Methods: In this investigation, a wide range of metallic compounds which potentially could be appropriate radiation shields, were studied. The Monte Carlo code MCNP4C was used to model the attenuation of x-ray photons in shields with different design. Besides simulation, experimental measurements were carried out to assess the attenuation properties of each shielding design. On the other hand, major mechanical properties of this shield such as tensile strength, modulus and elongation at break were investigated.

Results: Among different metals, tungsten and tin were the two most appropriate candidates for radiation shields in diagnostic photon energy range. A combination of tungsten (45%) and Tin (55%) provided the best protection in both simulation and experiments. In the next stage, attempts were made to produce appropriate Tungsten-tin-filled polymers which could be used for production of shielding garments. The density of this tungsten-tin-filled polymer was 4.45 g cm-3. The MCNP simulation and experimental measurements for HVL values of this shield at 100 kVp were 0.346 and 0.296 mm, respectively. On the other hand, this novel shield provides considerable mechanical properties and is highly resistant to chemicals.

Conclusions: The cost-effective lead-free flexible radiation shield produced in this study offers effective radiation protection in diagnostic energy range. This environmentally-friendly shield may replace the traditional lead-based shielding garments.

Keywords: Radiation Protection, Lead-free Shields, Non-Lead Shielding Garments, Tungsten, Tin, X-rays, Diagnostic Energy

Tayebi.mr@gmail.com

O9: Optimization of Body Composition Analyzer Facility, Considering Operator Dosimetry

Rezaei Moghaddam Y[1]*, Miri Hakimabad H[2], Raf'at Motavalli L[3]

[1] MSc, Physics Department, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran
[2] Professor of nuclear physics, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran
[3] Assistant Professor of nuclear physics, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran

Abstract

Measurement of body composition by total body in vivo neutron activation analysis is providing a valuable tool for clinical research in many areas of study. Changes in body composition may be diagnostic for the progression of disease or the results of therapy. Prompt γ-rays in vivo neutron activation analysis (IVNAA) has been widely used in recent years. Three major factors in this method are: 1) proper detection which leads to an accurate measurement 2) receiving low dose by the patient and 3) safety of facility for operator. As neutron sources are mostly mixed with γ-rays and these particles are very penetrating, the leakage is remarkable without proper shields. Thus, one of the important features in this method is optimization of shields to reduce operator receiving dose. Not only, must an appropriate shield reduce the operator receiving dose, but also it must have the less effect on detected spectrum. Because all parts of setup can be activated, the emitted γ-rays may be counted in detectors and increase background. So the selected shields may affect on gamma spectrum. In this research, several shields have been considered for an IVNAA setup. It has been tried to choose the best shield which have a low effect on detector spectrum and cause lower dose for operator. Four different shields (concrete, Epoxy colemanite resin, paraffin borated with Bismuth layer (PE-Bi layer) and paraffin borated with fine pieces of Bismuth (PE-Bi)) have been simulated by MCNPX code. The PE-Bi shield decreased the absorbed dose to 86% in compare with no shield state and 81% in compare to concrete. Also the rate of equivalent dose is reduced 97% in contrast to no shield and 94% to colemanite. The annual equivalent dose for an operator who works 8-hour a day, would be 4.04 mSv. The neutron flux decreases 100 times in the presence of PE-Bi while it has the lowest background in γ-spectrum among other suggested shields.

Keywords: IVNAA- MCNPX code - operator shield- absorbed dose- equivalent dose

ya.rezaee@gmail.com

O10: The Study of Population Dosimetry in Highest Lung Cancer Occurrence Area in India.