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Parametric study of the ionizer induced Thoron progeny concentration depletion

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It is well known that the negative ions emitted from the negative ion generator (NIG) help in charging the airborne particles, thereby removing them by electromigration in space charge-induced electric fields (Mayya *et al.,* 2004). The NIGs have also been used to reduce activity concentration of radon/thoron decay products (Sheets and Thomson 1995). The physical arguments suggest different reasons for the activity reduction namely; 1) direct plate-out of freshly formed, charged fine fraction of progeny through drift in the electric field and 2) removal of the coarse fraction, thereby increasing the highly mobile fine fraction and its consequent plate-out. To investigate these aspects, measurements of various parameters like activity concentrations, deposition velocity, aerosol number concentration and the unattached fraction in presence of NIG; a systematic study has been carried out in a room environment wherein a thorium nitrate powder was placed as a source of thoron progeny. The overall decrease in the progeny concentration with NIG is depicted in Fig. 1.

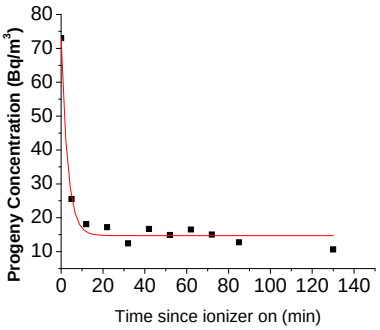

Figure 1: The decrease in the progeny concentration with the ionizer switched on.

Deposition velocity of the progeny was measured using passive direct progeny sensors, which are deposition based absorber mounted LR115 detectors. It was observed that the deposition velocity increased from ~0.06 mh^{-1} to 0.3 mh^{-1} in presence of negative ions. The unattached fraction, estimated by wire-mesh and filter-paper sampling followed by Alpha counting, was also found to increase from 2% to 6.5%. Additionally, the activity deposited in the vicinity of the needles of the NIG showed negligible increase with NIG switched on. All these observations strongly point at the possibility of argument (2) cited above as the mechanism of activity reduction.

The particle concentration, measured using GRIMM 5.403 Scanning Mobility Particle Sizer (SMPS) in the size range of 9.8 nm to 875 nm, showed a 3-fold decrease after switching on the ionizer. The attachment rate, *X*, of the progeny to the ambient aerosols (concentration, *Z* /cc) can be estimated using the relationship: X= β(d)Z, where *β(d)* is the size dependent attachment coefficient (cc/s). This is plotted in Fig. 2 and a decrease in the attachment rate is seen when the ionizer is switched on. Also, the activity median diameter was found to shift to larger sizes (94 nm to 150 nm). The lowered attachment rate also points at the increase in the unattached fraction as observed by wire-mesh filter paper sampling techniques. However, the implication of the reduction in activity concentration might not necessarily lead to a reduction in the lung dose and this requires a careful investigation.

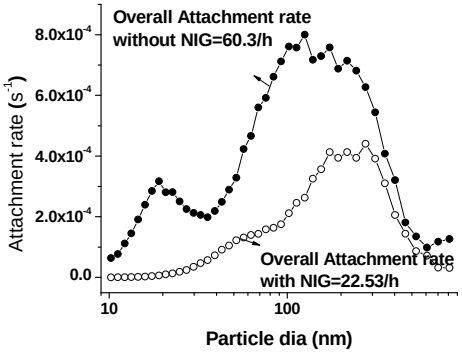

Figure 2: Effect of ionizer on the attachment rate under ambient aerosol conditions

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