

ARTICLES

Reliability of the Assessment of Water Pollution by Petroleum Hydrocarbons and Phenols Using Some of Total Indices

R. M. Khatmullina^a, V. I. Safarova^{a, *}, and V. Z. Latypova^b

^aDepartment of State Analytical Control, Ufa, 450104 Bashkortostan, Russia

^bKazan Federal University, Kazan, 420008 Tatarstan, Russia

*e-mail: guugak@mail.ru

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Abstract—The problems of the application of total indices “phenolic index” and “petroleum products” for water quality assessment are considered. It is demonstrated that these indices do not reflect the actual contamination of aquatic media by phenols and petroleum hydrocarbons. The effect of hydrocarbons of different classes on the error in determining petroleum products was revealed. The presence of phenols and other organic compounds was found to affect the results of the determination of the phenolic index. It is necessary to identify pollutants contained in wastewater to assess the applicability of total indices in the analysis of such waters. Marker components of wastewater must be included in the research program, in addition to total indices.

Keywords: phenolic index, phenol, oil products, petroleum hydrocarbons, HPLC, IR spectrophotometry

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A chemical-analytical study of the environment and sources of its contamination is a specific and complex section of analytical chemistry because many of the impurities are contained in the investigated objects in trace amounts. Samples of wastewater, effluents, and components of the natural environment are usually complex multicomponent systems, in which a large number of different inorganic and organic substances are present. Thus, there may be compounds in wastewater, represented by the target products, by-products, or intermediates formed in the technological process. In the process of wastewater treatment, new compounds can also form, and their properties may be unavailable.

Water pollution by xenobiotics is most often assessed by the results of determination of general and total (group) indices and, more rarely, of individual compounds [1]. Depending on the purpose, the list of components to be determined, appropriate analytical methods, sample preparation methods, and standard reference samples (or a mixture of substances) for measurement are specified.

Total indices are used to estimate the total concentration of pollutants that have similar properties and group them according to some characteristic, based on which measurements are made [1–3]. However, in a real sample of sewage or natural water, subject to anthropogenic processes, a complete list of components involved in the formation of an analytical signal cannot be determined. Therefore, the compounds that

are not related to the desired group of substances can contribute to the numerical expression of these indices, or, on the contrary, some of them are taken into account. The indices “phenolic index,” “petroleum products,” and some others are among the most common integrated indices in eco-analytical practice.

The goal of the work was to consider the factors that form the indices of the phenolic index and petroleum products and to assess the scope of their application in the control system of natural and waste waters.

EXPERIMENTAL

The objects of the study were sewage waters from oil refineries and petrochemical enterprises, domestic wastewater, and river water, that is, the recipient of wastewaters.

The total concentration of phenols volatile with steam (phenolic index) was determined by the standard procedure [4]. The method is based on the distillation of phenols from an acidified water sample, their reaction with 4-aminoantipyrine (4-AAP) in the presence of potassium hexacyanoferrate(III) at pH 10, extraction of the resulting colored reaction products with chloroform, and measurement of light absorption at 460–490 nm using a KFK-2 photocolormeter (Russia) in cuvettes with an optical path length of 5 cm. The results of the analysis were evaluated using the previously plotted calibration curve.