World Academy of Science, Engineering and Technology
International Journal of Industrial and Manufacturing Engineering
Vol:16, No:08, 2022

Design of a Portable Shielding System for a Newly Installed NaI(Tl) Detector

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Abstract : Recently, a 1.5x1.5 inch NaI(Tl) detector based gamma-ray spectroscopy system has been installed in the laboratory of the Nuclear Science and Engineering Department of the Military Institute of Science and Technology for radioactivity detection purposes. The newly installed NaI(Tl) detector has a circular lead shield of 22 mm width. An important consideration of any gamma-ray spectroscopy is the minimization of natural background radiation not originating from the radioactive sample that is being measured. Natural background gamma-ray radiation comes from naturally occurring or man-made radionuclides in the environment or from cosmic sources. Moreover, the main problem with this system is that it is not suitable for measurements of radioactivity with a large sample container like Petridish or Marinelli beaker geometry. When any laboratory installs a new detector or/and new shield, it “must” first carry out quality and performance tests for the detector and shield. This paper describes a new portable shielding system with lead that can reduce the background radiation. Intensity of gamma radiation after passing the shielding will be calculated using shielding equation I=Ioe-μx where Io is initial intensity of the gamma source, I is intensity after passing through the shield, μ is linear attenuation coefficient of the shielding material, and x is the thickness of the shielding material. The height and width of the shielding will be selected in order to accommodate the large sample container. The detector will be surrounded by a 4π-geometry low activity lead shield. An additional 1.5 mm thick shield of tin and 1 mm thick shield of copper covering the inner part of the lead shielding will be added in order to remove the presence of characteristic X-rays from the lead shield.

Keywords : shield, NaI (Tl) detector, gamma radiation, intensity, linear attenuation coefficient
Conference Title : ICPSDT 2022 : International Conference on Production Systems and Design Technology
Conference Location : Vancouver, Canada
Conference Dates : August 08-09, 2022