Tokzhanova M., Suleimenova S.

Reasons for reducing radiation at Semipalatinsk Nuclear test site

This article describes the reasons for reduction of radiation at Semipalatinsk nuclear test site: first period half-life of a radioactive isotope. Currently, the level of radiation at the Semipalatinsk nuclear test site composes from 6 to 20 micro-roentgen per hour. Only at some points the radiation level higher than the plains. In this regard, our aim is to clarify the cause of the reduction of radiation and space distribution of nuclear residues at Semipalatinsk nuclear test site. Second is radionuclide flushing with water, soaking with soil, picking up ground water. Counting the number of flushing water depends rainfall in the warm season. Third is influence of organisms in order to reduce radiation. The plants and animals actively participate to reduce radiation. The plant gives a lot of biological products. The study used methods: general scientific, cartographic method, comparative, quantitative mass spectrometry.

Key words: nuclear test, radionuclide, Semipalatinsk, radioactive isotope.

Токжанова М., Сулейменова С.

Семей ядролық полигонындағы радиация азаюының себептері

Мақалада Семей ядролық полигонындағы радиация азаюының себептері анықталып жазылған. Ең бірінші және негізгі себеп радиоактивтік изотоптардың жартылай ыдырау периоды. Қазіргі уақытта Семей ядролық сынақ полигонында жалпы радиация деңгейі сағатына 6-дан 20 микрорентгенге жетеді. Кейбір нүктелерде ғана радиация деңгейі жоғары. Радиация әсерін зерттеу өте өзекті болғандықтан Семей ядролық сынақ полигонындағы радиация деңгейі неге азайды және ядролық қалдықтары қайда кеткенін анықтайық деген мақсат қойдық. Радиация азаюының екінші себебі - радионуклидтердің сумен шайылып, топыраққа сіңіп, грунтқа жетіп, тереңдеп жерасты суларында жиналуы. Санау жалпы жауын-шашынның жылы кездегі көлеміне негізделді. Радиация азаюының үшінші себебіне тірі организмдер өз үлесін қосады. Ең көп биологиялық өнімді өсімдік жамылғысы береді. Семей полигонында өсімдік жамылғысы әр экожүйеде әртүрлі. Зерттеу процесінде осындай әдістер қолданылды: жалпы ғылыми, картографияық әдіс, салыстырмалы, сандық, жалпыспектрометрлік.

Түйін сөздер: Семипалатинск, радиоактивті қалдықтар, радионуклид, ядролық полигон.

Токжанова М., Сулейменова С.

Причины снижения радиации Семипалатинского ядерного полигона

В данной статье исследуются причины снижения радиации Семипалатинского ядерного полигона: первая причина – периодные полураспады радиоактивного изотопа. В настоящее время уровень радиации на Семипалатинском ядерном испытательном полигоне составляет от 6 до 20 микрорентген в час. Только в некоторых точках уровень радиации высокий, чем в равнинных местах. В связи с этим нашей целью является выяснение причины снижения радиации и места распространение ядерных остатков СЯИП. Вторая причина – смывание радионуклида с водой, впитывание с почвой, собирание в грунтовые воды. Смывание воды связано с выпадением дождей в теплое время. Третья причина – влияние организмов на снижение радиации. Активное участие принимают растения и животные для снижения радиации. В процессе исследования использованы методы: общенаучные, картографический метод, сравнительный, количественный, масса-спектрометрический.

Ключевые слова: Семипалатинск, радиоактивные изотопы, радионуклид, ядерный полигон.

© 2015 Al-Farabi Kazakh National University

UDC 614.876 (7)

***Tokzhanova M., Suleimenova S.**

Kazakh National Medical University named after Asfendiyarov,
Kazakhstan, Almaty
*E-mail: Madina.tokzhanova@mail.ru

REASONS FOR REDUCING RADIATION AT SEMIPALATINSK NUCLEAR TEST SITE

Introduction

Semipalatinsk nuclear test site was one of the two main nuclear test of the USSR in 1949-1989 years. The landfill is located in three regions of Kazakhstan and occupies an area of 18 500 square meters. km, its perimeter of about 600 km. During the existence, the landfill has brought a lot of problems for people, contaminating large areas of Kazakhstan and Russia, and also contributed to the negative attitude people have products that come from contaminated areas, and others.

The landfill was used for a variety tests of nuclear weapons the Soviet Union - in the ground (in tunnels and wells) and in the atmosphere. From 1949 to 1963. 116 explosions were produced in the atmosphere and on the surface [1]. By radioactive cloud were 55 air and ground explosions, by gas fraction 69 underground explosions. 12 August 1953 have been tried thermonuclear weapons in the atmosphere - at a height of 30 meters above the ground (the charge was placed in a special tower). Then it began a rapid contamination of the landfill site and surrounding land with radioactive elements. November 22, 1955 another thermonuclear bomb was dropped from a plane and exploded at an altitude of 2 km above ground level.

