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Gamma Dose Measurements in the Beach Sands of Tatvan, Ahlat and Adilcevaz

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Abstract

The determination of radiation level is important in living areas for human health. The aim of this study is to determine environmental radiation in the beach sands of Tatvan, Ahlat and Adilcevaz. Environmental gamma radiation and alpha-beta concentrations determined for 15 different points. It has used portable gamma survey meter which is NaI(TI) scintillation detector. It has also used portable alpha-beta survey meter which consist of ZnS(Ag) scintillator adhered to 0.25 cm (0.010 in) thick plastic scintillator. For α/β emission measurements mean value was measured 81.2 cpm. The mean gamma dose rate value was measured as 0.149 µSv/h for ground level and 0.130 µSv/h for 1 m above the ground. The annual effective dose equivalent was obtained as 261.0 µSv/y. The obtained results were compared with literature.

Keywords: radiation, beach sand, environment gamma

1. INTRODUCTION

People are exposed to ionizing radiation throughout their lives. therefore, determining the risks of gamma radiation is important for health physics. The main sources of background radiation are cosmic radiation and terrestrial radiation [1, 2, 3]. The cause of terrestrial radioactivity is natural or artificial radioactive elements in the soil, air, sand, water and rocks. exposed radioactive elements are commonly ^{238}U, ^{232}Th and ^{40}K for natural radioactivity, ^{137}Cs, ^{90}Sr and $^{239}+^{240}Pu$ for artificial radioactivity [4, 5]. Cosmic radiation can also have a significant effect on high altitude areas [6].

In the recent years; in many countries, determining the level and risk of radiation has become important. Therefore, many researches have been done associated with radiation levels and risks in these countries [4, 5, 6, 7, 8] and in Turkey [9, 10, 11].

The beach sands are mineral deposits formed through weathering and erosion of either igneous or metamorphic rocks [4, 8]. The radiation hazards arising from sand are known that natural radiation is the important contributor to external radiation dose [8]. The most important point in radiation protection is the determination of the radiation dose from external sources.

The coastline of Lake Van is especially used by local residents to swim in the lake and to sunbathe in summer. Therefore, the objective of this paper is to determine the radiological hazards due to natural radioactivity associated with beach sands by measuring environmental gamma dose and α/β emissions. Radiological studies were made on sand of beach locations in Tatvan, Ahlat and Adilcevaz. The obtained results were compared with limit values determined by UNSCEAR [2].

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2. MATERIAL AND METHOD

Figure.1 Location of study area in Turkey and Van Lake (Google Maps).

Tatvan, Ahlat and Adilcevaz are located in the north western part of Van Lake (Figure 1). 15 different points were determined for measurement of radioactivity in Tatvan, Ahlat and Adilcevaz beachs where covers almost 100 km of Van Lake coastline and locations of these points were fixed by GPS device. Because of these regions are also located in Nemrut and Süphan volcanic mountains, beach sands have different types from each other. The measurements were recorded in autumn.

Gamma dose levels and α/β emissions of sample points were determined at the site. The environmental gamma measurements were made by Dose Rate Meter (LUDLUM Model 2241 Digital Scaler/Ratemeter + LUDLUM Model 44-10 Prob) that it is containing scintillation counter having to 2"x2" NaI (Tl) crystal at ground and 1m above the ground. Also α/β measurements were made portable (LUDLUM Model 2224-1 alpha/beta Scaler/Ratemeter + LUDLUM Model 43-2-2 Prob) alpha-beta survey meter which consist of ZnS(Ag) scintillator adhered to 0.25 cm (0.010 in) thick plastic scintillator at ground [12]. Readings are represented in terms of R/hr, Sv/h, cpm, or cps. Uncertainty in reading was less than 20% at maximum sensitivity (using manufacturer's calibration) [12].

The locations of the sample points were given in Figure 1 and coordinates of locations were given in Table 1. Measurements were made on-site in areas. Gamma dose rates were recorded as μSv/h. The obtained results are average of five measurements.

The annual effective dose equivalent (AEDE);

$$AEDE = ADRA * OF * T \quad (1)$$

where ADRA is absorbed dose rate in air, OF is outdoor occupancy factor (0.2) and T is the time (8760 hy^{-1}) [2].

3. RESULTS AND DISCUSSION

Environmental gamma measurements were taken on the sand ground and 1m above the ground levels. α/β concentration measurements were also taken on the sand ground and the results were given in Table 1 and are shown Figure 2 and Figure 3.

