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Radioactivity and radiological hazard in cement

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Cement is mainly used in Sri Lanka for construction work. It can cause external and internal radiation exposure due to the presence of natural radionuclides ^{226}Ra, ^{232}Th and ^{40}K.The radiation exposure risk can be estimated by some indices. If the indices are within the internationally accepted values the radiological hazard is insignificant and use of cement is safe. Activity concentration of ^{226}Ra, ^{232}Th and ^{40}K in six cement types from 30 samples were measured using gamma ray spectroscopy with HPGe detector and four types of indiceswere calculated to determine the radiological hazard from the natural radioactivity in the samples. The average activity concentrations for ^{226}Ra, ^{232}Th and ^{40}K ranged from 24.61 $\pm$ 0.73 to 66.16 $\pm$ 1.07, 19.52 ± 1.13 to 60.92 $\pm$ 2.91 and 81.04 ± 4.92 to 228.35 ± 6.73 Bq kg^{-1} respectively. The highest activity for both ^{226}Ra and ^{232}Th were obtained from the studied pozzolanic cement where fly ash from the coal power plant is added in the manufacturing process. The lowest activity for ^{226}Ra was from Portland limestone cement while Indian (Mahasen) ordinary Portland cement recorded the lowest activity for ^{232}Th. The Radium equivalent activity (Ra_{eq}) which is the representative level index, indoor absorbed dose rate, the external hazard index and the annual effective dose were estimated to determine any potential radiological hazard from the studied cement samples. All samples gave a Ra_{eq} value less than the recommended maximum level 370 Bq kg^{-1} for building raw materials and products indicating it is safe to use as the external dose rate could be kept below 1.5 mSvy^{-1}. The average indoor absorbed dose rate ranged from 28.11- 73.08 nGyh^{-1} and is lower than the population weighted world average of 84 nGyh^{-1}. The estimated annual effective dose rate (0.14 – 0.36 mSvy^{-1}) is lower than the dose criterion of 1 mSvy^{-1}. The external hazard index was also less than unity indicating an absorbed gamma dose rate of less than 1.5 mSvy^{-1}. The results obtained in this study indicate no significant radiological hazard arising from the studied cement varieties in building construction.

Keywords: Cement, fly ash, radiological hazard, radionuclides

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