DEPOSITION FRACTIONS OF INHALED INDOOR RADON DECAY PRODUCTS IN HUMAN RESPIRATORY SYSTEM WITH VARIOUS LEVELS OF PHYSICAL EXERTION.

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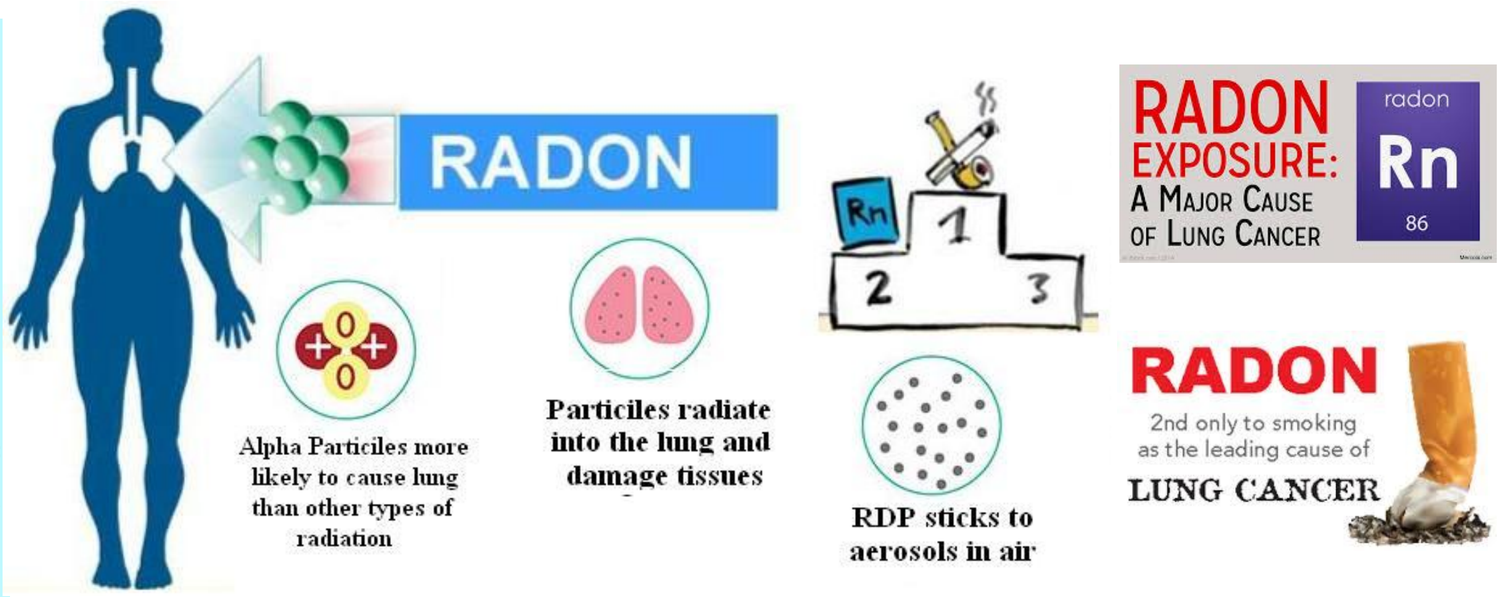
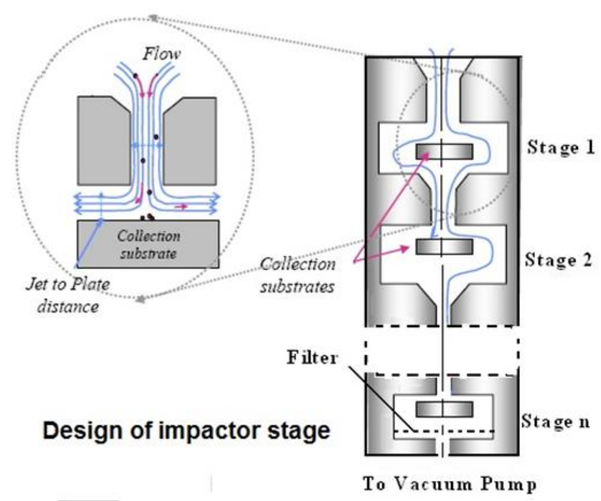
INTRODUCTION

Radon decay products are the second cause of lung cancer after smoking. Therefore, a lot of dosimetric model has been built in to calculate the effective dose and effective depth dose in different region and tissues of human respiratory system. The first step of dose calculation is the deposition fraction estimation. Deposition fraction of radioactive aerosols in human respiratory system is mainly depending on their size. In this work, the activity size distributions of accumulated inhalable particles of ^{222}Rn decay products (^{214}Pb and ^{214}Bi) are tested in indoor air.



