Survey of Radon Concentrations in Air at Dong Pao Rare Earth Mine, Lai Chau, Vietnam

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Radon concentration in the air in the Dong Pao rare earth mine area and surrounding residential areas Satisfied surveyed. Measurements were performed using measurement techniques using the RAD7 instrument (RAD7 RAD H 2 O). The results show the annual effective dose caused by Radon in ambient air ranges from 0.28 – 4.90 mSv/y with an average value of 1.06 mSv/y. The values of inhalation dose effective breathing row year lie in gender limit security full.

Keywords: Natural Radioactivity, Radon concentration, dose rate.

1. INTRODUCTION

Environmental radiation is one of the important environmental quality indicators, receiving special attention from society because the effects of radiation on the human body, although not perceptible to the senses, are very complex. Radiation rays can affect health and cause serious consequences for humans.

Among naturally occurring radioactive elements, Radon gas is a descendant of naturally occurring radioactive series, Radon-222 of the Uranium-238 series, Radon-220 of the Thorium-232 series and Radon-119 of the Uranium-235 series, commonly known as Radons and Thorons, respectively. Radon and Thoron are inert gases; they do not form any chemical compounds. Compared to Thoron-220 and Radon-119, the radioactive danger of Radon-222 gas is very high because the half-life by radioactive decay is 3.825 days, while the half-life of Thoron is 55 seconds and that of Radon-119 is 4 seconds [1, 2]. Radon gas can enter the human body through the respiratory tract, especially Radon decays alpha, so its danger is great. When we inhale Radon and its daughter nuclei, some radioactive decay occurs in our lungs. The alpha particles produced can damage lung tissue. Therefore, Radon-222 isotope is the leading cancer risk agent among substances that cause lung cancer. Therefore, many countries are increasingly concerned about the risk of Radon accumulation in the environment, especially the air [3].

Every year, on average, each person receives a dose of radiation from natural radioactive sources of about 2 mSv. According to studies by the International Commission on Radiological Protection (ICRP), this dose level can cause 80 deaths from cancer out of 1000,000 people [4]. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) in 2000 compiled statistics and showed the contribution of Radon to the radiation dose to humans by natural radiation up to 50% [4]. Therefore, Radon can be considered a natural source of radiation with the greatest impact on human health.

Due to its widespread distribution in the Earth's crust, Uranium and its descendant isotopes are present in almost all types of soil, rocks, and minerals in varying concentrations. Humans living on Earth are always affected by ionizing radiation from these radioactive isotopes. When dispersed into the environment, radioactive isotopes can penetrate living organisms through food, drinking water and air. In particular, Radon exists in gas form so its ability to disperse into different environments is very high. At least 80% of Radon in the air is released from the soil.

Due to the movement of the earth's crust and the release of heat due to radiation in rocks and soil... there exist gas currents flowing at a slow speed from the bottom to the ground. Underground water flows, fracture zones, etc. are very favorable factors for dispersing radioactive gases in soil and rock far away from the source of supply.

Dong Pao rare earth mine is the mine with the largest rare earth reserves in Vietnam. There have been many studies over the years on geology, reserves, and rare earth processing and acquisition. Rare earths are found in many minerals, but the most common are three types: bastnaesite, xenotime and monazite. The special thing is that minerals always contain radioactive elements thorium and uranium. The content of these radioactive elements depends on each type of mineral and each mining area, so rare earth ores are always present. radioactive and causes natural radiation.

Therefore, studying Rn-222 concentrations in the environment at the Dong Pao rare earth mine will contribute to adding a lot of important information in assessing the level of Radon radioactive pollution in the environment in the above area. and assess the population dose caused by Radon.

2. RESEARCH METHODS

2.1 RAD7 measuring device.

The method of measuring radon concentration in the air environment using the RAD7 device is an active, continuous measurement method, capable of separately determining radon and thoron concentrations. The radon detector (Radon Detector - RAD7) manufactured by the American company DURRIDGE is a machine with many functions, considered a specialized device for measuring radon (Rn-222) and thoron (Rn-220) gas completely. adjustable, meeting many different uses: Surveying, monitoring (real time monitoring) and quickly detecting radioactive gas (sniffing) [5].

