

RESPONSE IN WATER COMPARED TO AIR OF TWO IONIZATION CHAMBERS EXPOSED TO LOW-ENERGY X-RAYS

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Introduction: This work investigated the effect of two media (liquid water and air) on the charge collected by two ionization chambers after exposure to low-photon energy.

Material and method:

Two Farmer-type ionization chambers (IC) were exposed in air and liquid water to ten x-ray beams from 20 kV to 160 kV produced by a YXLON x-ray tube at a current of 2 mA. The ICs were Exradin A12 and A19 with 0.64 cm³ and 0.62 cm³ volume, respectively. The beam qualities were previously characterized in our lab. For liquid water, the measurements were performed at 2 cm depth and 61 cm source to surface distance. Whereas, for the measurements in air, the chambers were situated at 63 cm source to detector distance to conserve the same distance from the focal spot. The collected charges were corrected due to the variations of the temperature and pressure during the experiment.

Results:

To evaluate the effect in the response of the ionization chambers due to the presence of the two media, the charge collected in water was divided to that collected in air. Figure 1 shows the results as a function of the effective energy of the x-ray beam for the A12 and A19 ionization chambers.

Independent of the ionization chamber, at effective energies below 32 keV (80 kV), the charge collected in liquid water can be up to 84% less than that generated in air. The lower is the energy, the smaller is the response in water compared to air. This can be associated to the rapid attenuation of the low-energy photon fluence by the water depth. At effective energies greater than 32 keV, the response in water becomes larger than that in air, reaching a maximum of 27% and 35% at 65 keV (150 kV) for A19 and A12 chamber, respectively. The difference in response between the two media is consistently greater for ionization chamber A19 at energy above 25 keV.

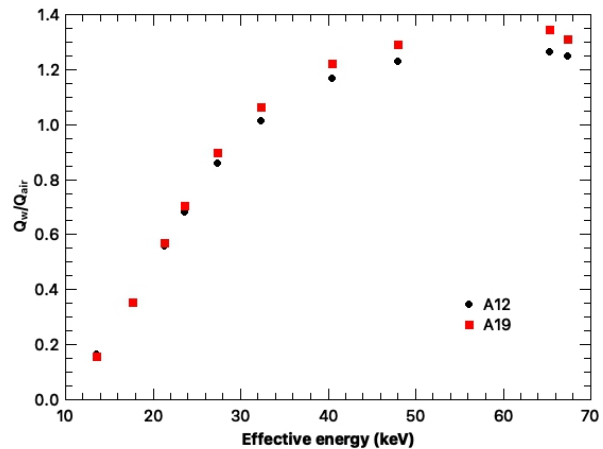


Figure 1. Ratio of the collected charge in liquid water, Q_w and that in air, Q_{air} for the ionization chambers A12 and A19.

Conclusions: Differences in the response of two ionization chambers in water and air, as a function of energy, for low-energy x-rays, were investigated. It was found that for effective energies below 32 keV, the response in water decreases with energy, while for energies above this value, the trend is reversed and the response in water is greater than the response in air until reaching a maximum at 65 keV.

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