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Toxicity of Natural Radioactivity in Water Samples from a Gold Mine in Gauteng Province, South Africa

Naturally Occurring Radionuclide Materials (NORMs) are a common occurrence in the environment, but anthropogenic activities such as mining have resulted in elevated levels of these contaminants in the environment. A radiological toxicity assessment of NORMs in water samples from a gold mining area in the Gauteng Province of South Africa was evaluated. In this study, 29 water samples were collected from around the mine and 5 water samples were collected from the control area for laboratory analyses. A broad energy germanium (BEGe) detector with a relative efficiency of 60 % and a resolution of 2.0 keV at 1332 keV gamma ray emission of Coibalt-60 was used to measure the activity concentrations of these NORMs. The average values for Uranium-238 (238U), Thorium-232 (232Th), and Potassium-40 (40K) in Bq.L-1 were 0.66±0.03, 0.56±0.03 and 7.36±0.58, respectively. These activity concentrations were used to calculate radiological hazard parameters for the area. The average value of the Radium Equivalent Activity (Raeq) in water samples from the mining area was found to be 2.03±0.07 Bq.L-1. This was significantly higher than 1.39±0.08 Bq.L-1, a figure estimated from the control area. The values recorded in all the water samples were, however, lower than the allowable limit of 370 Bq.L-1. From the calculations the average outdoor absorbed dose rate in air due to 238U, 232Th, and 40K in water samples from the mining area was found to be 0.95±0.03 nGy.h-1. From this figure, the Annual Effective Dose Equivalent (AEDE) calculated, recorded an average of 1.17×10-3 mSv.y-1, a figure greater than 8.39×10-4 mSv.y-1 recorded from the control area. These AEDE values were also way below the worldwide average of 0.48 mSv for external terrestrial radiation. Average external hazard (Hex) index for water samples from the mining area was found to be 5.49×10-3 while the average internal hazard (Hin) index was 7.28×10-3. Both these quantities were less than unity, making water samples safe to the population in the area.

Apply to be
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No

Level for award
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N/A

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