EXPERIMENTAL METHODS AND DATA EVALUATION

A low-pressure Berner cascade-impactor is using as an aerosol sampler (size range of 70–6000nm). The measured attached activities of (**^{214}Pb and ^{214}Bi**) are associated with the aerosol particles of the accumulation mode (200 nm to 2000 nm).



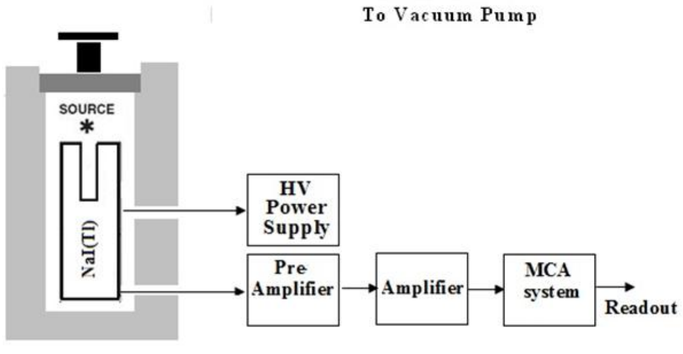
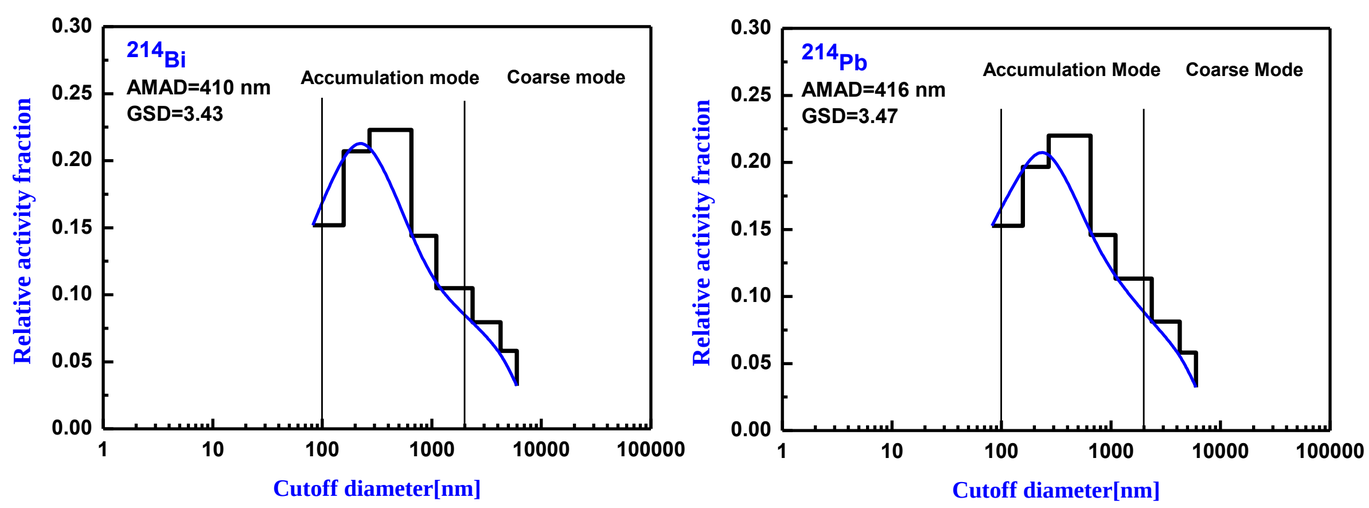


Table 1 Calculated values of active median aerodynamic diameter (AMAD) and relative geometric standard deviation (GSD) of radon progeny (214pb and 214Bi), extreme values of measurements are given in parenthesis.

