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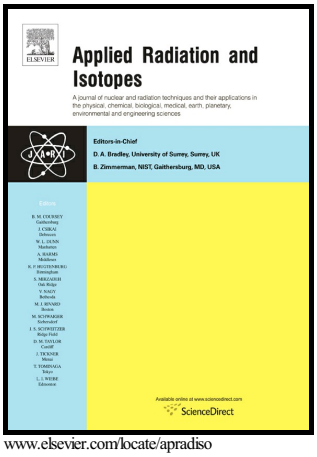

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Determination of transmission factors in beta radiation beams

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Abstract

In beta emitters, in order to evaluate the absorbed dose rate at different tissue depths, it is necessary to determine the transmission factors. In this work, the transmission factors determined in beta secondary standard radiation beams are presented. For this purpose, an extrapolation chamber was used. The results obtained were considered acceptable, and they are within the uncertainties in comparison with the values provided by the source calibration certificate. The maximum differences between the results obtained in this work and those from the calibration certificate were 3.3 %, 3.8% and 5.9 % for $^{90}Sr/^{90}Y$, ^{85}Kr and ^{147}Pm sources respectively.

Index Terms: Transmission factors, extrapolation chamber, beta radiation, BSS2

1. Introduction

In activities close to open and small radioactive beta-gamma sources, the dose rate due to beta radiation is often unexpectedly high. When a volume of matter is exposed to beta and to gamma radiation of the same fluence, the dose rate by beta radiation is considerably higher than the dose rate by gamma radiation (Caldas, 1980).

Beta radiation is a weakly penetrating radiation. The skin is the organ that most frequently receives significant doses. It is considered the basal layer of epidermis and its cells are at a shallow depth (Pook and Francis, 1975; ICRU, 1997). Beta particles cause ionization throughout their trajectory and because that radiation is easily absorbed, in the external irradiation, the highest dose is located at the skin surface (Caldas, 1980).

The standard ISO 6980-2 describes the calibration methods of the basic quantities that characterize the beta radiation fields (maximum energy of 0.066 MeV to 3.54 MeV) (ISO, 2004).

For calibration of beta sources and detectors, the transmission factors in the tissue must be determined (Böhm, 1986). Transmission factors are the factors, which give the change in dose rate with transmission through a range of tissue thicknesses (Owen, 1973). The transmission factors can be represented in the depth–dose curve. (ISO, 2004, Brunzendorf, 2012a). They are very important for the determination of the absorbed dose rates at different tissue depths. To determine the transmission factors, the ionization current for different absorber