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Variation of Radon with Relative and Absolute Humidity- II

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Abstract: ***In continuation with study of variation of RH and AH with EEC_{Rn}, Temperature and RH were used as variables to calculate AH using 3D MATLAB Program. An equation relating AH, RH and T with $EEC_{Rn}$was obtained. Calculated AH values were plotted vs measured EEC_{Rn}. At all places positive slope has been found between RH and EEC_{Rn}whereas AH vs EEC_{Rn} curves have negative slope at all the places confirming our previous results for Amritsar.***

Keywords: EEC_{Rn}, DSAABC Method, Relative Humidity, Absolute Humidity, 3D MATLAB equation.

1. Introduction

It has been observed that inhalation of radon and its short lived progenies is responsible for more than 50% of annual effective radiation dose from all natural sources **[1]**.Radon and its decay products cause hazardous effects on health. A large number of measurements of Radon and its progeny have been published (**[2]**-**[8]**). Majority of reports have shown their measurements for indoor and outdoor. In the present work results of Radon daughter products are determined from gross beta counts by Defined Solid Angle Absolute β Countingmethod [7]. The EEC_{Rn} was computed from activity concentrations by use of **Bateman differential equations[9]** .The effective dose rates of Radon have been calculated from activity concentrations. Measurements were taken from two sites in Amritsar & Bathinda, Pb. and two sites Hamirpur, Chakmoh, Himachal Pradesh of India. These measurements were made three times a day morning, noon and evening.

The DSAABC method[7] has various advantages over old alpha counting methods and gamma spectrometry **[10]**. Gamma spectroscopy is low efficiency, high background and high cost technique. A low permeability membrane filter and low air flow rate are major requirements of alpha counting methods to prevent strong self-absorption and energy degradation of alpha particles. In beta counting method high air flow rate and glass fibre can be used. As beta particles have high penetration power than alpha particles, sensitivity is also higher. The method developed by Papp and Daroczy **[7]** is used to measure the counting efficiency of radon and its progeny one by one, having errors less than 10%. RH and Temperature values have been used to calculate AH using MAT Lab 3D equation. Correlations between EEC_{Rn} vs AH, and EEC_{Rn} vs RH were determined graphically.

2. Methodology

It has been estimated that the airborne concentration level of radon progeny depends on the meteorological conditions such as rainfall, snow, wind, humidity and temperature after creeping out from cracks .Out of these parameters temperature, absolute humidity and relative humidity variation has been studied. To measure individual concentrations of radon progeny DSAABC method has been used at four sites of Punjab and Himachal. For each site 40 observations were taken. The measured values of RH and Temperature were used to calculate AH using 3D MATLAB program equation[11].The data has been listed in Table-1.Graphs between EEC_{Rn} and RH are listed shown in Figure-1 and those between EEC_{Rn} and AH in Figure-2.

Table 1: EEC_{Rn}, RH and AH at Four sites (Two in Punjab and Two in Himachal Pradesh)

Amritsar			Bathinda			Hamirpur			Chakmoh		
EEC	*RH*	*AH*	*EEC*	*RH*	*AH*	*EEC*	*RH*	*AH*	*EEC*	*RH*	*AH*
4.49	94	10.60	1.79	22	12.53	18	63	3.36	17.7	74	6.88
4.62	92	11.15	1.55	25	11.59	5.42	43	5.32	20.8	77	4.35
1.66	54	23.05	1.15	26	14.26	6.17	51	4.07	10.1	41	5.65
0.9	58	24.97	0.9	30	14.45	11.6	62	3.35	18.1	70	5.52
1.19	55	31.55	1.46	30	15.74	6.79	44	5.07	22.2	82	3.72
0.98	65	28.60	2.91	31	10.77	5.83	56	4.97	6.54	54	6.67
0.75	57	23.99	2.23	31	11.18	13.1	63	3.29	18.7	69	5.05
8.56	68	8.48	2.07	32	11.89	5.89	40	4.59	15	77	7.87
2.4	44	10.69	1.65	33	13.32	6.09	49	3.98	6.47	56	9.76
4.09	45	6.25	1.57	33	16.01	13.7	64	3.41	18.6	71	6.81
8.39	70	7.98	2.07	36	13.37	6.95	49	6.58	13.8	81	5.72
3.18	47	9.14	0.64	37	18.85	18	58	5.27	4.79	57	8.45
2.14	45	9.60	1.45	37	15.73	14.7	66	3.65	11.7	71	6.32
5.9	55	10.41	1.13	38	18.72	6.02	46	6.20	16.3	93	15.12
8.14	74	9.31	1.93	38	16.72	6.5	51	5.40	6.69	80	18.18
3.21	61	8.75	7.6	39	14.65	16.2	68	4.67	11.9	83	12.74
15.81	65	6.13	1.4	39	19.58	7.56	59	8.45	14.6	92	15.46
3.14	47	8.26	2.7	39	13.82	8.87	74	7.74	7.24	69	16.34
4.56	43	5.78	2.26	39	19.69	13.6	74	5.00	12.1	70	10.04
4.02	40	6.38	1.75	39	18.59	5.62	43	6.09	11.6	90	12.85
3.91	51	7.01	0.06	40	18.02	2.07	40	4.27	6.97	41	6.60
18.84	62	8.64	2.66	40	15.88	2.63	44	3.73	18.2	71	6.01
2.67	40	6.85	1.29	40	19.99	11.6	61	3.42	5.29	47	7.02
6.06	60	7.76	0.95	41	14.06	5	48	6.22	13.3	54	5.90
11.91	72	7.59	8.87	42	13.24	4.32	52	4.92	18.6	80	6.47
3.55	45	7.76	1.87	43	13.48	4.93	54	7.84	14.9	70	7.61
2.52	57	7.63	5.72	44	15.08	15.5	70	10.26	18.1	74	7.05
8.38	55	20.25	5.43	45	13.85	6.23	51	7.17	6.48	49	9.67
8.12	52	17.78	1.23	45	20.41	3.94	55	8.66	10.2	72	7.53

