INTERNATIONAL BULLETIN OF MEDICAL SCIENCES AND CLINICAL RESEARCH
IF = 9.2
IBMSCR
ISSN: 2750-3399

ANALYTICAL CONTROL OF THE COMPOSITION OF DRINKING WATER USING MKSP-01 RADEK (SGS) SPECTRA AND X-RAY DIFFRACTOMETRY (XRD) INSTRUMENT

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https://doi.org/10.5281/zenodo.14894150

Abstract: In this work, the radioactivity properties of groundwater drinking water were evaluated based on radon-222 and the chemical composition was determined using an X-ray diffractometer (XRD).

Keywords: water, radioactivity, composition, X-ray diffractometer (XRD), sensitivity.

The determination of small amounts of these metals using currently available methods poses some difficulties, since the compositional complexity of environmental objects, the presence of a large number of interfering substances, and various other factors may influence them. Therefore, today the demand for highly sensitive, inexpensive, selective, and convenient methods is increasing. Organic reagents that form complexes with metal ions are widely used in many methods of analytical chemistry to solve problems and in physicochemical methods of analysis, spectrophotometric, polarographic, chromatographic, and other analytical methods. A comparison of various analytical methods shows that almost every reagent used in the analysis can be a masking reagent in another way. Complexes of metals with organic reagents are often colored. If the colored complex is soluble in water and has a high color intensity, it can be used in spectrophotometric or colorimetric methods of concentration [1].

Sodium carboxymethylcellulose (NaCMC) is the only cellulose derivative belonging to the group of polyelectrolytes. Sodium carboxymethylcellulose is widely used in the food, cosmetic and pharmaceutical industries due to its several properties. Aqueous solutions of NaCMC are non-Newtonian liquids. The results of the research published to date show that the rheological properties of aqueous solutions of NaCMC depend not only on the concentration and molecular weight of the polymer, but also on its degree of substitution (DS). To analyze the bonds and functional groups formed in IPK hydrogels, FTIR (Bruker, INVENIO S, Germany) analysis of hydrogels in 3 different ratios was studied. The spectra were analyzed in the wavenumber range of 400-4000 cm-1 [2].

In our country, part of the drinking water is springs, wells and artesian waters. The concentration of radon in such water sources is much higher than in water from surface water sources such as reservoirs or lakes. The usual quantitative proportion of radon dissolved in drinking water is much higher than in the air a person breathes. There are many scientific works in this area on the radioactivity properties of groundwater [3] and surface waters, their drinkability properties and their impact on living organisms in water [4].

Radiation of micro- and macroorganisms in excess of the safe limit causes the development of various pathological processes in the body that are dangerous to life.

IBMSCR | Volume 5, Issue 02, February

Therefore, constant monitoring of the amount of radon in water and air, its migration, search for and application of methods for its reduction are an urgent problem from a radioecological point of view. The lowest concentration limit in radon-containing waters can be up to 185-370 Bq/1. In drinking water, the permissible level should not exceed 60-80 Bq/1. Constant monitoring of the changes in the amount of various substances in the composition of environmental objects at the norm is one of the current problems of modern analytical chemistry.

Constant monitoring of the changes in the amount of various substances in the composition of the Earth's atmosphere at the norm is one of the current problems of modern analytical chemistry. It is not for nothing that their achievements in the field of environmental protection, the establishment of scientifically based methods, devices and creation of modern sensors for analytical control are recognized by scientists from developed countries of the world.

The amount of radon-222 isotope up to the permissible level also has beneficial properties. In this regard, it is used in medicine to restore human health and is called a method of radiotherapy. Radon baths, rich in natural and artificial radon waters, are currently one of the most common treatment methods and are installed in special sanatoriums and central recreation areas. They are used not only in baths, but also in showers and drinking. As a result, microcirculation in the skin improves, heart function normalizes, blood pressure is normalized, the immune system is activated, the effect against colds increases, the serum and morphological composition of the blood normalizes, the regeneration process of tissues is stimulated and the main metabolic processes are normalized.

In this Figure 1 and Table 1 based on it, the activity values of the above-mentioned radioactive isotopes are presented.

