



Contribution ID: 147

Type: Oral Presentation

Potential Human Risk of Dissolved Heavy Metals in Gold Mine Waters of Gauteng Province, South Africa

Thursday, 28 June 2018 12:00 (20 minutes)

This paper evaluates the health risk caused by heavy metals in water around a gold mining area. In this study, samples of water were collected around the mining area. After appropriate preparation, all samples were analyzed for As, Pb, Hg, Cd, Cr, Cu, Zn, Co and Ni using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Measured concentrations of the various heavy metals were then used to calculate the average daily intake (ADI) for the inhabitants of the area through ingestion and dermal contact. This ADI was then used to calculate the hazard quotient (HQ) and hazard index (HI) leading to the determination of carcinogenic and non-carcinogenic effects of these heavy metals. The average concentrations of heavy metals decreased in the order of Ni>Cu> Zn>As> Cr>Co>Pb. In mg.L⁻¹ the average concentrations were as follows: Ni (0.39); Cu(0.38); Zn (0.33); As (0.19); Cr (0.14); Co (0.08); Pb (0.01), respectively. Hg and Cd were not detectable. For the non-carcinogenic risk assessment, calculated values of HQ showed an HI value of 3.38×10^{-1} , a value less than 1, which is potentially safe according to USEPA and South Africa guidelines. When the carcinogenic risk assessment was carried out, the results showed that the total cancer risk due to the heavy metals was 2.94×10^{-6} mainly due to dermal contact. The US Environmental Protection Agency considers a cancer risk in the range of 1×10^{-6} to 1×10^{-4} acceptable for regulatory purposes. From the findings presented, it was concluded that dissolved heavy metal levels in mine water were within permissible limits in the mining area.

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Session Classification: Nuclear, Particle and Radiation Physics

Track Classification: Track B - Nuclear, Particle and Radiation Physics