ТЕЗИСЫ ДОКЛАДОВ

МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ
«Перспективные материалы с иерархической структурой для новых технологий и надежных конструкций»

X МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ
«Химия нефти и газа»

Томск

Издательский Дом ТГУ

2018

DOI: 10.17223/9785946217408/384

RADIOACTIVE ISOTOPES OF TOSON-ULA BASIN OF MONGOLIA

[1]Erdenethya M., [1]Alimaa V., [1]Tseweenjav J., [2]Svarovskaya L., [2]Altunina L., [3]Norov N.
[1]Department of Geology and petroleum, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia
[2]Institute of Petroleum Chemistry SB RAS, Tomsk, Russia
[3]Nuclear research center, National University of Mongolia, Ulaanbaatar, Mongolia

Recently, studies of oil and radioactive isotopes exploration in the area of oil-producing basins take a particular importance for advanced environmental research. It is already has proven that radioactive isotopes are dangerous for environment and human health. Hence, it is very important to measure the level of oil radiation background before exploration, drilling, and extraction of a crude oil [1]. Oil producing and drilling activities result in an increase in radioactive isotopes within the geochemical and hydrochemical processes. An increase in radioactive pollution in the basin is due to the impact of fluidic system, formation water, drilling solid wastes etc. Uspensky et al. have identified several toxic elements, such as Ba, V, S, Cd, Co, As, Ni, Hg, Pb, Sr, and Zn during the exploration process. The radioactive pollution was also observed in the drilling tubes and other equipment. Many years' experience in worldwide oil exploration shows that the presence of radioactive isotopes is indicative of the environmental pollution. In 2006, Russian researcher Yury Mironov has found out that the natural activity of Tamtsag basin in percentage terms is rather high [2].

In 1990, the company that named 'Soko' has started to perform exploration works in the XIX and XXI fields of the Tamtsag basin of Mongolia. However, over a ten year period of 1990-2010 no researches on radioactive isotopes occurring in the fields of basin have been performed. Our study group has conducted an investigation of radioactive isotopes contained in soil and water samples from these oil fields. The investigations of radioactive elements from the oil fields of Mongolia were conducted at the Nuclear Research Center of the National University of Mongolia [2]. By now we have identified uranium (^{238}U), radium (^{226}Ra), thorium (^{232}Th), potassium (^{40}K), and cesium (^{137}Cs) in 230 soil samples from XIX, XXI oil fields from Toson-Uul basin and bismuth (^{214}Bi) and lead (^{214}Pb) isotopes in 120 water samples. We proceed with an environmental radiation monitoring. From 2012, we have been investigated radioactive isotopes in the Toson-Ula exploration region. In July and September 2017 the soil was sampled from XIX, XXI-fields and these samples exhibited the presence of natural radioactive isotopes. Assessments of the absorbed dose rate and effective equivalent dose for real population in the exploration region were made and the results were compared with a worldwide average value.

In order to evaluate the inventory of radioactive material in the area of Tamtsag basin, samples of soil and water were appropriately collected and analyzed in the laboratory via gamma spectrometry. The measurements were performed using a typical high-resolution gamma spectrometer based on a shielded coaxial High-Purity Germanium detector with 52 cm^3 effective volume and energy resolution of 2.0 keV FWHM for the 1332 keV gamma ray line of ^{60}Co. The detector was coupled to the Multi Channel Analyzer system (MCA) and PC board card S-100 Canberra analyzer. The spectrometer was calibrated using 1000 mL, 700 mL Marinell liquid calibration source of ^{241}Am, ^{109}Cd, ^{57}Co, ^{139}Ce, ^{137}Cs, ^{88}Y and ^{60}Co traceable to international standards and emitting g-rays in the energy range of 59-1836 keV. Calculated values of specific activity of ^{226}Ra, ^{232}Th, ^{40}K, and ^{137}Cs were based on the most intensive gamma energy of 609.3 keV (Bi214), 581.3 keV (Tl209), 1460 keV and 661.7 keV, respectively [3]. The following formula has been used to determine the specific activity of radioactive isotope within the soil sample using the total absorption peak: (Source, Effects and Ricks of Ionizing Radiation, 1993):

$$A = \frac{S(E_i) - S_{\delta}(E_i)}{k \cdot \varepsilon_0(E) \cdot k_{\gamma} \cdot V \cdot t}$$

Where: N(Ei) is the area under total absorption peak maximum -rays with the energy Ei; k is the geometry factor of the detector; is the detector efficiency; is the gamma ray emission factor; t is

the time of measurement (s); À is the bulk specific activity (Bq/l), S(Ei) is the area under of total absorption peak, and V is the water volume.