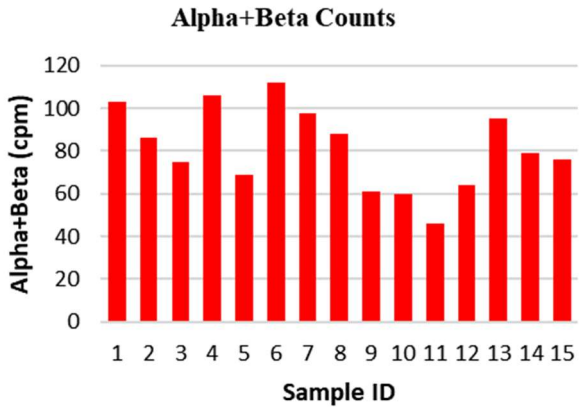

Figure.2 Alpha+Beta count results for each sampling points

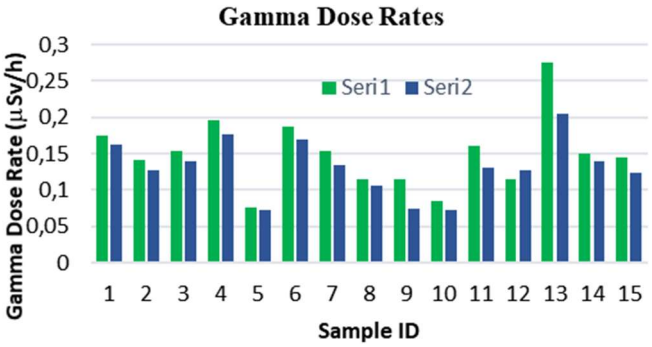

Figure.3 Gamma dose rates on ground and above 1 m for each sampling points

As shown in Table 1 and Figure 2; in the environmental gamma measurement, values in sand ground level are higher than values that were measured at 1 m level.

Table.1 Environmental gamma dose rate and α/β emissions measurement results and coordinates of sampling points.

Sample ID	Latitude	Longitude	Alpha+Beta (cpm)	Gamma (ground) μSv/h	Gamma (1m above) μSv/h
TTVN-01	38°28'53.03"N	42°18'26.44"E	103	0.174	0.162
TTVN-02	38°31'43.03"N	42°18'49.12"E	86	0.142	0.127
TTVN-03	38°31'39.89"N	42°19'00.49"E	75	0.154	0.139
TTVN-04	38°32'58.31"N	42°21'23.19"E	106	0.196	0.177
TTVN-05	38°35'07.15"N	42°23'22.20"E	69	0.076	0.072
AHLT-01	38°37'01.63"N	42°24'16.66"E	112	0.187	0.170
AHLT-02	38°37'40.06"N	42°27'28.43"E	98	0.154	0.134
AHLT-03	38°43'04.30"N	42°25'50.35"E	88	0.115	0.106
AHLT-04	38°45'17.12"N	42°30'36.56"E	61	0.115	0.075
AHLT-05	38°45'22.11"N	42°31'05.65"E	60	0.085	0.073
ADCZ-01	38°46'48.90"N	42°36'28.33"E	46	0.160	0.130
ADCZ-02	38°47'51.83"N	42°44'10.30"E	64	0.115	0.127
ADCZ-03	38°47'41.31"N	42°44'52.58"E	95	0.275	0.205
ADCZ-04	38°47'05.48"N	42°50'34.60"E	79	0.150	0.140
ADCZ-05	38°47'13.43"N	42°50'42.51"E	76	0.145	0.124
Min.			**46**	**0.076**	**0.072**
Max.			**112**	**0.275**	**0.205**
Mean			**81.2**	**0.149**	**0.130**

Maximum value is 0.275 μSv/h in sample ADCZ-03 and minimum value is 0.076 μSv/h for sample TTVN-05 in ground level. Likewise, for 1 m above the sand level, maximum value is 0.205 μSv/h in sample ADCZ-03 and minimum value is 0.072 μSv/h in sample TTVN-05 as ground level. The mean gamma dose rate value is 0.149 μSv/h for ground level and 0.130 μSv/h for 1 m above the ground. Ground levels are lower than 1 m above sand levels. But 1 m above sand level is higher than ground level for ADCZ-03. This sample point is area of beach sports.

As shown in Table 1 and Figure 3; for α/β emission measurements, maximum alpha+beta emission value is 112 cpm in sample AHLT-01, minimum value is 45 cpm in ADCZ-01 and the mean value is 81.2 cpm.

Table.2 The annual effective gamma dose equivalent value of different area in the literature.

Area	Annual effective dose equivalent (μSv/y)
Artvin, Turkey [13]	214.5
Pahang State, Malesia [14]	215.8
Kashmir, Pakistan [15]	497.0
Bushehr, Iran [16]	360
İstanbul, Turkey [17]	75
Present study	261.0
World average [2]	73.6

As shown Table 2, when the obtained results were compared with the literature, it was determined that the results were higher than the world average. However, these results are approximately the same as other studies.

4. CONCLUSION

When the radioactivity values in these regions are evaluated in themselves; Tatvan region has the maximum average alpha+beta emission value as 87.8 cpm and Adilcevaz region has the minimum average alpha+beta emission value as 72 cpm. Beta background levels on floors range from 250 to 450 cpm and alpha background level is 1 cpm in the literature [18]. Hence, the obtained results are lower than the litarature.

For annual gamma dose values; Adilcevaz region has the maximum average gamma dose rate value as 481.8 μSv/y and Ahlat region has the minimum average gamma dose rate value as 126.1 μSv/y.

The mean annual effective dose equivalent is 261.0 μSv/y. This mean obtained result for Tatvan, Ahlat and Adilcevaz beaches is approximately two times bigger than the world average, 73.6 μSv/y [2]. But the radiation received by the population due to beach sands is mainly the result of the spent time on the beach during summer. Therefore, the results show that Tatvan, Ahlat and Adilcevaz beaches can't be considered as an unsafe area with natural background radiation. The higher dose of the gamma radiation dose

of the Tatvan, Ahlat and Adilcevaz beaches can be related to the geological soils and rocks of the Nemrut and Süphan volcanic mountains.

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