

Investigating radiological risk due to solid-phase 'black powder' from the Secunda Gas Pipeline

The extraction and transport of natural gas leads to the accumulation of black powder, a hazardous byproduct composed of corrosion species, microorganisms and Naturally Occurring Radioactive Materials (NORM) within gas pipelines. These NORM contaminants tend to concentrate within dust filters and during periodic 'pigging' operations, posing a potential radiological threat to workers and the environment. The study evaluated the radiological assessment of black powder collected at the Secunda gas pipeline by determining the activity concentrations of naturally occurring radionuclides ^{226}Ra , ^{232}Th and ^{40}K using gamma spectrometry. Results show that the average activity concentrations for black powder obtained from pigging operations were 2.53 ± 0.18 (range: 1.87 - 2.94), 4.23 ± 0.32 (range: 2.78 - 5.00) and 27.17 ± 1.75 (range: 23.59 - 29.76) Bq/kg for ^{226}Ra , ^{232}Th and ^{40}K respectively. Similarly, the average activity concentrations for black powder obtained from dust filters during normal operations resulted in 1.82 ± 0.21 (range: 1.34 - 2.24), 1.67 ± 0.26 (range: 1.27 - 2.21), 25.98 ± 1.73 (range: 18.36 - 2.71) Bq/kg for ^{226}Ra , ^{232}Th and ^{40}K respectively. Radiological hazard indices were also determined by calculating the R_{aeq} , D, Hex, Hin, AEDE and ELCR. Average values for these indices for black powder samples from pigging operations were 10.68 Bq/kg, 4.86 nGy/h, 0.03, 0.04, 5.96×10^{-3} mSv/yr and 2.0×10^{-5} respectively. For black powder samples from dust filters, the corresponding average values were 5.13 Bq/kg, 2.47 nGy/h, 0.01, 0.02, 3.03×10^{-3} mSv/yr and 1.06×10^{-5} , respectively. All calculated radiological hazard indices were significantly below the recommended regulatory safety limits, indicating negligible radiological risks to maintenance workers during pigging and filter replacement operations.

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