Figure 1

Isotopes of Radium-226, Thorium-232, K-40, Cesium-137 in Conditional Object No. 1. SGS spectrum obtained from artesian water at a depth of 50 meters, Qorateri Q.F.Y., Akdarya district

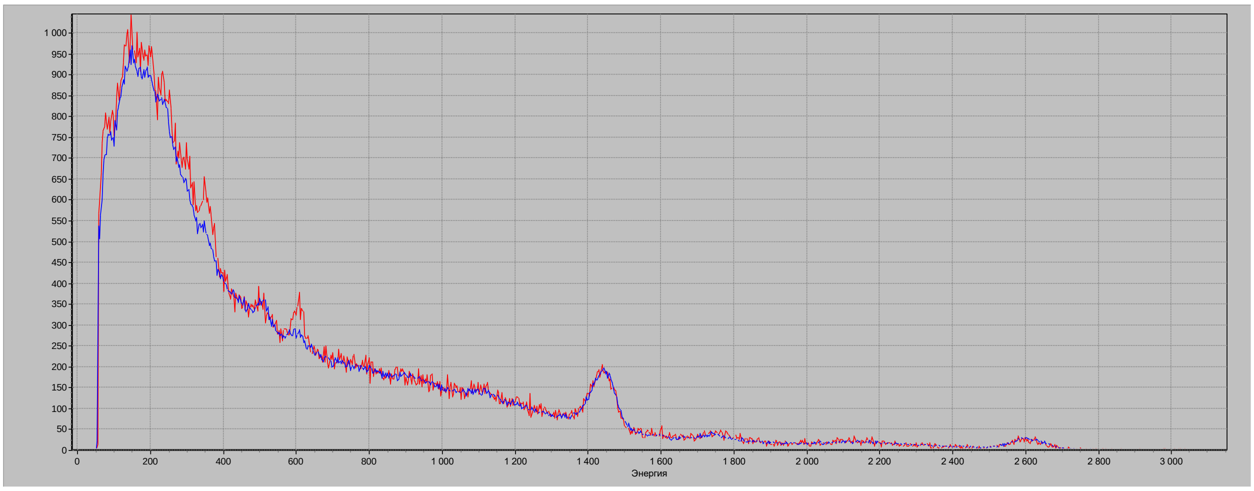


Table 1 below shows the values of the radioactivity properties of analytical samples taken from groundwater in the village of Karateri through activity and relative activity.

Table 1.

Results of quantitative assessment of the radioactivity of isotopes such as Ra-226, Th-232, K-40 and Cs-137 in the groundwater of Karateri

IBMSCR | Volume 5, Issue 02, February

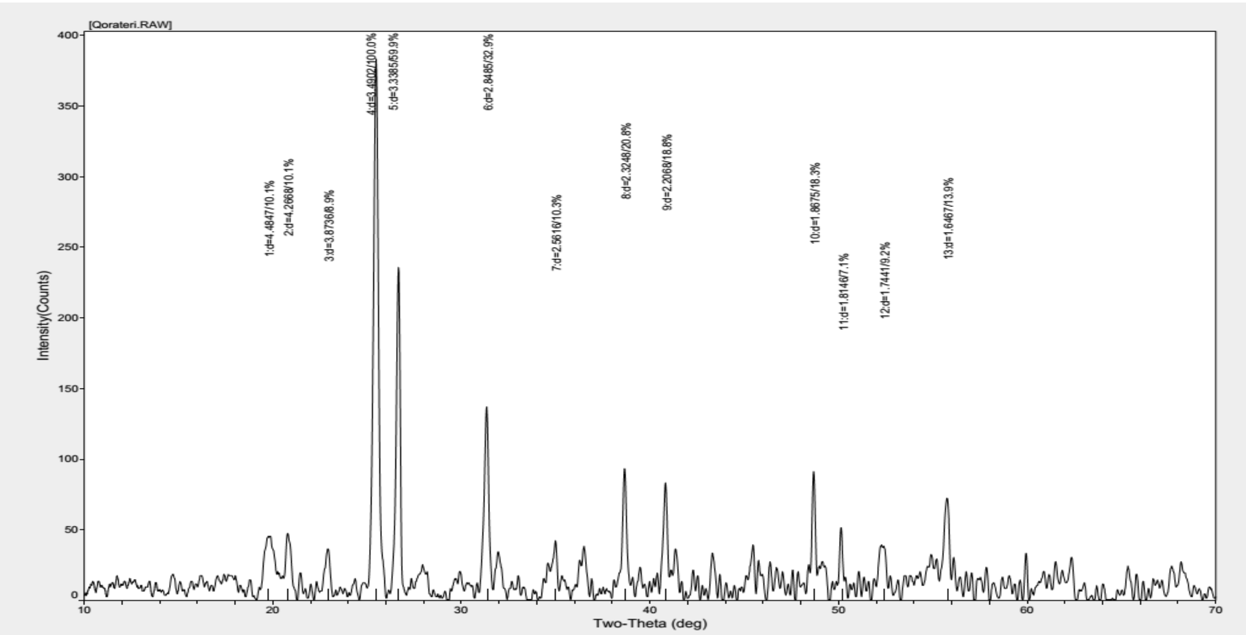
Nuklid	Aktivligi / Bk/kg	Tasodifiy xato.,%	Solishtirma aktivligi. Bk/kg	Mutlaq xato Bk/kg	Nisbiy xato.,% (P=0.95)
Ra-226	6,08 ± 0,94				
Th-232	< 1,79	-		-	-
K-40	< 13,54	-		-	-
Cs-137	< 1,02	-		-	-

The hygienic standard of radiation safety of the Ra-226 isotope is $8.1 \cdot 10^4$ Bk/year, Th-232- $7.8 \cdot 10^2$, the half-life of the K-40 (0.01%) isotope is $1.32 \cdot 10^9$ years, and the permissible standard (Bk/year) of Cs-137 is $9.6 \cdot 10^8$, it can be noted that the quantitative assessment results are not much higher than the stated standards.

