

NAMANGAN DAVLAT
UNIVERSITETI
ILMIY AXBOROTNOMASI, [2026-9]
ISSN:2181-1458
ISSN:2181-0427



02.00.00-KIMYO FANLARI
journal.namdu.uz
CHEMICAL SCIENCES

UDK: 543.05; 543.06, 543.4

ОПРЕДЕЛЕНИЕ ИОНОВ ТЯЖЕЛЫХ МЕТАЛЛОВ В ОБЪЕКТАХ ОКРУЖАЮЩЕЙ СРЕДЫ СОРБЦИОННО-СПЕКТРОСКОПИЧЕСКИМИ МЕТОДАМИ

M.N. Mamedova¹, Z.A., Smanova²

Tashkent State Agrarian University, d.f.ch. PhD¹

National University of Uzbekistan, professor, doctor of chemistry²

Аннотация: В ходе исследования были изучены пробы почвы, отобранные на территории промышленной зоны Ахангаранского завода, с использованием масс-спектрометрического (ИСП-МС) анализа. Представлены результаты анализа ионов V, Cr, Mn, As, Sr, Mo, Cd, Sn, Sb, Pb в исследуемой почве. В результате мониторинга установлено превышение допустимых концентраций ионов Cr в пределах ПДК и ПДК.

Ключевые слова: Тяжёлые металлы, почва, масс-спектрометрия, индуктивно-связанная плазма (ИСП), масс-спектрометрия (МС), МПС, мониторинг, Ташкентская область, Охангаронский промышленный район, сорбционная спектроскопия.

ATROF-MUHIT OBYEKTLARIDA OG' IR METALL IONLARINI SORBSION-SPEKTROSKOPIK USULLARDA ANIQLASH

Annotatsiya: Tadqiqotda Ohangaron zavodlar joylashgan sanoat hududidan olingan tuproq namunalari mass-spektrometrik (ICP-MS) tahlil usullar bilan o'rganildi. Tahlil qilingan tuproqdagi og'ir metallardan V, Cr, Mn, As, Sr, Mo, Cd, Sn, Sb, Pb ionlari tahlil natijalari keltirilgan. Monitoring natijasida Cr ionlari ruxsat etilgan chegaraviy miqdorga nisbatan olindi va RChM dan yuqori ekanligi aniqlandi.

Kalit so'zlar: Og'ir metallar, tuproq, mass-spektrometriya, induktiv bog'langan plazmali (ISP), mass-spektrometriya (MS), MPS, monitoring, Toshkent viloyati, Ohangaron sanoat hududi, sorbsion-spektroskopiya.

DETERMINATION OF HEAVY METAL IONS IN ENVIRONMENTAL OBJECTS BY SORPTION-SPECTROSCOPIC METHODS

Abstract: In the study, soil samples taken from the industrial area of Ahangaran factories were studied using mass spectrometric (ICP-MS) analysis methods. The results of the analysis of heavy metals in the analyzed soil are presented: V, Cr, Mn, As, Sr, Mo, Cd, Sn, Sb, Pb ions. As a result of monitoring, Cr ions were found to be above the permissible limit and exceeded the RPL.

Keywords: Heavy metals, soil, mass spectrometry, inductively coupled plasma (ISP), mass spectrometry (MS), MPS, monitoring, Tashkent region, Ahangaran industrial zone, sorption spectroscopy.

Introduction. Nowadays, the state of the environment is the most important factor determining the vital activity and development of man and society as a whole. One of the most common chemical pollutants is pollution by heavy metals. The high content of many chemical elements and their compounds is associated with natural and man-made processes occurring in the world around us. Heavy metals are found in all natural environments - the atmosphere, soil, water, plants, and animals. In terms of toxicity, they occupy the second place in environmental pollution and constitute the most dangerous group of pollutants of the biosphere.[1].

Factories, ore mines, and waste dumps are chromium concentrators. Anthropogenic pollution of soil and atmospheric air with chromium ions leads to increased environmental pollution, as well as an increase in the amount of chromium ions in plants growing in areas contaminated with chromium ions, especially in the leaves of plants. In the conditions of the industrial zone of a metallurgical plant, the accumulation coefficient of the element in leaves ranges from 2.38 to 6.68. [2].

Taking into account the high toxicity of heavy metals and their ability to accumulate in soil, plants, animals, and humans, they are included in the list of the most dangerous chemical pollutants, it is necessary to study the levels of soil pollution and ensure that they do not exceed the established standards.

Chromium is an inert element in most natural conditions. It is present in the soil mainly as Cr^{3+} , and the presence of organic matter contributes to its accumulation in the soil system. As an element with a small electron radius, it also binds to moist soils, and this situation increases with increasing pH. Wetting the soil profile has a significant effect on the mobility and accumulation of chromium in plants, and chromium uptake in moist soil can increase by up to 5 times. In addition, chromium also binds to organic matter in the soil. [3].