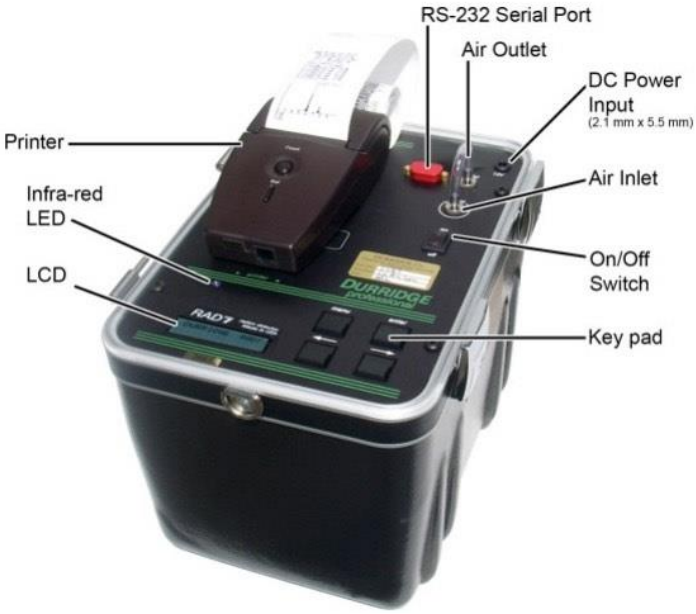

Fig.1. Main parts of the RAD7 device [5].

2.2 Method for measuring Radon concentration in the air

Radon concentration in the Dong Pao rare earth mine area was surveyed at 40 locations. Indoor and outdoor radon measurements around the Dong Pao Su rare earth mine use set bag measure radon RAD7 detector.

Radon concentrations in the air at 40 locations in the Dong Pao mine area were surveyed. The annual effective dose to the population is calculated from the experimental value of the Radon C_{Rn} concentration determined using the expression given by UNCEAR 2000:

$$H(mSv/y) = C_{Rn} * F * O * DFC \qquad (1)$$

C_{Rn} : Radon concentration in the air (Bq/m ^{3}).

F: global balance coefficient of Radon and its descendants (value equal to 0.4).

O: global indoor occupancy coefficient (valued at 7000 h/y).

DFC: Dose conversion factor (9 nSv/(h.Bq.m $^{-3}$)

With the task of environmental survey, radiation monitoring and safety, the air sampling height is 1m above the ground.

Fig. 2. Location for measuring Radon concentration in the air in the Dong Pao rare earth mine area

A total of 40 Radon concentration monitoring locations were surveyed. Location and coordinates of points monitoring Okay submit present live Table 1.

Table 1. Location for monitoring Radon concentration in the air at Dong Pao rare earth mine area.

No	Symbol sample	Latitude	Meridian
1	MRKK1	22 o 1 7 '50"	103 o 33'16"
2	MRKK2	22 o 17'49"	103 o 33 ' 16 "
3	MRKK3	22 o 17'50"	103 o 33' 16 "
4	MRKK4	22 o 17'51"	103 o 33'17"
5	MRKK5	22 o 17'52"	103 o 33'17"
6	MRKK6	22 o 17'5 2 "	103 o 33'16"
7	MRKK7	22 o 17'52"	103 o 33'17"
8	MRKK8	22 o 17'49"	103 o 33'15"
9	MRKK9	22 o 17' 5 0"	103 o 33 ' 14 "
10	MRKK10	22 o 17'4 6 "	103 o 33' 13 "
11	MRKK11	22 o 17'46"	103 o 33'14"
12	MRKK12	22 o 1 7 '35"	103 o 33'12"

13	MRKK13	22 ^{o} 17'35"	103 ^{o} 33'11"
14	MRKK14	22 ^{o} 1 7 '33"	103 ^{o} 33'14"
15	MRKK15	22 ^{o} 17'32"	103 ^{o} 33'14"
16	MRKK16	22 ^{o} 17'36"	103 ^{o} 33 ' 25 "
17	MRKK17	22 ^{o} 17'36"	103 ^{o} 33' 26 "
18	MRKK18	22 ^{o} 1 8 '44"	103 ^{o} 34'7"
19	MRKK19	22 ^{o} 1 8 '45"	103 ^{o} 33'31"
20	MRKK20	22 ^{o} 1 8 '46"	103 ^{o} 33'27"
21	MRKK21	22 ^{o} 1 9 ' 4 "	103 ^{o} 33'42"
22	MRKK22	22 ^{o} 19'4"	103 ^{o} 33 ' 22 "
23	MRKK23	22 ^{o} 19'4"	103 ^{o} 33' 20 "
24	MRKK24	22 ^{o} 19' 26 "	103 ^{o} 33'8"
25	MRKK25	22 ^{o} 19'26"	103 ^{o} 33' 7 "
26	MRKK26	22 ^{o} 19'25"	103 ^{o} 33'7"
27	MRKK27	22 ^{o} 19'12"	103 ^{o} 32'36"
28	MRKK28	22 ^{o} 18'38"	103 ^{o} 3 1 '25"
29	MRKK29	22 ^{o} 18' 39 "	103 ^{o} 31 ' 25 "
30	MRKK30	22 ^{o} 18'35"	103 ^{o} 31' 23 "
31	MRKK31	22 ^{o} 18'38"	103 ^{o} 31'22"
32	MRKK32	22 ^{o} 1 8 '27"	103 ^{o} 31'26"
33	MRKK33	22 ^{o} 1 8 '28"	103 ^{o} 31'25"
34	MRKK34	22 ^{o} 18'27"	103 ^{o} 3 2 '6"
35	MRKK35	22 ^{o} 18'27"	103 ^{o} 32 ' 7 "
36	MRKK36	22 ^{o} 18' 26 "	103 ^{o} 32' 6 "
37	MRKK37	22 ^{o} 18'27"	103 ^{o} 32'6"
38	MRKK38	22 ^{o} 18'27"	103 ^{o} 3 2 '7"
39	MRKK39	22 ^{o} 1 8 '27"	103 ^{o} 32'7"
40	MRKK40	22 ^{o} 18'27"	103 ^{o} 3 2 '7"

