Comparative assessment of extraction methods of 3,4-benzopyrene from soils, bottom sediments and sewage sludge

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Annotation. The article is devoted to the scientific basis and principles of extraction methods of extraction of 3,4- benzopyrene (B(a)P) from soils, bottom sediments and sewage sludge, which can be used in monitoring studies, particularly in assessing the impact on the environment; in assessing the degradation changes in the soil; in monitoring the state of soils, as well as in assessing the natural and disturbed ecosystems from human activity in general; in the environmental regulation of soil pollution and other degradation processes. The data obtained may be useful in the development of environmental maps of priority pollutants. The results of studies of 3,4- B(a)P from soils, B(a)P sediments and sewage sludge can be used for zoning, actual and forecast parameters; in forecasting the environmental consequences of economic activity in the area; in assessing the risk of disasters; in assessing the feasibility and effectiveness of soil remediation contaminated with oil and petroleum products, during the environmental assessment, certification, certification of the territory or economic object of industrial and construction, industrial and transport, agro-industrial and industrial and commercial complexes.

Introduction

Nowadays a large-scale technospherization takes place in many countries all over the world, transforming them into urban areas. Accumulated waste is the cause of soil contamination with contaminants of biological and chemical origin [1].

Scientific substantiation, search of ecologically safe, economically justified, acceptable express methods and their application in practice as an innovative method of extraction of 3,4-B(a)P from sewage sludge is not a fully solved problem in applied science. Polyaromatic compounds (PAHs) occupy leading places among the common harmful factors in the habitat of plants, animals and human substances-ecotoxicants, in the complex socio-economic damage caused to the environment [2]. Most of them are formed in the enterprises engaged in oil and gas processing, industrial and energy complex, as well as the reason for their formation is road transport, chemical and oil refining industry. 3,4- B(a)P, due to its high toxicity, contaminant, carcinogenic and other unexplored and unknown properties, comes out on top in the priority pollution of the environment and in the negative impact on plants, animals and human health indicators.

3,4-B(a)P has a general structural chemical formula and is a representative of the class of polycyclic aromatic hydrocarbons (PAHs) – organic compounds, which are characterized by the presence of three or more condensed benzene rings in the chemical structure. The melting and boiling point of 3,4-B(a)P is 177°C and 456°C, respectively [2]. It is established that the studied organic chemical substance and the extracted compound has toxic, carcinogenic and mutagenic properties. Its
relative content is about 80% of the total amount of PAHs in polluted soils of urbanized and technosphere territories of Russian regions. Domestic and foreign scientific researchers have experimentally established that 3,4- B(a)P is a universal indicator for assessing the presence of the entire list of polycyclic aromatic hydrocarbons (PAHs) [2], so its presence is the main and determining criterion and indicator of the degree of well-being or environmental pollution of PAHs. Predisposing environmental factors and external sources of 3,4- B(a)P and they can be caused by natural, man-made, chemical and biochemical, microbiological and metabolic processes in soils, while its amount does not exceed the maximum permissible concentration (MPC), which is subject to mandatory control and is for the soil-20 ng/g [4].

The aim of the paper is to provide a scientific justification and assessment of methods for extracting 3,4-B(a)P from soils, sediments and sewage sludge, and a comparative assessment and methodological analysis of the use of various well-known 3,4- B(a)P extraction methods from soils, sediments and sewage sludge.

Materials and Methods of Research.

Experiments and test results on the extraction of PAHs from soils with various organic solvents (methylene, acetone, acetone-hexane mixture) has shown that the most effective extraction of PAHs is with acetone for 20 minutes at a temperature of 120°C [5]. Therefore, one methylene chloride [6], 2-methoxyethanol [7], or a mixture of hexane, methylene chloride and methanol can be used for these purposes [8]. In another known method, alcohol was used as an extractant for PAHs (Polycyclic aromatic hydrocarbons) [8], while 25 ml of 2-methoxyethanol was added to 25 mg of soil. And then the mixture was placed on a rotary converter (shaker) and stirred for 15 minutes. The resulting extract after filtration was parted on a separating funnel with silica gel and eluted with pentane for subsequent determination by high-performance liquid chromatography (HPLC).

A method for the extraction of polycyclic aromatic hydrocarbons from the soil using acetone in the Soxlet apparatus is well known [10]. The share of extraction of the desired substance in the laboratory is insignificant and equals to 40% of the total PAH content in the soil obtained by hexane extraction. According to a similar method [11], PAHs were extracted with acetone and purified on a stainless steel column with a chromosphere.

Research results and discussion.

Nowadays a well-known method of extraction of polycyclic aromatic hydrocarbons from solid samples (RU 20181110 IPC 9 G01N 21/25; 1994-08-15) is environmentally safe and economically justified and effective in scientific and practical terms [12].

Currently, the method of saponification, consisting in the hydrolysis of organic compounds to extract 3,4- B(a)P from soil samples, bottom sediments and sewage sludge, using an ultrasonic bath, hexane extraction, purification by solid-phase extraction and HPLC analysis, is most often used. Yaroshchuk A.V., Maksimenko E.V., Borisenko N. I. in the article “The Development of Extraction Methods of Benz (a) pyrene from Soil” published in the journal, cite their own research results. // Izvestiya vuzov. Severo-Kavkazskiy region. Estestvennyie nauki. Priložhenie. - 2003. - №9 - P. 44-47.
The authors in a positively protected patent for inventions №2018110 (RU) described "A Method for Extracting Polycyclic Aromatic Hydrocarbons from Solid Samples" more detailed [12].

The device developed and proposed by the authors [16], is prepared by the state standard procedure (GOST 17.4.4.02-84 Methods of sampling and preparation of samples for chemical, bacteriological, helminthological analysis; Introduced 19.12.84. - 9 P. - Group 019) [14]. The content of Benz(a)pyrene in the analyzed samples was calculated by the method of external standard (absolute calibration) for standard solutions of different concentrations [16,17].

**Conclusion.**

Thus, this paper sets out the scientific basis and principles for assessing methods for extracting 3,4-Benz(a)pyrene from soils, bottom sediments and sewage sludge.

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