In the period from 1963 to 1989 it produced only underground tests, but they have brought irreparable damage to the environment: 169 gas fraction of underground tests has moved beyond the range and contributed to strong radioactive contamination of the eastern regions of Kazakhstan. From 1949 to 1989 there were no less than 456 nuclear tests, which were detonated at least 616 nuclear and thermonuclear devices, including at least 30 ground nuclear explosions and at least 86 air [2]. There were also carried out dozens of hydro-nuclear and hydrodynamic tests. The region has been caused considerable environmental damage. The population exposed to radiation over time has entailed disease, premature death, genetic diseases among the local population. Explosions were halted only in 1989, and the landfill is closed in August 1991 [3].

Materials and methods

The study used methods: general scientific, cartographic method, comparative, quantitative mass spectrometry. The

period 2007-2012 were investigated number of rainfall dropped in the Semipalatinsk nuclear test site. Weather data and materials taken from Kazhydromet. To determine the amount of water to wash off the radiation in the soil using this formula:

$$V = V_1 * S * h * d * a, m^3$$

where V_1- amount of rain in the warm, m^3;

S - area of the region where water accumulates, m^2;h - evaporation coefficient

d –ability of conduct water on the soil during the day, m;

a – coefficient for

Result and discussion

Currently, the level of radiation at the Semipalatinsk nuclear test site composes from 6 to 20 micro-roentgen per hour. Only at some points the radiation level higher than the plains. In this regard, our aim is to clarify the cause of the reduction of radiation and space distribution of nuclear residues at Semipalatinsk nuclear test site. This study is necessary to explore the radiation on the body. The most the main reason is the half-life of radioactive isotopes. (Table 1.) The products consist of a nuclear explosion, more than 200 isotopes of 36 chemical elements. Many of the radioactive isotopes decompose rapidly radionuclides [5]. Active products of nuclear emissions reduced by 10, 100 and 1000 times after the explosion at 7, 49 and the 343 day of the half-life. When the nuclear discharge excitable radionuclides (^{3}H, ^{14}C, ^{28}Al, ^{24}Na, ^{56}Mn, ^{59}Fe, ^{60}Co, and others.) And undivided uranium, plutonium pollut environment. Subsequently, if the plutonium (^{239}Pu) is based in the soil, ^{137}Cs, ^{131}I particularly ^{90}Sr radionuclides may accumulate in the human body, such as ^{90}Sr in the bones and ^{131}I in the thyroid gland [5].

Table 1 – Radionuclide products from nuclear tests

Isotopes	Energy (Charge)	Half life	The amounts of the decay	Activity 1 Mt, (10^{15} Bk)
Strontium-89	38	50,5 days	2,56	590
Strontium-90	38	28,6 years	3,5	3,9
Zirconium-95	40	64 days	5,07	920
Ruthenium-103	44	39,5 days	5,2	1500
Ruthenium-106	44	368 days	2,44	78
Iodine-131	53	8 days	2,90	4200
Cesium-136	55	13,2 days	0,036	32
Cesium-137	55	30,2 year	5,57	5,9
Barium-140	56	12,8 days	5,18	4700
Cerium-141	58	32,5 days	4,58	1600
Cerium-144	58	284 days	4,69	190
Tritium-3	1	12,3 years	0,01	$2,6\ 10^{-2}$

The second reason is the reduction of radiation is radionuclides are washed with water to penetrate into the soil before reaching the ground, gather in groundwater [6]. The sufficient level of rain in the warm season of the year for the blur of radionuclides (Figure 1.2). The average intensity composes 1 hectar 7.2 ton. Module blur in the study area of space that is not same spread large amounts in the mountains, the lowest in the steppe.