BI					
Attached parameters of ^{214}Pb and ^{214}Bi					
Nuclide	AMAD (nm)	GSD	**Nuclide**	AMAD (nm)	GSD
^{214}Pb	422 (345-572)	3.4 (2.9-3.9)	**^{214}Bi**	410 (314-562)	3.4 (3-3.7)



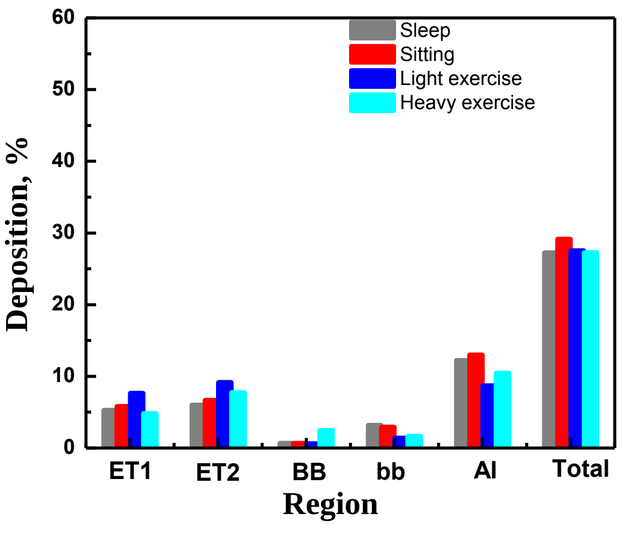
Average calculated activity size distribution of attached radon progeny (^{214}Pb and ^{214}Bi).

Deposition Calculation

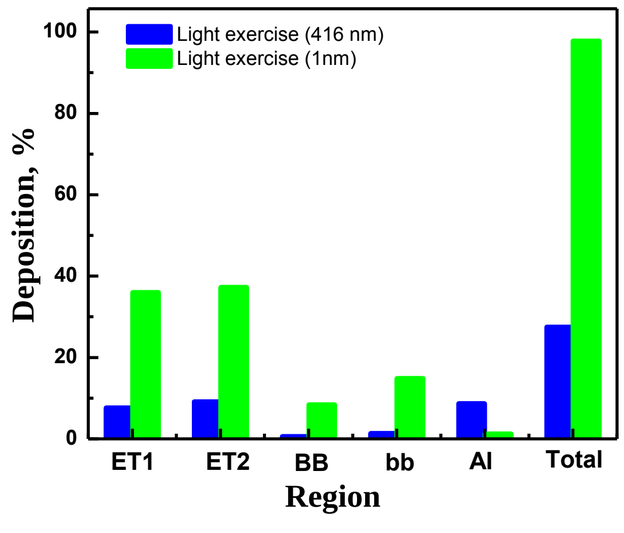
The principal criteria of the ICRP 66 model have been adopted in LUDEP 1 PC-software NRPB SR264, which predicts regional particle deposition in each lung compartment. Therefore, this program offers a useful means for determining the regional deposition probability functions in the human respiratory tract during different physical activities. The deposition probability functions were calculated for four selected activity levels (sleeping, sitting, light exercise and Heavy exercise) of an adult person when breathing takes place through the nose. The activity-related breathing parameters are shown in table 2.

Table 2. Selected ventilation parameters for four activity levels in an adult male.

Activity level	Hourly ventilation (m^3/h)	Breathing frequency (time/min)	Tidal volume (cm^3)	Volumetric flow rate (cm^3/s)	Fraction breathed through nose
Sleeping	0.45	12	625	250	1
Sitting	0.54	12	750	300	1
Light exercise	1.5	20	1250	833	1
Heavy exercise	3	26	1923	1667	0.5



Calculated regional and total deposition fractions of attached radon progeny (^{214}Pb) in different regions of human respiratory tract for 416 nm various levels of physical exertion.



Deposition fractions of attached (416 nm) and unattached (1 nm) radon progeny in different regions of human respiratory tract for physical exertion light exercise.

We found that the deposition fraction is lower in the bronchi and increases with succeeding bifurcations of the human respiratory airways. This is may be due to the attached fraction of aerosol penetrate the upper part of the respiratory tract and deposited in the tracheobronchial (T-B) and pulmonary (P) regions. So that the deposition fraction of attached particles of radon decay product were high throughout the alveolar interstitial region. Attached particles are deposited in different parts of the pulmonary region (p) due to different sizes of aerosol particles.

A significant factor that must be accounted for calculating the deposition profile of radon progeny within the respiratory tract is the typical variability or dispersion in size of the aerosol particles.

Although unattached radon decay product fraction may be not more 10 % in ambient air but it has a high deposition fraction depending on their size.