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Radon gas concentration at different baptism depth in soil of oil exploration area in Serchhip district of Mizoram, India

Lalnunpuia[1], Remlalsiama[2], Lalmuanawma Chhangte[3]
[1]Department of Physics, Govt. Champhai College, Champhai, Mizoram
[2]Department of Physics, Govt. Zirtiri Residential Science College, Aizawl, Mizoram
[3]Department of Physics, Lunglei Govt. College, Lunglei, Mizoram

Abstract- Radon gas concentration at different depth beneath the ground surface is studied at different oil exploration areas of Mizoram, India. The oil exploration areas of Thenzawl(TZ) in Serchhip district, is studied. The main instrument utilized for the study was RnDuo machine devised to survey Radon 222 (222Rn). The other instrument is a soil probe of 1mtr long to be baptised at different depth. The study was conducted at four different depths namely 10cm, 30cm, 50cm and 70cm. For each oil exploration areas, an in-situ measurement of soil gas was carried out at three different spots to cover the oil fields. The minimum value of radon gas concentration is observed at TZ-2 spots at 10cm deep; and the maximum concentration is recorded at TZ-2 spot at 70cm deep. The radon gas concentration beneath the soil, within the study area ranges from 0.14 kBq/m3 to 1.37 kBq/m3. The Radon gas concentration obtained in these areas are below the worldwide average of 35-40 kBq/m3.(UNSCEAR 2000).

Keywords: Soil Probe, in-situ measurement

I. INTRODUCTION

The Radon gas is a gas that comes from the naturally occurring radionuclide. The isotope 222Rn is mostly the decay product of 238U (approximately 55%) of the internal radiation exposed to human (ICPR 1993) and it is found in almost all types of soil. Radon penetrates through the ground and comes out to the air. It is present in the water as well. Despite porosity, the radon movement in rock depends upon various factors like compaction, fractural, tectonic features like earths thrust, earths faults and earths joints (Choubey et al. 1997).

Like the name suggests, oil and gases were drawn from oil exploration areas. It is interesting to study the Radon Concentration in soil gas of those areas. In India and Pakistan, radon survey in soil gas was carried out at different parts and locations (Mujahid et al. 2008; Ali et al. 2010; Prasad et al. 2005, 2008; Bajwa et al. 2010; Singh et al. 2010; Mehra and Bala 2013).

The main aim of the present study is to see and compare if the Radon gas present beneath the ground surface of Thenzawl oil exploration areas of Serchhip district is extremely high or low as compared to any other areas. The table 1, given in this paper shows the various Radon gas concentration obtained from the study area. The table 2, on the other hand shows the various radon gas concentration already obtained at different areas worldwide. Depending upon our finding, further experimentation is planned. Any major variance in the radon gas concentration will indicate the contribution of crude oil and its by-products. In oil exploration areas, it is eminent that huge crude deposits may have the potential to contribute for either the increase or decrease in the concentration of Radon gas concentrations as compared to non oil exploration areas.

II. STUDY AREA

The only oil field area in Serchhip district is studied. Mizoram is located in the North Eastern part of India neighbouring the state of Assam in the north. The oil field under study is situated in Thenzawl village area located at Serchhip district of Mizoram.

The present study location Thenzawl area stretches from 23018’08.3”N to 23018’12.4”N and between 92’42’5.8”E to 92’47’11.9”E with an elevation range of 2454 ft and 2483 ft from sea level.

The Fig.1 shows the location maps of all the oil exploration areas in Mizoram. Out of these six oil exploration areas, during this presentation, studies were conducted from one area which is present in Serchhip district.

