THE INVENTION OF RADIATION SHIELDING CONTAINER FROM EPOXY RESIN MIXED WITH BISMUTH OXIDE FOR IODINE-131 RADIOPHARMACEUTICALS.

การประดิษฐ์อุปกรณ์กำบังรังสีสำหรับบรรจุสารเภสัชรังสีไอโอดีน-131 จากอีพ็อกซีเรซินผสมบิทมัสออกไซด์

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Abstract

Nowadays, radiation is widely used especially for medical purpose. In nuclear medicine, radiopharmaceuticals are useful for both diagnosis and treatment. However, the radiation exposure can cause the health effect to the worker who involved with unsealed radiation source. Therefore, radiation shielding is the most important equipment for radiation protection issue to reduce an unnecessary radiation exposure. Lead has been considered as the standard material for radiation shielding in several decades but lead also have a drawback about heaviness and toxicity. Thus, the aims of this study was to innovate the lightweight and lead-free radiation shielding by using an Epoxy-resin based loading with bismuth oxide (Bi_2O_3) powder for Iodine-131 (131I) radiopharmaceuticals container. The optimal ratio between epoxy-resin and Bi_2O_3 was determined by loading different weight of Bi_2O_3 20, 30, 40 and 50g to the epoxy-resin. Measured the transmission radiation from 131I activity 7.5, 15, 30, 50, 100 and 200 mCi that passing through the container then compared with the commercial lead material. The result showed that the 50 g Bi_2O_3 added provide the best radiation shielding propertie with 43% to 48% of transmission. The comparison between 50g Bi_2O_3 and lead showed our material was absorbed only 52% to 57% when lead was 99% which it lower 1.7 to 1.9 times than lead. In the other hand, the heaviness of our material was lower about 20 times. According to our study, the epoxy-resin loading with Bi_2O_3 can reduce the radiation. The radiation shielding efficiency of our container was lower than lead material but if we increasing the container's thickness to 4 cm., the efficiency of bismuth based container was similar to the commercial lead material. Therefore, we concluded that bismuth oxide can be an alternative elements instead of lead which also provide a low cost, lightness and non-toxicity.

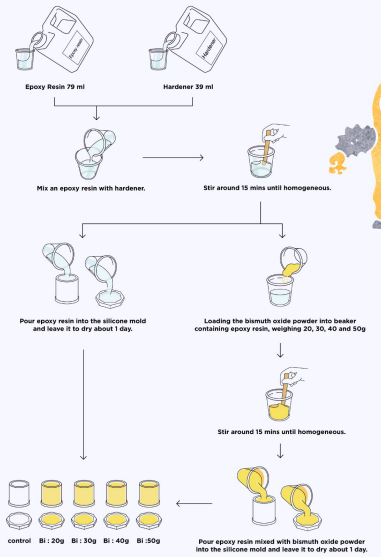
Methodology

The sample forming process :

1.Mix an epoxy resin and hardener in to a beaker with a ratio of 2:1, and stir around 15 mins until homogeneous

2.Loading the bismuth oxide powder into a beaker containing epoxy resin, weighing 20,30,40 and 50 g, respectively.

3. Pour Epoxy resin mixed with bismuth oxide into the silicone mold and leave it to dry about 1 day.



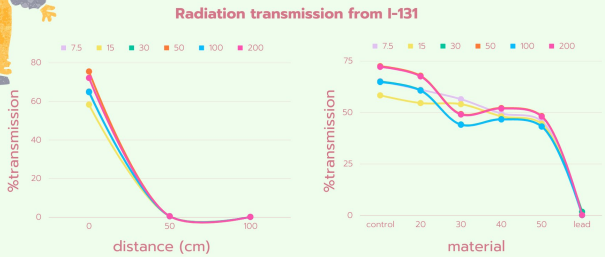
After the molding of the specimen was completed, the research group took the specimen to test its radiation shielding efficiency at the National Institute of Nuclear Technology.

The measurements were performed with 6 activities of radiopharmaceutical iodine-131 7.5, 15, 30, 50, 100 and 200 mCi, measured at 0, 50 and 100 cm. In addition, the measured were also done at 0, 90, 180, 270 degrees above and below to determined the sample's homogeneous.

Purpose

1. To study the optimal ratio between epoxy-resin and bismuth oxide for innovating the radiation shielding container for Iodine-131 radiopharmaceuticals container.
2. To compare the radiation shielding efficiency of bismuth based container with commercial lead container.

Results



The result showed that the 50 g Bi_2O_3 added provide the best radiation shielding propertie with 43% to 48% of transmission. The comparison between 50g Bi_2O_3 and lead showed our material was absorbed only 52% to 57% when lead was 99% which it lower 1.7 to 1.9 times than lead.

References

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Yu, Le, et al. "Lightweight Bismuth Titanate (Bi4Ti3O12) Nanoparticle-Epoxy Composite for Advanced Lead-Free X-ray Radiation Shielding." ACS Applied Nano Materials 4.7 (2021): 7471-7478.

Keywords : Radiation Shielding / I-131 / Bismuth oxide / Epoxy resin

The Invention of Radiation shielding container from Epoxy Resin mixed with Bismuth oxide for Iodine-131 Radiopharmaceuticals.

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