The levels of external gamma radiation around the exploration oil field were measured using ATOMTEX AT-6130 gamma radiation survey meters (Russia). Absorbed gamma dose rate in air at 1 m above the ground surface for the uniform distribution of radionuclides (^{238}U, ^{232}Th and ^{40}K) were calculated by a relevant formula. HP-Ge gamma-spectrometric analysis was conducted at the Nuclear Research Center of Mongolia.

The results of gamma ray spectrometric analysis of radioactive elemental compositions of water samples from Toson-Ula basin, XIX field are shown in Tables 1 and 2.

Table 1.

Bulk specific activity of radioactive isotopes in a water sample from Toson-Ula basin.

Sample	Bulk specific activity (Bq/l)				
	^{214}Pb	^{214}Bi	^{222}Rn	^{226}Ra	^{238}U
Domestic tap water from XIX area	147	227	187	<0.4	<0.4
Purified water in TA-1 construction, XIX-field	792	1485	1139	<0.4	<0.4
Water sampled before purification using the TA-1 facility at the Toson-Ula oil field	156	249	203	<0.4	<0.4
1-14 compressed water from facility of redistribution	841	1400	1121	<0.4	<0.4

Table 2.

Bulk specific activity of radioactive isotopes in the water samples from XXI exploration oil field.

Sample	Bulk specific activity (Be/l)				
	^{214}Pb	^{214}Bi	^{222}Rn	^{226}Ra	^{238}U
Water sampled before purification using a TA-2 facility, Toson- Ula field	61.1	102.1	81.6	<0.4	<0.4
Domestic tap water from 21st field	16.2	87.3	51.8	<0.4	<0.4
Water purified using a TA-2 facility, 21st field	45.5	22.1	33.8	<0.4	<0.4
Water sampled from Buir lake	109.6	112.2	110.9	<0.4	<0.4

XIX-field bulk specific activity highest value of 214Pb, 214Bi, 222Rn were in the samples purified water in TA-1 construction and 1-14 compressed water from construction of redistribution. The amount of bulk specific activity of radioactive elements in water separated from oil testifies that 222Rn is transferred from water into oil.

The amount of bulk specific activity in the water produced before its purification in TA-1 facility is 10 to 11 times higher than that for the tap water according to standard of Mongolia MNS 900:2005/222Rn 100Bq/l/. There are yet no standards for the amount of bulk specific activity of industrial water in Mongolia, so the comparison is possible only with the tap water standard. The refining factories will be built in Mongolia as soon as possible, so the standard for industrial water should be developed in the near future.

From 2014 to 2017 the soil of the XXI field was tested for radioactivity two times per year. The absorbed dose rate is 1.5 times higher than the worldwide average value for absorbed dose rate. The specific activity of potassium have been found to be 2 to 3 times higher than the worldwide average value, where it related to the properties of oil source rock. Since the presence of cesium is believed to be a good indicator of soil quality, the decrease in specific activity of cesium (137Cs) is indicative of soil erosion.

References

1. Erdenetuya M., Alimaa V., Norov N., Investigation of Radioactive Isotopes in Water Samples from Toson-Uul Basin of Mongolia. Oil &Gas. 2016. Ulaanbaatar. P. 46-51.

2. Geology and mineral resources of Mongolia. Ulaanbaatar. 2009. V. 6. P. 329-335.

3. Erdenetuya M., Alimaa V., Norov N., Tseweenjav J., Erkhembayar Ts., Jargalsuren Sh. Natural radiation background in the some petroleum fields of Mongolia // Proceedings 11th International Forum on Strategic Technology (IFOST). 2016. Novosibirsk, Russia.