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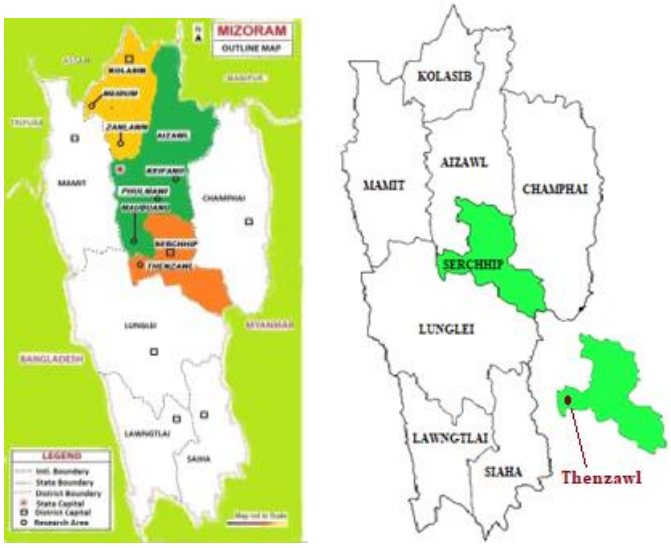


Fig.1 (a) (b)

Fig.1 (a). Map of Mizoram showing different location of oil Exploration areas (2020).
(b). Map of Mizoram showing oil exploration areas in Serchhip district.

III. METHODOLOGY

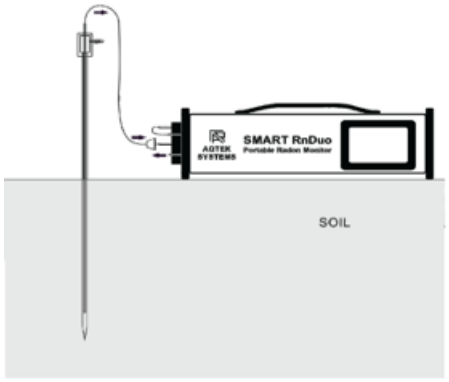


Fig.2. Set up for measurement of radon in soil

The Radon concentration in soil gas was carried out at three different spots in the oil exploration area. A total of three spots covering the entire oil field area is studied. The radon concentration was determined at four different depths namely 10cm, 30cm, 50cm and 70cm. An in-situ measurement was done with an instrument specially designed for the purpose namely Smart RnDuo. Fig.2 shows the Smart RnDuo for measuring radon concentration in soil gas at different depth which is fitted with a stainless steel probe that could be baptized at different depths. After the probe has been baptised at a particular depth, with the RnDuo fitted, four reading at 15mins cycle was taken. The mean of the three readings gives the final reading for that depth. Fig.3 shows the block diagram of the mentioned smart RnDuo.

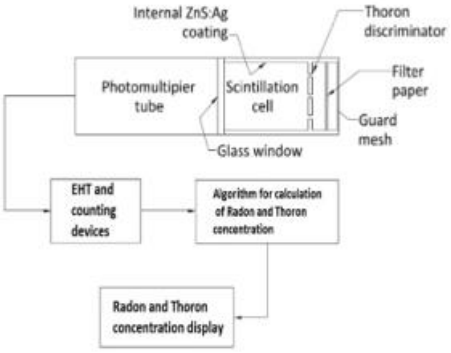


Fig.3. Block diagram of Smart RnDuo

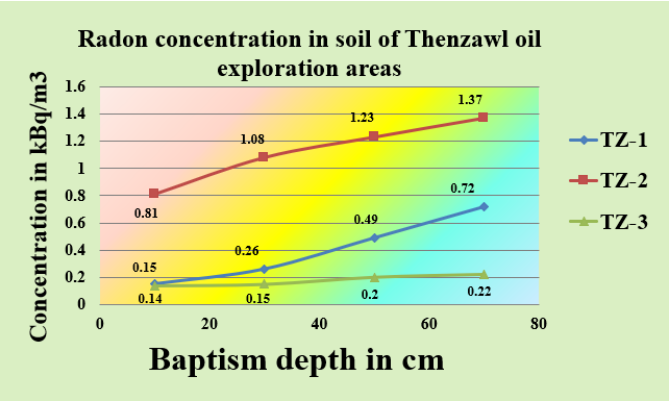
IV. RESULT AND DISCUSSION

The result and observation of Radon Concentration in soil gas is given in Table 1. below. The radon concentration in Thenzawl location varies from 0.14 kBq/m3 at 10cm depth to 1.37 kBq/m3 at 70cm depth. The readings are taken in the month of January. During this month the weather is dry and there are no rainfall for the last 30 days. The soil in the study area is free from moisture.

