fatty acids, were calculated based on the results of the test studies. The test results were carried out gravimetrically in accordance with the requirements of GOST - 9.506.87.

The protection levels of the PF-1 brand corrosion inhibitor soluble in petroleum products were studied at different proportions. In this case, the inhibitor concentration was 3%, and the test time was 72 hours.

Table 1

Corrosion rates, protection levels, and surface coverage coefficient values for various mass ratios of PF-1 brand corrosion inhibitor

Mass ratios P:F	Corrosion rate	Protection level	θ
1:1	0,065	72,31	0,7231
1:2	0,08	89	0,89
1:3	0,071	78,98	0,7898
2:1	0,058	64,5	0,645
3:1	0,051	56,7	0,567

As a result of the tests, we can see from Table 1 that the best mass ratio of the organochlorine mixture and fatty acid was found to be 1:2, and the protection level was 89%.

PF-1 inhibitors obtained on the basis of the processing of these organochlorine wastes are widely used in oil, gas, gas condensate wells, in the process of drilling wells, and in the production of oil and fatty acids.

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