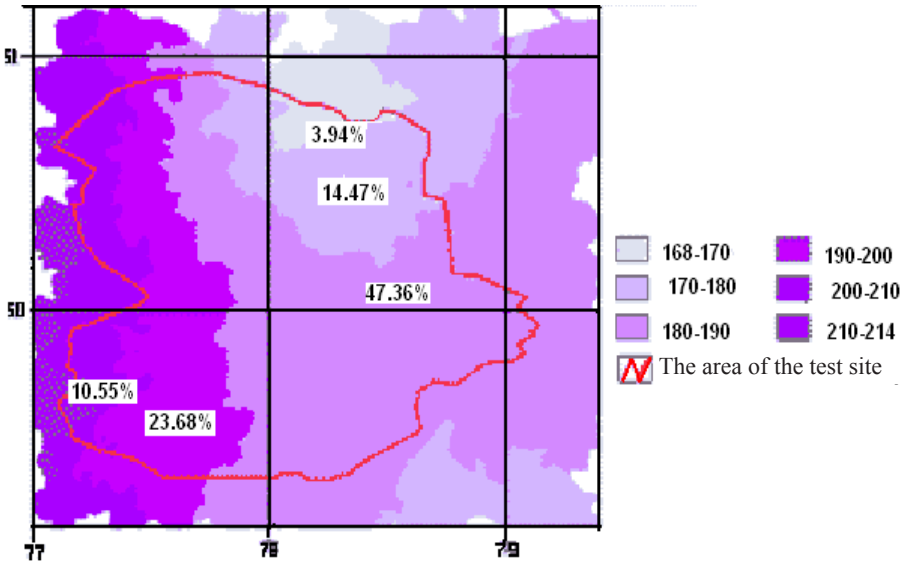

Figure 1 – The amounts of rainfall in warm weather

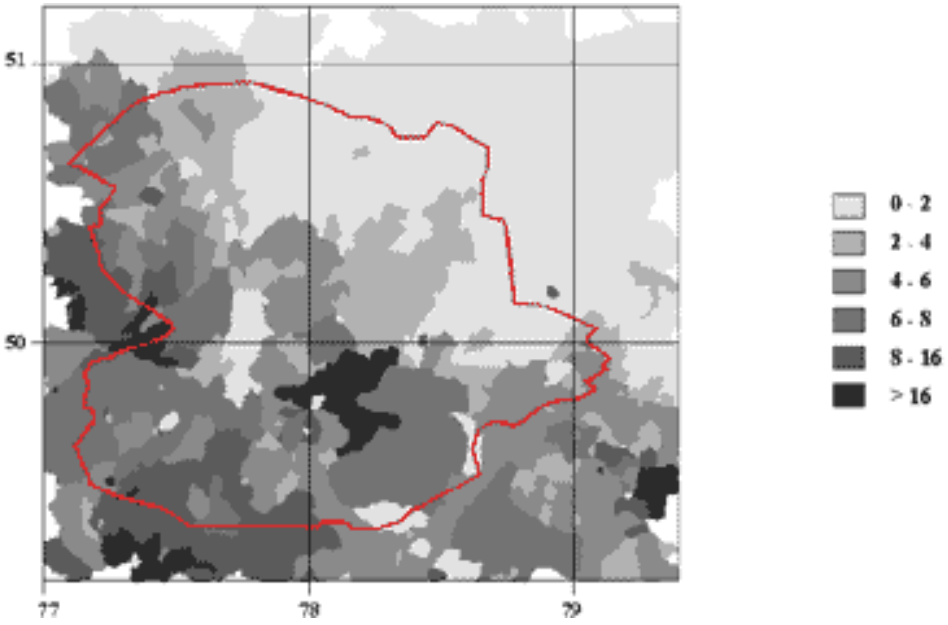

Figure 2 – The intensity of flushing t / ha

We count the number of flushing water. The process of flushing water from the high hills is fast. Counting the number of flushing water depends rainfall in the warm season. Coefficient of stream for forest area is – 0,4-0,5 m, without the forest zone – 0,6-0,65 m. The coefficient of evaporation for the forest zone is -0,4-0,5 meters. Forest steppe zone- 0.6 m, steppe zone – 0,7-0,8 m. The ability to conduct water on the soil during the day – 0,00025 m. The total area of the region – 18,5 million hectares.

Determination of the amount of the regions from volume of the rainfall in the warmer time

168-170 mm. for year = 3,94% 18,5 mil. he = 728900 he

170-180 mm. for year = 14,47% 18,5 mil. he = 2676950 he

180-190 mm. for year = 47,36% 18,5 mil. he = 8761600 he

190-200 mm. for year = 23,68% 18,5 mil. he = 4380800 he

200-214 mm. for year = 10,55% 18,5 mil. he = 1951750 he

We determined amount of water by wash-off radioactive isotopes in the each area

V=728900 he * 10000 m^2 * 0,00025 m. * 0,65 * 0,8 * 0,16 m^3 = 151611,2 m^3

V=2676950 he * 10000 m^2 * 0,00025 m. * 0,65 * 0,8 * 0,17 m^3 = 591605,95m^3

V=8761600 he * 10000 m^2 * 0,00025 m. * 0,65 * 0,8 * 0,18 m^3 = 2050214,4 m^3

V=4380800 he * 10000 m^2 * 0,00025 m. * 0,65 * 0,8 * 0,19 m^3 =1082057,6 m^3

V= 1951750 he * 10000 m^2 * 0,00025 m. * 0,65 * 0,8 * 0,2 m^3 = 507455 m^3

The total amount of water wash-off radioactive isotopes of the Semipalatinsk test site

∑=151611,2 +591605,95+2050214,4+1082057, 6+507455 = 4382944.15 m^3

As a result of counting it turned out, that every year 4 million 382 thousand 944 m^3 of water washes away the radioactive isotopes in the ground water. In wells №1419, where was not nuclear test site, found tritium from water [4]. In this regard, the wash-off radionuclides contaminate groundwater.