Table-1. Radon Concentration in soil gas at various baptism depth of oil exploration areas in Serchhip district and Kolasib district of Mizoram, India

Table-1. Radon Concentration in soil gas at various baptism depth of oil exploration areas in Serchhip district and Kolasib district of Mizoram, India						
Sl. No	Sampling Location	Sampling ID	GPS Location (Latitude/Longitude)		Baptism Depth	Radon Concentration kBq/m^3
1	Thenzawl	TZ-1	Elev(ft)	: 2460	10cm	0.15
			North	: 23^{0}18’08.3”	30cm	0.26

			East	: 92’47’04.4”	50cm	0.49
					70cm	0.72
2	Thenzawl	TZ-2	Elev(ft)	: 2454	10cm	0.81
			North	: 23^{0}18’10.2”	30cm	1.08
			East	: 92’42’05.8”	50cm	1.23
					70cm	1.37
3	Thenzawl	TZ-3	Elev(ft)	: 2483	10cm	0.14
			North	: 23^{0}18’12.4”	30cm	0.15
			East	: 92’47’11.9”	50cm	0.20
					70cm	0.22



Graph-1. Radon concentration in soil at different spot of Thenzawl oil exploration areas

V. COMPARISON WITH STUDIES FROM OTHER NON-OIL EXPLORATION AREAS IN INDIA

The Table-2 shows radon concentrations in soil obtained from various other investigators. Prasad et al. (2008) have reported the concentration that varies from 1.10 kBq/m3 to 31.80 kBq/m3 in the Budhakedar area of Tehri Garhwal, India. Bajwa et al. (2010) have found the radon concentration that varies from 42.80 kBq/m3 to 71.50 kBq/m3 in Tusham ring complex, Haryana, India. The radon concentration in soil gas ranges from 0.01 kBq/m3 to 2.33 kBq/m3 in Garhwal, Himalaya, India.(Bourai et al. 2013). The radon concentration as reported from Hamirpur district, Himachal Pradesh, India varies from 0.03 kBq/m3 to 2.28 kBq/m3. (Mehra and Bala. 2013). Kumar et al.(2011) have found the radon concentration in soil of Malwa belt Punjab to vary from 1.90 kBq/m3 to 16.40 kBq/m3. The radon concentration in soil of Murree, Pakistan as obtained by Ali et al. (2010) varies between 0.61 kBq/m3 to 3.89 kBq/m3 only. This is very close to that obtained by Mujahid et al.(2010) in Southern Punjab, Pakistan whic varies between 0.42 kBq/m3 to 3.56 kBq/m3. The radon concentration in soil as obtained by Ali et al. (2010) in Islamabad, Pakistan ranges from 17.34 kBq/m3 to 72.52 kBq/m3, which is quite high.

Most of the Radon Concentration in Soil Gas as obtained from various other locations falls within the range of the present investigation except those in the Tusham ring complex of Haryana. Moreover the radon concentration in soil gas as obtained in this study are found to be less than the worldwide average value for outdoor radon activity recommended by United Nations Scientific committee on the Effects of Atomic Radiation (UNSCEAR 2000).

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Table-2. Radon gas Concentration in soil at various places in India and Pakistan

Sl. No	Locations	Concentration kBq/m^3.	References
1	Tusham ring, Haryana granitic regions	42.8 - 71.5	(Bajwa *et al.* 2010)
2	Islamabad, Pakistan, soil	17.34 - 72.52	(Ali *et al.* 2010)
3	Tusham ring, Haryana non-granitic regions	16.3 - 44.1	(Bajwa *et al.* 2010)
4	Hamirpur district, HP, soil	0.035 - 2.28	(Mehra and Bala 2013)
5	Upper Siwaliks, India, soil	11.50 - 78.47	(Singh *et al.* 2010)