Heavy metals and their compounds have a strong negative impact on human health and constitute an important group of pollutants. The main group of environmental pollutants is heavy metals. These metals are the most commonly used metals in industrial facilities. In environmental monitoring and environmental pollution studies, metals with a density of 5 g/cm³ and above are mainly included. These heavy metals pose a serious threat not only to humans, but also to all organisms on Earth. These mainly include Cr, Pb, Co, Zn, Cu, Sn, Mo, As, V, Hg, Cd, Bi, Ni, Sb, Mn. The chromium ion studied in our research work belongs to class II in terms of hazard level.

Depending on the level of toxicological impact, according to StateS (GOST) 17.4.1.0283, chemicals are divided into three classes:

Class I (highly hazardous) - As, Cd, Hg, Be, Se, Pb, Zn;

Class II (moderately hazardous) - B, Co, Ni, Mo, Cu, Sb, Cr;

Class III (low hazardous) - Ba, V, W, Mn, Sr. [4].

It is located in the Ahangaran district of Tashkent region, 50 km from Tashkent. Ahangaran district has a large industrial area, where about ten different production and processing plants are located. In particular, the "Ahangaran Cement" joint-stock company is one of the largest cement manufacturers in the republic, and "Ahangaranshifer" JSC and various other plants are located in the industrial zone.[5].

Although the factories located in the Ahangaran industrial zone play an important role in the development of the economy of Uzbekistan, they have a serious impact on the environment and the health of the population. Cement, metal, fittings, industrial waste are associated with the ecological state of the Ahangaran district, and pollution of water, soil and atmosphere has a negative impact on plants and animals. [6].

Experimental part. In order to determine the important components of the soil and study some of its properties, it was prepared for analysis according to SS (GOST).[7]. The soil was spread on clean paper and dried at room temperature. After the soil dried, the large components in it were crushed. In order to obtain an average soil sample for laboratory analysis, it was divided into several cells using the envelope method, soil was taken from each and weighed on an analytical balance to a mass of 10 g. This prepared soil was ground in a special mortar and passed through special 1 mm sieves. Each of the soil samples taken from the industrial zone areas was prepared for analysis using the above method.

10 g of soil samples were taken from the areas. The samples were dissolved in a 1:1 ratio, i.e., 20 ml of concentrated HCl acid and 20 ml of distilled water. The solution was heated to boiling in a water bath for 1 hour. The solution was cooled and heated in a water bath twice in succession. After a day, the solution was heated again and precipitated. The color changed due to the presence of various metal ions in the composition. The solution was filtered into 250 ml volumetric flasks and the precipitate was separated. [8].

To concentrate chromium ions from the soil solution, a polymer sorbent immobilized with an organic reagent was used. Polymer sorbents were used from natural silk fibroin fiber, a waste fiber of the "Urgench teks" LLC factory. Sulforsazen, eriochrome black, thoron, arsenazo (III), sulfosalicylic acids were used from organic reagents, and the results showed good results with black eriochrome, i.e. GNGS organic reagent. An aliquot of the soil solution was placed in a 50 ml beaker from the sample to be analyzed, and 5 µg of Cr ion solutions and 5 ml of a covering agent, 0.2 g of an organic reagent immobilized on silk fibroin fiber were added to 5 ml of a universal buffer solution pH=7-8 and sorption was carried out for 10-15 minutes.

The results obtained and their discussion. In the study, heavy metals in soil samples taken from the Ahangaran industrial zone and adjacent areas were analyzed using the mass spectrometric (ICP-MS) instrument "UzOU 0677:2015 (МБИ №499-АЭМ/МС)". Soil samples from the industrial zone were taken from distances of 1 km, 5 km, 10 km from the area and monitored. The presence of 61 elements in the soil sample was determined. The amount of some metals present in the data (ppm, mg/g, g/t) is presented in table-1 below.

table-1

The composition of elements in soil samples according to ICP-MS data, mkg / g

№	Metal name	From the zone 1 km	From the zone 5 km	From the zone 10 km
1	V	150	110	100
2	Cr	120	81,0	65,0

3	Mn	1300	1100	910
4	As	29,0	23,0	21,0
5	Sr	250	220	190
6	Mo	4,40	4,00	3,50
7	Cd	0,170	0,280	0,094
8	Sn	3,90	2,90	3,40
9	Sb	2,00	2,70	2,70
10	Pb	41,0	46,0	37,0

The distribution of Cr ions in soil samples from the Ahangaron industrial area is presented in Table 2 and Diagram 1. When analyzing the results, it was observed that the amount of chromium metal in the soil composition decreases with distance from the industrial area.

