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DEVELOPMENT OF AUTOMATED ANALYTICAL SYSTEMS OF PHYSICAL AND CHEMICAL PARAMETERS OF OIL AND PETROLEUM PRODUCTS

Abstract: *In this article highlights of development of automated analytical systems for optical control of physical and chemical parameters of oil and petroleum products.*
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Introduction

With increased production and consumption of fuel and energy products, development of oil and gas transportation systems, quality control tasks production, as well as reducing production costs by resource saving and energy efficiency improvement of enterprises they have become urgent. Modern operating practices fuel and energy companies confirm the feasibility of using technological analyzer complexes not only for solving such problems tasks, but also for monitoring the safety of enterprises and environmental monitoring.

Solving these problems requires the use of modern methods design and use a wide range of the latest industrial analytical equipment, as well as the creation of information and analytical systems and complexes of various profiles, adapted to the specific conditions of work in enterprises.

Integrated industrial analyzer systems complexes can be successfully used on almost all chemical and petrochemical enterprises, transport and pipeline systems, as well as in the metallurgical and food industry.

Just 20 years ago, there was a revolution in the field of analytical chemistry of a wide variety of materials. Its first component was a theory developed about 10 years earlier-the mathematical theory of multiparameter nonlinear correlations, whose practical application became possible with the advent of powerful industrial computers. Its second component was the technique of IR spectroscopy in the near and middle IR range. IR analyzers in the near-infrared region (BIC analyzers or NIR-analyzers), created on this principle, have been used to control the quality of a wide variety of materials and indicators that are completely far from infrared Spectroscopy.

For example, in the field of oil refining and petrochemistry, using NIR-analyzers began to control the octane number of gasoline or cetane number of diesel fuel, and, in addition, a variety of other indicators, up to the fractional composition. What relationship can be found between the compression ratio of gasoline on a single-cylinder engine and the IR spectrum of gasoline? Perhaps a very indirect and distant connection can be through the component composition. Since the chromatogram clearly conveys the component composition; each component has its own peak, and it is possible to calculate physical and chemical parameters using the chemometric approach.

However, attempts to make an octanometer from a chromatograph were unsuccessful. At the same time, the absorption array of gasoline in the IR spectrum, where there are no peaks of individual compounds (all CH, CH2 or CH3 groups have the same absorption peak), has become more informative than a clear chromatogram. The reason is that, according to the theory of multiparameter nonlinear correlations, it is possible to form an "image" of the octane number, just as our brain forms an image of a smell from the signals of receptors from individual substances or distinguishes the image of an individual from a set of photos of other people. A complex mathematical model allows you to recognize images of fuel with different octane numbers, different fractional composition, etc., not to mention simpler tasks such as determining the content of oxygenates, aromatics, benzene, etc. This was the essence of the analytical revolution: very quickly and using standard technology, it became possible to determine a lot of indicators.

The relevance of chemometric methods on the one hand is a significant increase in global production and consumption of hydrocarbon fuels in the late 20-early 21 century, increasing requirements for the quality of motor fuels and tightening requirements for the environmental burden of fuel and energy companies and the petrochemical complex on the environment. On the other hand, the creation of new computerized generations of analytical devices and automatic control systems, automated analytical systems based on them.

Thus, to date, specific information technologies have appeared that are designed to ensure the production, transportation and consumption of high - quality petroleum products while ensuring energy conservation, technological, explosion and environmental safety. Currently, the technical regulations for the production of motor fuels adopted by the government of the Russian Federation encourage oil companies to produce high-octane and low-sulfur motor fuels, for which almost all major vertically integrated oil companies are undergoing production reconstruction and implementing in-line quality analyzers. An assessment of the effectiveness of using analytical equipment capabilities in projects implemented in the last 3-5 years shows that neither enterprises using complex analytical equipment nor design organizations have a clear idea of how to choose the most appropriate equipment and achieve maximum efficiency in the case of specific technological applications. This situation is due to the lack of experience in the practical application of industrial flow analyzers in most enterprises and gaps in the regulatory and technical framework. Currently, there is no recommended regulatory documentation for the use of flow devices and analyzers (for example, similar to API 551 and API 555). Moreover, specific issues related to the metrological aspects of the application of sectrophotometric analyzer software, which is actively implemented at refineries as a means of operational technological control in the implementation of projects for gasoline displacement stations, as well as for primary oil distillation, isomerization, etc., have not yet been studied in detail. Therefore, a detailed understanding of the measuring capabilities of spetrophotometric analyzers is now particularly relevant. Currently, companies and institutions that license and control technological processes and installations recommend using only specialized analyzers to analyze the main physical and chemical parameters of petroleum products (for example: viscosity, density, fractional composition, flash point, low-temperature properties, etc.), since:

1. Measurement of these parameters by methods that are not standard and not applied to petroleum products (for example, using spetrophotometric IR analyzers) cannot provide the accuracy of measurements required for technological control and is practically not used in the practice of oil refining

2. When determining the fractional composition, especially large errors occur when determining the start and end points of boiling, and even when using laboratory devices.

3. The use of R & d analyzers (mainly portable) to determine certain parameters of fractional composition (for example, temperatures of 50% and 90% of distillate) is justified only for Express analysis of motor fuels, which is confirmed by the practice of their use in mobile quality laboratories.

4. Despite the advantages of R & d measurements such as continuity and multithreading, it is recommended to conduct a detailed analysis of their metrological characteristics in order to determine the feasibility of their use for technological control.

5. The use of IR analyzers as a means of technological control is recommended when determining the research and motor octane numbers, but in this case, it is necessary to conduct a detailed account of the capabilities of specific models of analyzers.

Organic sulfur compounds are a natural component of crude oil. When exposed to heat during oil refining, sulfur and its compounds are found in petroleum products in various concentrations.

The main existing sulfur-containing compounds and sulfur in petroleum products have the following forms:

- Hydrogen sulfide H2S, formed by thermal decomposition of sulfur-containing compounds;
- Elemental sulfur, a product of hydrogen sulfide oxidation;
- The mercaptans R-SH;
- Sulfides or thioesters of I-B-I.;
- Disulfides and polythioesters I-B... B-I;
- Thiophene C4Y4 S and its derivatives, etc.

We know that the presence of these compounds is undesirable, because they give oil products an unpleasant smell, cause corrosion of equipment and pollute the atmosphere during combustion. Also, sulfur compounds destroy expensive catalysts for oil refining and, releasing sulfur oxides into the atmosphere during combustion, create global environmental problems for us.

The world has developed a number of optical methods and devices for determining sulfur in the ultraviolet, x-ray, near-infrared and IR range. The choice of a suitable optical method for solving this analytical problem depends on the nature and composition of the analyzed object, the required concentration range, accuracy, and budget capabilities of the laboratory. The purpose of this work is to analyze existing laboratory optical methods for determining sulfur, compare their capabilities and limitations, and develop an optoelectronic method for determining the sulfur content in oil and petroleum products.

In conclusion, we can say that the proposed device increases the accuracy of measurement by repeatedly measuring the parameters of the controlled liquid and summing the electrical signals from several photodetectors. In addition, using this device in the laboratory, you can determine the content of sulfur, transmit the sulfur spectra to a PC and the operator can fill in the passport of the oil product.

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