6	Malwa belt, Punjab, soil	1.90 - 16.40	(Kumar *et al.* 2011)
7	Kangra district, HP, soil	1.10 - 82.20	(Singh *et al.* 2006)
8	Budhakedar, Tehri Garhwal, soil	1.10 - 31.80	(Prasad *et al.* 2008)
9	Murree, Pakistan, soil	0.61 - 3.89	(Ali *et al.* 2010)
10	Southern Punjab, Pakistan, soil	0.42 - 3.56	(Mujahid *et al.* 2010)
11	*Thenzawl oil exploration area*	0.14 - 1.37	*Present investigation*
12	Garhwal Himalaya, soil	0.012 - 2.33	(Bourai *et al.* 2013)

The radon concentration in soil gas of oil exploration areas is found to be higher than the dwelling radon concentration of non oil exploration areas. But the soil radon concentration as obtained in the study areas were found to be less than the worldwide average value of 35 kBq/m3 for outdoor radon activity recommended by United Nations Scientific committee on the Effects of Atomic Radiation (UNSCEAR 2000).

The fig.4 shows minimum and maximum radon concentration in soil of some areas taken from Table 2. The Radon Concentration in Soil of the study areas were found to be less than the worldwide average value of 35 kBq/m3 for outdoor radon activity recommended by United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2000).

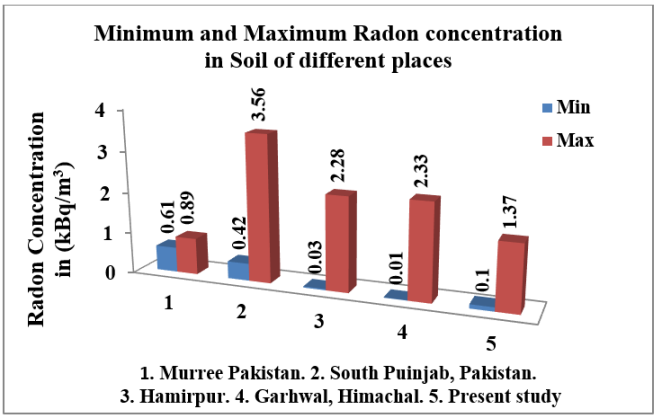

Fig.4. Minimum and Maximum Radon concentration in soil of various locations in India

The Table-3 shows radon gas concentrations in dwelling and outdoor region obtained from various other investigators. Ali et al. (2010) have reported the concentration that varies from 0.043 kBq/m3 to 0.097 kBq/m3 in Islamabad, Pakistan. Duggal et al. (2014) have found the outdoor radon concentration that varies from 0.09 kBq/m3 to 10.40 kBq/m3 in Gangadhar district, Rajasthan. The radon concentration in air also ranges from 0.035 kBq/m3 to 0.096 kBq/m3 in Hamirpur district, Himachal Pradesh.(Mehra and Bala. 2013). The radon concentration in dwellings as reported by Rohmingliana et al. (2010) from Serchhip district, Mizoram varies from 0.028 kBq/m3 to 0.072 kBq/m3. The radon concentration in dwellings as reported by Vanchhawng Lalmuanpuia et al. (2009) from Aizawl district, Mizoram also ranges from 0.027 kBq/m3 to 0.085 kBq/m3. Vanchhawng Lalmuanpui et al. (2009) also reported the dwelling radon concentration of Kolasib district to vary from 0.021 kBq/m3 to 0.093 kBq/m3 which is very likely with the radon concentration abtained in Aizawl district.

Kant et al. (2004) have obtained radon concentration in oil refinery dwelling, Haryana between 0.055 kBq/m3 to 0.195 kBq/m3; whereas he obtained 0.034 kBq/m3 to 0.129 kBq/m3 in City dwelling of Haryana. He also obtained a radon concentration of 0.046 kBq/m3 to 0.190 kBq/m3 in Oil refinery environment of Haryana. The three radings obtained by Kant et al. in Haryana are very close to each other. Ali et al. (2010) also reported a radon concentration of 0.018 kBq/m3 to 0.042 kBq/m3 in Murree, Pakistan environment.