The results of the spectrum analysis obtained using the X-ray diffractometer (XRD) instrument were obtained from the water of the villages of Karateri, Jarqishlok, Loish, Chaychovul and Kurilly of the Akdaryo district using the following X-ray diffractometer (XRD) instrument and salt was extracted from it for analysis. To extract salt from water, 80 liters of water are evaporated by boiling and then separated from the water. After that, the salt content at the end of the container is scraped off, thoroughly dried and ground, and then placed in the cuvettes of the device. The following figures show the results of spectral analysis obtained using an X-ray diffractometer (XRD).

Figure 2.

Results of spectral analysis of salt obtained from the water of the Karateri Q.F.Y. facility in the Akdaryo district, obtained using an X-ray diffractometer (XRD).



[Qorateri.RAW] S/M Hit Listing

SCAN: 10.0/70.0/0.02/2(deg/m), Cu(30kV,30mA), I(max)=384, 11.14.24 17:04

NOTE: Intensity = Counts, 2T(0)=0.0(deg), S/M: Default Search_Match
J-Column: [+] Common/Good Patterns, [?] Uncommon/Non-Ambient Patterns, [ ] Intermediate Patterns, [D] Deleted
D-Column: C=Calculated, D=Diffractometer, F=Densitometer, V=Film/Visual, X=Other/Unknown

#	39 Hits Sorted on Figure-Of-Merit	FOM	I%	2T(0)	d/d(0)	PDF-#	J	D	#d/I
1	Quartz - SiO2	3.0	58	0.000	1.000	79-1906	C	C	18
2	Anhydrite - Ca(SO4)	3.4	94	0.040	1.000	72-0916	C	C	33
3	Quartz - SiO2	3.7	58	0.020	1.000	85-0797	C	C	18
4	Anhydrite - Ca(SO4)	3.7	94	-0.060	1.000	74-2421	C	C	30
5	Quartz low, dauphinee-twinned - SiO2	4.0	61	0.080	1.000	89-1961	C	C	18
6	Fe0.88Ti1.11Zr0.94O5 - Iron Titanium Zirconium O...	5.3	34	-0.080	1.000	40-0134	+	X	5
7	BN - Boron Nitride	5.4	58	-0.120	1.000	34-0421	+	D	6
8	Graphite-3R, syn - C	5.8	50	0.000	1.000	26-1079	+	C	6
9	BN - Boron Nitride	8.2	56	-0.080	1.000	45-1171	+	D	6
10	VH2 - Vanadium Hydride	9.0	7	-0.080	1.000	39-1326	+	V	3
11	CaSO4 - Calcium Sulfate	9.7	75	0.120	1.000	37-0184	+	X	20
12	Ca5WN5 - Calcium Tungsten Nitride	10.0	31	0.020	1.000	23-0131	+	D	6
13	Cr1.8TiH5.3 - Chromium Titanium Hydride	10.8	7	0.040	1.000	42-1124	+	C	3
14	Cuprite, syn - Cu2+1O	10.8	7	0.060	1.000	05-0667	+	D	6
15	BaNb3O6 - Barium Niobium Oxide	12.7	34	0.100	1.000	52-0273	+	X	13
16	Halite, syn - NaCl	13.2	7	0.100	1.000	88-2300	C	C	6
17	Sr2Sc0.3Fe1.7O5 - Strontium Iron Scandium Oxide	13.2	7	-0.100	1.000	52-1698	+	D	7
18	C - Carbon	13.4	58	0.040	1.000	26-1076	+	C	11
19	LiAlSiO4 - Lithium Aluminum Silicate	13.5	56	0.060	1.000	26-0839	+	D	48
20	Lead, syn - Pb	13.6	34	-0.060	1.000	87-0663	?	C	5

The results of the spectrum analysis obtained using the X-ray diffractometer (XRD) instrument presented above show that the values of the quantitative indicators determined in the composition of artesian water samples and the results of quantitative determination of mineral substances and analytical indicators obtained using chemical, ionometric and physicochemical methods are very similar and complement each other.

In addition to monitoring the radioactivity properties of groundwater drinking waters, we also evaluated the quantitative values estimating the potability properties of some of their chemical composition based on the results obtained using various standard and instrumental methods of analysis.

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IBMSCR | Volume 5, Issue 02, February

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