table-2
ICP-MS analysis of Cr ions in soil samples from the Akhangaran industrial zone, mkg/g

№	Metal name	From the zone 1 km	From the zone 5 km	From the zone 10 km
1	Cr	120	81,0	65,0

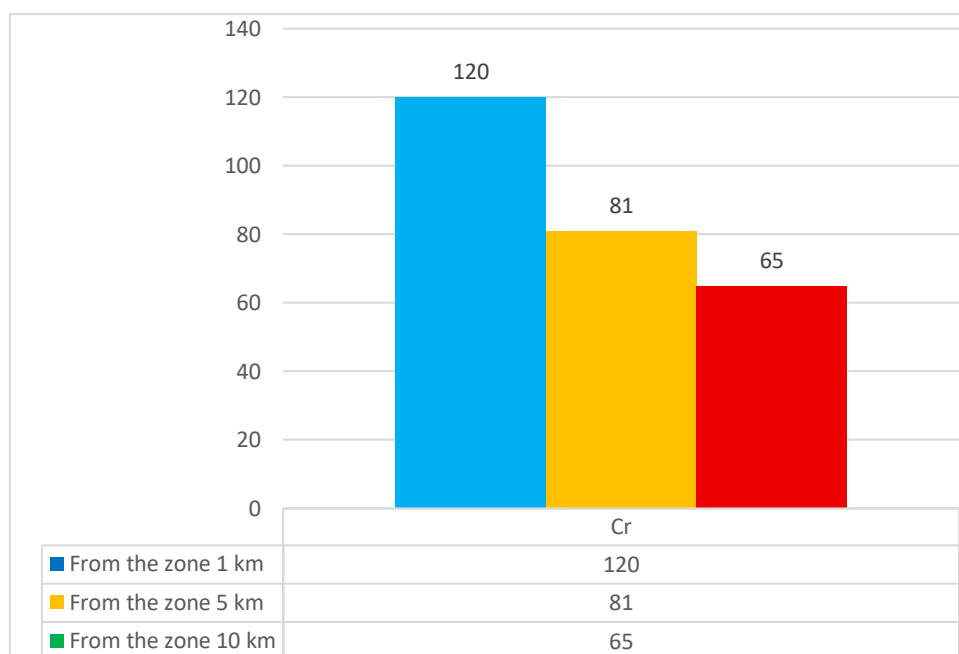


Diagram 1. Distribution diagram of chromium metal

A sorption-spectroscopic method for the determination of chromium ions in environmental objects has been developed. The method involves concentrating metals from a sample using a polymer sorbent immobilized with organic reagents.

The immobilization process of solutions of organic reagents used in the study on sorbents is carried out using the following methods: fiber samples with a diameter of 2 cm and a mass of 0.2 g are placed in a beaker with a 0.1 M HCl solution (50 cm³). In this case, the initial sorbent is converted to the Cl⁻ form. Then the carrier fibrous sorbent is washed several times with distilled water, and the organic reagent obtained for immobilization is measured in a volume of 10 ml and placed in a 50 ml measuring glass beaker. Then, the immobilization process is carried out by placing the fiber activated in HCl acid in the beaker, the process time is continued from 5 minutes to 24 hours. After that, the fiber is washed with distilled water, and the immobilized fiber is washed with distilled water 2 times with 50 cm³, while holding the immobilized fiber with a glass rod. In a wet state, the fiber is placed in a Petri dish. The organic reagent remaining in the beaker was determined using an absorption spectrometer, while the portion immobilized on the fiber was determined using a reflectance spectrophotometer [9].

The complexation process with organic reagents immobilized on polymer fibers is mainly carried out by passing metal solutions from 10 ml to 200 ml at room temperature through a microcolumn containing 0.2 g of sorbent at a rate of 1-10 ml/min for sorption concentration. The sorbent is initially concentrated by passing the solution at pH values that concentrate metal ions. The sorption concentration and spectroscopic determination of these metals helps to solve environmental problems.

Conclusion. As can be seen from the table, if we compare the depletion of metals, the metals are arranged in decreasing order from Figure 1 to Figure 4. Among the metals, the highest amount of Mn is 1300-910 µg/g. It can be observed that Sr is 250-190 µg/g; V is 150-100 µg/g; Cr is 120-81 µg/g; Pb is 41-37 µg/g; As is 29-21 µg/g; Mo is 4.4-3.5 µg/g; Sn is 3.9-3.7 µg/g; Sb is 2-2.7 µg/g; Bi is 0.51-0.46 µg/g; Cd is 0.17-0.094 µg/g. The main factor that causes the concentration of heavy metals to exceed the TLV is the emission of waste from metallurgical plants and other plants in the industrial area.

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