Gradient influence on P_{fl} of plane parallel electron chambers: Monte Carlo simulations and measurements.

Using EGS4 with an improved electron algorithm, the pertubation correction factor P_{repl} was calculated for the Markus chamber, the Roos chamber, and other, optimized chamber models and was compared to phantom measurements. P_{repl} is the product of the gradient correction factor P_{gr} and the fluence correction factor P_{fl}, caused by the differences in stopping power and scattering power, respectively. In this work the influence of the gradient on P_{fl} was investigated. It was found that P_{repl}(Markus) drops from 0.99 to 0.90 for a mean electron energy at depth of 2 MeV when the chamber is moved upstream from d_{max} (0.75 cm, E_0 = 4 MeV) to 0.186 mm (E_0 = 2.5 MeV) due to P_{fl} . P_{repl}(Roos) changes from 1 to 0.965 for the same case. For negative gradients, as in case of d_{max} measurements for low incident electron energies and for measurements beyond d_{max}, P_{repl} raises above unity. The overall dependence of P_{repl} on the percentage change of depth between chamber entrance window and backwall is approximately linear with
$P_{repl} = 0.97 - 0.005$ pdd[% mm^{-1}] for the Markus chamber and
$P_{repl} = 1 - 0.001$ pdd[% mm^{-1}] for the Roos chamber for energies at depth below 3 MeV. Optimized chambers show a smaller dependence. Fricke dosimetry measurements using clinical electron beams were used to confirm the simulation results.