3. RESULTS AND DISCUSSION

The results of the average concentration, Radon concentration range and annual effective dose in air determined by formula (1) for people in rare earth mine areas are presented in detail in Table 2.

Table 2. Radon gas concentration and annual effective dose in air at Dong Pao rare earth mine area, Lai Chau, Vietnam.

No	Sample symbol	Rn-222 (Bq/m ^{3})	Effective dose (mSv/h)
1	MRKK1	18.6 ± 9.7	0.46872
2	MRKK2	19.5 ± 10.1	0.4914
3	MRKK3	18.1 ± 9.5	0.45612
4	MRKK4	62.6 ± 22.5	1.57752
5	MRKK5	45.9 ± 18.7	1.15668

6	MRKK6	36.2 ±19.3	0.91224
7	MRKK7	41.8 ± 20.8	1.05336
8	MRKK8	41.7 ± 17.1	1.05084
9	MRKK9	11.1 ± 11.3	0.27972
10	MRKK10	22.2 ± 11.0	0.55944
11	MRKK11	63 ± 20.2	1.5876
12	MRKK12	50.1 ±17.1	1.26252
13	MRKK13	38.4 ± 11.1	0.96768
14	MRKK14	38.3 ±11.8	0.96516
15	MRKK15	33.2 ±9.0	0.83664
16	MRKK16	100.3 ± 29.2	2.52756
17	MRKK17	111.5 ± 31.9	2.8098
18	MRKK18	38.3 ± 10.7	0.96516
19	MRKK19	31.6 ± 10.1	0.79632
20	MRKK20	30.2 ± 8.0	0.76104
21	MRKK21	38.4 ± 10.6	0.96768
22	MRKK22	44.5 ± 11.7	1.1214
23	MRKK23	194.5 ± 52.4	4.9014
24	MRKK24	43.1 ± 11.8	1.08612
25	MRKK25	35.2 ± 13.2	0.88704
26	MRKK26	48.2 ± 15.4	1.21464
27	MRKK27	33.3 ± 8.8	0.83916
28	MRKK28	45 ± 11.9	1.134
29	MRKK29	44.5 ± 11.6	1.1214
30	MRKK30	33.4 ± 9.3	0.84168
31	MRKK31	39.8 ± 10.4	1.00296
32	MRKK32	28.6 ± 12.1	0.72072
33	MRKK33	40.3 ± 11.1	1.01556
34	MRKK34	22.3 ± 10.5	0.56196
35	MRKK35	46.4 ± 17.3	1.16928
36	MRKK36	31.1 ± 8.7	0.78372
37	MRKK37	11.1 ± 3.1	0.27972
38	MRKK38	11.1 ± 3.0	0.27972
39	MRKK39	21.8 ± 6.1	0.54936
40	MRKK40	11.1 ± 7.7	0.27972

From Table 2, it can be seen that the annual effective dose in residential air ranges from 0.28 - 4.90 mSv/y with an average value of 1.06 mSv/y, lower than the world average value 1. of 15 mSv/y [3] and is below the lower limit of the recommended level of 3-10 mSv/y [6]. The values of the annual effective dose and annual inhalation dose are within safe limits.

Conclusion

The study aimed to measure the radon concertation in Air at Dong Pao Rare Earth Mine, Lai Chau, Vietnam. The results show the annual effective dose caused by Radon in ambient air ranges from 0.28 – 4.90 mSv/y with an average value of 1.06 mSv/y. The values of inhalation dose effective breathing row year lie in gender limit security full.

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