Introduction

Nuclear radiations are widely utilized in nuclear medicine, nuclear power plants, agriculture, and industry. However, their interaction with human body could be very harmful. The research of different radiation shielding factors against harmful and dangerous radiations has been needed. Coming up with the best radiation shielding material that fits the size and transparency requirements to visible light is a difficult task. In early attempts, various concretes were used for this purpose because these are cheap and can be easily molded into any structural design. Concrete, on the other hand, has many disadvantages and can be impacted by a variety of behaviors, such as concrete temperature rises when it is exposed to radiation and its density decreases. In addition to that, concrete is opaque for visible light. Alternate materials like glasses are better for radiation shielding because of their transparency to visible light, and physical properties that can be easily changed by adding other compounds. Tellurite based glasses are acquiring the attention due to their significant characteristics. They have high glass forming ability, high refractive index, low melting temperature, and high mass attenuation coefficient. Therefore, research of their shielding parameters against various forms of ionizing radiation is needed. In this work, we aim to investigate the different shielding parameters like linear attenuation coefficient, mass attenuation coefficient, half value layer, tenth value layer, and mean free path.

Experimental Setup

Fig. 1. Geometry used in MCNP simulation

Results

Fig. 2. MAC Values of 5 glass samples vs photon energy.

Fig. 3. MAC values of 5 glass samples vs photon energy.

Fig. 4. HVL Values of 5 glass Samples vs photon energy.

Fig. 5. TVL values of 5 glass samples vs photon energy.

Fig. 6 MFP values of 5 glass samples vs photon energy.

Conclusion

The results show that the values of these shielding parameters HVL, TVL, MFP and TF decreases with the increases of the concentration of Bi₂O₃ in our investigated glass samples for their gamma radiation shielding properties. Results show that radiation protection efficiency of the tellurite rich heavy metal oxide glasses was improving by the addition of Bi₂O₃. Among the 5 investigated glass samples our sample S5 is found to possess lower values of HVL, TVL and MFP at all the energy ranges from 0.015 MeV 15 MeV. We also compared the MFP values of glass sample S5 with traditionally used different types of concretes. This work shows that tellurite rich heavy metal oxide glasse has great potential for used in industrial development for radiation shielding purposes.