Radioactivity Measuements in Commonly used Granites

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1. Introduction

Granite is a form of igneous rocks, consists mainly of quartz, mica, and feldspar, used for interior and exterior decorative and flooring for buildings. Commercial names of granite are derived from the place of origin, colour, patterns, etc. These granites, due to their composition contains some radionuclides. The radionuclides of ^{238}U and ^{232}Th radioactive series are the sources of both external and internal exposures in building materials [1]. It is important to assess the radiation hazards arising due to the use of soil, sand and other building materials containing high concentrations of naturally occurring radionuclides (^{238}U, ^{232}Th and ^{40}K) in the construction of dwellings [2].
Radon is formed from the decay series of uranium, which is present to some extent in all rocks but is most common in those of granitic composition[4]. Long term inhalation of alpha particles emitted from radon damages the cells in the lungs and lead to lung cancer. The present study is initiated with the objective of understanding the concentration of various radionuclides present in some of the granites used for construction and to measure the radiation hazard parameters associated with it. The obtained results are compared with the recommended limits of UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) 2008 data [3].

2. Materials and methods

Eight commonly used granite samples were collected from Local suppliers and construction sites of Kerala. The granite samples were cut into circular disk shape of diameter 2.5 cm and weight varies from 13-27 gm. The natural radionuclides in the samples were measured using sodium iodide NaI(Tl) (2"×2") scintillation detector coupled to a 8K MCA data acquisition system. It is surrounded by lead shield which suppress the background gamma radiation present at the laboratory. It has a resolution of (5.4%) at 1173.0 keV. Each prepared granite sample was placed directly over the detector and counted for a period of 96 hrs. The background spectra was also determined with the same conditions and is subtracted from the sample spectra. The activity concentration of ^{226}Ra was estimated from ^{214}Bi (1377.0 keV, 1401.0 keV, and 1408.0 keV), whereas activity concentration of ^{232}Th is assessed from ^{228}Ac(209.2 keV, 338.3 keV). The activity concentration of ^{40}K was determined from 1460.83 keV .

3. Result and discussion

Activity concentration of nuclei obtained from this study is summarised in the Table 1. The average activity concentration of ^{226}Ra, ^{232}Th and ^{40}K is 81.17, 6.80 and 37.60 Bq/kg respectively, where the average activity concentration of ^{226}Ra is above the max recommended limit[3]. In the present study red and pink colour granites are observed to have high range of activity concentration of ^{226}Ra as observed by Xinwei et al [5].
As per the prescription for calculating radiation hazard parameters (R.H.P) given in [1, 6, 7], R.H.P are calculated and given in the Table 2. The average value of radium equivalent activity (R_{eq}) levels is 93.5 Bq/kg. The values of the representative level index (I_r) ranged from 0.3 to 1.1 with an average value of 0.63. All values are under the limit, except one sample (Ubatuba). The average value of the external (H_{ex}) and internal (H_{int}) haz-

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TABLE I: The activity concentration of radionuclides in the samples

Samples	Origin	Colour	Activity Concentration (Bq/kg)		
			^{226}Ra	^{232}Th	^{40}K
Lakha red	Karnataka	Red	74.30 ± 1.03		13.92 ± 0.24
Black galaxy	Andhra Pradesh	Black	56.26 ± 0.94		35.03 ± 0.34
S.K Blue	Andhra Pradesh	Bue	56.41 ± 1.12		39.06 ± 0.38
Almond pink	Karnataka	Pink	114.97 ± 0.98		42.41 ± 0.33
Smoky red	Karnataka	Red	85.76 ± 0.83		42.96 ± 0.35
Imperial red	Karnataka	Red	82.25± 0.75	29.31± 4.1	49.40± 0.33
Ubatuba	Brazil	Green	129.36± 0.99	25.11± 0.2	33.22± 0.27
Black lapothara	Andhra Pradesh	Black	50.06 ± 0.62		44.80 ± 0.34
Average			81.17	6.80	37.6
UNSCEAR 2008(Maxlimit)			50	50	500

TABLE II: Calculated radiation hazard parameters in the samples

Samples	R_{eq} (Bq/kg)	I_r	Rad.Hzd.Indx		D (nGyh^{-1})	D_{eff}(mSvy^{-1})	
			H_{int}	H_{ex}		Indoor	Outdoor
Lakha red	75.3 ± 1.03	0.5±0.006	0.4±0.005	0.20±0.003	34.83±0.48	0.17±0.002	0.04±0.0006
Black galaxy	58.7±0.94	0.4±0.006	0.3±0.005	0.15±0.002	28.99±0.44	0.14±0.002	0.03±0.0005
S.K Blue	59.1±1.12	0.4±0.007	0.3±0.006	0.16±0.003	28.88±0.52	0.14±0.003	0.03±0.0006
Almond pink	117.9±0.98	0.8±0.006	0.6±0.005	0.32±0.002	54.70±0.45	0.27±0.002	0.07±0.0005
Smoky red	88.8±0.83	0.6±0.005	0.5±0.004	0.24±0.002	41.30±0.38	0.20±0.001	0.05±0.0004
Imperial red	127.6±5.91	0.9±0.040	0.5±0.016	0.34±0.010	58.22±2.58	0.28±0.010	0.07±0.0030
Ubatuba	167.6±1.02	1.1±0.007	0.8±0.005	0.45±0.002	76.64±0.47	0.37±0.002	0.09±0.0005
Black lapothara	53.1±0.29	0.3±0.004	0.2±0.003	0.27±0.002	24.92±0.29	0.10±0.001	0.03±0.0003
Averege	93.5	0.63	0.47	0.26	43.5	0.21	0.05
UNSCEAR 2008	370	1	1	1	84	0.48	0.48

ard index are 0.26 and 0.47 respectively. For absorbed dose (D) 43.5 nGyh^{-1} is the average value. The indoor and outdoor annual effective dose rate (D_{eff}) are having an average value of 0.21 and 0.05 mSvy^{-1} respectively. All these Radiation hazard parameters obtained are lower than the limit [3].

4. Conclusion

Commonly available granites in Kerala have been measured for the activity concentration of ^{226}Ra, ^{232}Th and ^{40}K. The average value of ^{226}Ra is higher than the max recommended limit[3]. The average value of all the Radiation hazard parameters obtained are lower than the limit reported [3]. Therefore, commonly used granites are safe for construction.

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