Table-3. Radon gas Concentration in dwellings and outdoor of various places

Sl. No	Locations	Concentration kBq/m^3.	References
1	Islamabad, Pakistan, air	0.043 - 0.097	(Ali *et al.* 2010)
2	*Thenzawl Area*	0.14 - 1.37	*Present investigation*
3	Gangadhar Dist Rajasthan, air	0.09 - 10.40	(Duggal *et al.* 2014)
4	Hamirpur district, HP, air	0.035 - 0.096	(Mehra and Bala 2013)
5	Serchhip district, Mizoram,	0.028 - 0.072	(Rohmingliana 2010)

	Dwellings		
6	Aizawl district, Mizoram, Dwellings	0.027 - 0.085	(Lalmuanpuia 2009)
7	Kolasib district, Mizoram Dwellings	0.021 - 0.093	(Lalmuanpuia 2009)
8	Oil refinery environment, Haryana	0.046 - 0.190	(Kant *et al.* 2004)
9	Oil refinery dwelling, Haryana	0.055 - 0.195	(Kant *et al.* 2004)
10	City dwelling, Haryana	0.034 - 0.129	(Kant *et al.* 2004)
11	Murree, Pakistan, air	0.018 - 0.042	(Ali *et al.* 2010)

The fig.5 shows minimum and maximum radon concentration in dwellings and outdoor areas taken from Table 2. The Radon Concentration in dwellings and outdoor areas were found to be very much less than the Radon Concentration in Soil of the study areas. All the concentrations were but very less as compared to the worldwide average value of 35kBq/m3 for outdoor radon activity recommended by United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2000).

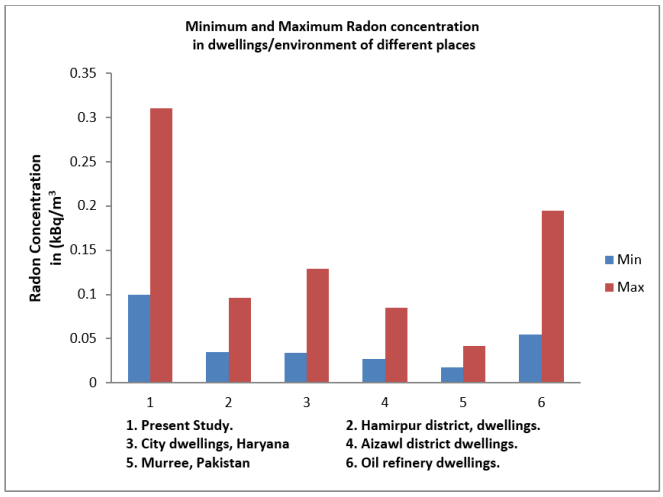

Fig.5. Comparison of minimum and maximum radon concentration in dwellings of some areas in India and Pakistan with the present study.

VI. CONCLUSION

The Radon concentration in soil gas of oil exploration areas in Serchhip district of Mizoram is studied. An in situ measurement was taken at four different depth such as 10cm, 30cm, 50cm and 70cm with the help of a Smart RnDuo and a stainless steel probe. The study was carried out during winter season in the month of January. The soil has no moisture content. It has been observed that the concentration of radon gas increases as we baptize the soil probe deeper and deeper. This means that for every spot chosen, the radon gas concentration at 10cm deep is lowest and the radon gas concentration at 70cm is highest and the concentration at 30cm and 50 cm lie in between. The radon gas concentration within Serchhip district does not show any notable difference in the concentration as compared to results obtained from other locations within India.. With the present study we may conclude by saying that the concentration of radon soil gas that emanates in oil exploration areas in Serchhip district of Mizoram, India does not increase the radon gas concentration. This may be because of less uranium deposits within the areas. The radon gas concentration obtained in these locations are far below the world average of 35-40 kBq/m3.

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