The plants and animals actively participate to reduce radiation. The plant gives a lot of biological products. In each ecosystem in the region of Semipalatinsk nuclear range of different plants grow. The overall average productivity of urgent problems steppe plant cover is - 4-5 centner for he. Cover the plant absorbs 5% of radioactive contamination. Here, under the laws of the ecological pyramid number of insects it is 10 times more. From 1 ha of land Semipalatinsk nuclear test site is found 45-50 different species of insects. In order to reduce radiation, the insect feeds on the plant, bird - insects and thus the process of reduction of radiation in the region.

Conclusions

Radiation levels of Semipalatinsk nuclear test site is reduced for three reasons:

1. Activity products of nuclear emissions reduced by 10, 100 and 1000 times after the explosion at 7.49 and 343 days during the half-life of the radiation.

2. Sufficient level of rain in the warm season of the year for the blur of radionuclides. Every year 4 million 382 thousand 944 m^3 of water washes away the radioactive isotopes in the ground water.

3. The biological spread reduces radiation.

References

1 Simon S.L. (2000), “Evaluation of possible radiation exposures near the Semipalatinsk nuclear test site.” Unpublished manuscript.

2 Gusev B. I., Abylkassimova S. N., and Apsalikov K. N. (1997), The Semipalatinsk nuclear test site: a first assessment of the radiological situation and the test-related radiation doses in the surrounding territories. Radiat. Environ. Biophys. 36: 201-204.

3 Peterson L. E., Z. S. Zhumadilov S., Kripalani U. V., Progulo T. M., Wheeler B. I., Gusev R., Arem S., Yonov and Weinberg A. D. (1998), “Diagnosis of benign and malignant thyroid disease in the east Kazakhstan region of the Republic of Kazakhstan: a case review of pathological findings for 2525 patients.” Cancer Research Therapy and Control 5: 307-312.

4 Ptitskaya L.D. Current status of the radiation situation on the territory of the test site “Balapan” the former Semipalatinsk test site // Vestnik NNC RK “radioecology, protection of the environment” edition 3, September 2002, p. 11 -19

5 Vasilenko O.I., Ishkhanov B.S., Kapitonov I.M., Seliverstov J.M., Shumakov A.V. Radiation. - M .: MGU, 1996. 6 Aidarkhanova G.S. Influence of underground nuclear tests in the underground environment massif Delegen. // Abstract... candidate of biol. sciences. , Almaty, Kazakh State University, 1998

Литература

1 Simon S.L. (2000), “Evaluation of possible radiation exposures near the Semipalatinsk nuclear test site.” Unpublished manuscript.

2 Gusev B. I., Abylkassimova S. N., and Apsalikov K. N. (1997), “The Semipalatinsk nuclear test site: a first assessment of the radiological situation and the test-related radiation doses in the surrounding territories.” Radiat. Environ. Biophys. 36: 201-204.

3 Peterson L. E., Z. S. Zhumadilov S., Kripalani U. V., Progulo T. M., Wheeler B. I., Gusev R., Arem S., Yonov and Weinberg A. D. (1998), “Diagnosis of benign and malignant thyroid disease in the east Kazakhstan region of the Republic of Kazakhstan: a case review of pathological findings for 2525 patients.” Cancer Research Therapy and Control 5: 307-312.

4 Ptiskaia L.D. Sobremennoe sostoianie radiasionnoi obstanobki na territory ispitatelnoi ploshadki «Balapan» bivshego Semipalatinskogo poligona - // Vestnik NIS RK , Radioekologia, ohrana okrujaushei sredi. - Vyp. 3, sentiabr 2002. - s. 11-19

5 Vasilenko O.I., Ishkhanov B.S., Kapitonov I.M., Seliverstova J.M., Shumakov A.V. Radiasia. M:. MGU, 1996.

6 Aidarhanova G.S. Vlianie podszemnih iadernih ispitanii na podzemnu sredu gornogo massiva Degelen. // Avtoreferat … kanditata boil.nauk, Almaty KazGu, 1988