Response of a PMMA graphite coated parallel-plate ionization chamber in 60-Co beams

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The ionization chambers are the most common type of dosimeter employed in radiotherapy dosimetry. In this work, a parallel-plate ionization chamber, developed at the Calibration Laboratory of Instruments of the IPEN (LCI), was tested to be utilized for dosimetry in ^{60}Co beams. The main advantage in the development of an ionization chamber, for a calibration laboratory as the LCI, is that it allows the knowledge of the dimensions, configuration and composition materials. This information is essential to determine the correction factors or the influence of different materials on the chamber response. Furthermore, the dosimeter evaluated in this work showed to be of simple construction, with easily-available materials, and may be assembled and tested in other calibration laboratories interested in the development and characterization of their own dosimeters. The ionization chamber characterized in this work was made by utilizing PMMA coated with graphite with a sensitive volume of 6.3 cm^3. The tests undertaken in order to evaluate the dosimeter in the ^{60}Co beams were: stability, saturation, ion collection efficiency, polarity effect, leakage current, angular dependence and linearity of response. These tests were undertaken according to the IEC 60731 standard, and all results were within the recommended limits. The maximum variation obtained in the stability test was lower than 0.5% and the leakage current was lower than 0.3%. The maximum polarity effect observed was 0.4% and the collection ion efficiency was better than 99.99%. In the test of linearity of response, the correlation coefficient (R^2) was 1.000, and the maximum variation obtained in the angular dependence test was only 0.3%. Besides that, some Monte Carlo simulations, utilizing the PENELOPE code, were made to verify the influence of some components (collecting electrode, stem and insulator) on the ionization chamber response. The simulations showed a small influence of the studied components on the chamber response. Therefore, with the experimental and simulation results obtained, it is possible to verify that the ionization chamber tested in this work has applicability for dosimetry in ^{60}Co beams.