4.64	51	12.65	1.7	46	21.72	12.4	71	10.16	18.7	89	6.29
7.12	59	24.18	1.01	47	19.82	4.71	51	7.83	8.36	62	11.31
5.7	58	22.50	1.33	47	15.21	3.55	54	7.45	8.36	78	8.21
4.16	52	16.67	1.79	47	16.27	8.51	63	3.55	10.5	66	10.01
9.8	61	27.74	1.76	47	23.93	4.29	43	5.69	4.51	84	15.87
25.36	64	26.64	3.79	48	19.19	5.36	57	5.26	9.95	96	12.59
7.84	62	26.09	1.55	48	21.67	10.4	70	2.87	5.99	80	17.84
8.9	47	9.21	1.01	51	21.73	4.42	36	3.45	9.12	83	14.50
22.84	61	9.75	12.77	51	15.87	5.8	53	4.20	12.3	90	12.26
9.1	51	8.54	1.69	51	18.61	12.4	64	3.34	7	72	15.84
47.02	55	8.00	1.81	51	20.02	5.49	33	3.82	7.26	79	14.44

3. Results and Discussion

From Figure-1, The plots between EEC_{Rn} and RH for(a)Amritsar,(b) Bathinda, (c)Hamirpur and (d)Chakmoh reveal positive slopes between EEC_{Rn} and RH at all the places. Similarly the plots with EEC_{Rn} and AH at all the places show negative slope. These are in line with our earlier findings [10], [11] and contradict those of Blaauboer and Smetsers [12] which shows positive slope between EEC_{Rn} and AH. The correlation coeffients of EEC_{Rn} vs RH and EEC vs AH are listed in Table 2.The correlation coefficient EEC_{Rn} and RH at Hamirpur is significant and Correlation coefficient EEC_{Rn} and AH at Chakmoh is also higher than at other places.

Table 2: Correlation coefficients between EEC_{Rn} vs RH and AH at four sites

	Amritsar	Bathinda	Hamirpur	Chakmoh
RH	R=0.15	R=0.24	R=0.73	R=0.35
AH	R=-0.11	R=-0.23	R=-0.13	R=-0.54

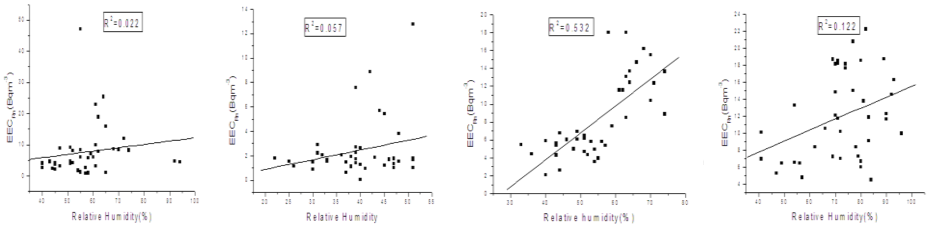

Figure 1: EEC_{Rn} vs. RH (a)Amritsar (b) Bathinda (c)Hamirpur (d)Chakmoh

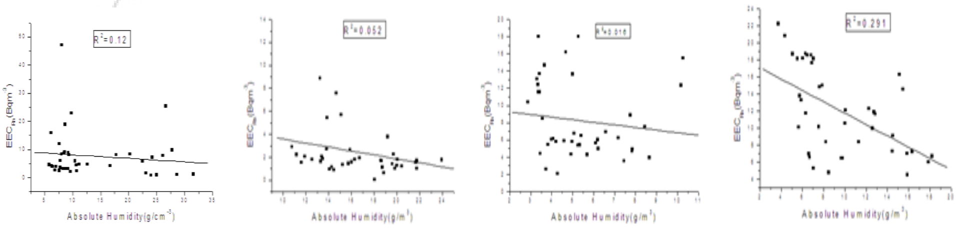

Figure 2: EEC_{Rn} vs. AH (a)Amritsar (b) Bathinda (c)Hamirpur (d)Chakmoh

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