Determination of appropriate proportional in-house flexible radiation shielding material using bismuth powder and natural-silicon rubber compounds

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Abstract

Currently, ionizing radiation is widely utilized in several institutions, especially medical departments. However, the use of radiation can be hazardous. Commonly, lead shielding was approved as commercial radiation protection. The use of lead is also common, but it is an encumbrance to workers due to the weight and potential toxicity. So, the purpose of this study was to determine the appropriate ratio of natural-silicon rubber and bismuth powder for producing in-house radiation shielding and comparing the protection efficiency of the test piece to commercial lead shielding. To begin, pre-vulcanizable natural rubber was blended with silicone rubber in 5 different ratios, injected into a mold and allowed to cure. An exposure technique was set up at 120 kVp, 10 mAs then penetrative radiation was measured through the test pieces. The appropriate ratio of natural:silicon rubber 40:60 was chosen for later experiments. The bismuth powder 40, 45, and 50 grams was added to the ratios, respectively. We then investigated the radiation protection efficiency of the test pieces. Lead aprons and lead gloves were also examined for the ability of x-ray shielding and were compared to the radiation shielding efficiency of the test pieces. The results showed that the suitable ratio of natural rubber and silicon rubber was 40:60 mixed with 50 grams bismuth powder. The test piece provided the highest protection efficiency with radiation attenuation of 89.63%. Even so, the test piece still cannot provide better performance than lead. However, when the test piece thickness was increased to 1.75 cm, the results showed it provided a higher efficiency than lead materials. So, this study showed that pre-vulcanizable natural rubber and silicone rubber mixed with bismuth powder can be applied to reduce the radiation exposure equivalent to commercial lead shielding. In the future, these components might be developed to produce gloves or aprons for radiation shielding.

Keywords**:** *Radiation shielding, Natural rubber, Silicon rubber, Bismuth powder*