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Review of occupational exposure and radioactivity associated with Amang in mineral processing industries in Peninsular Malaysia

Past history has explained the importance of Peninsular Malaysia as the greatest tin producing country in the world, with 30–50% of the world's annual tin production in the mid-1960s were produced from the rich-stanniferous areas; most notably in Kinta Valley and Klang Valley. However, due to the dramatic depletion of cassiterite reserves, a newly economic activity of amang processing industry has emerged. Amang is locally coined name for tin-tailing in Malaysia. Its mass productivity in mineral processing industry has been publically recognised as a TENORM after long period time of its recoveries for commodity and trade values since early 80's. Amang composed of extremely high radionuclide concentrations from U238 and Th232-series, varies from a few hundred - 60,000 ppm. Radiological safety concern and risks against ionising radiation exposure to workers as well as member of public in immediate vicinity emerged due to elevated ambient gamma radiation exposure, inhalation of radon and long-lived airborne radioactive dust and unavoidable soil contamination from past operational process of tin and amang mineral. The highest gamma absorbed dose rate recorded in open air at the amang processing plant was exceeding 100,000 nGy h⁻¹ owing to huge open-air mineral stockpiles. Mineral segregation activities in the amang processing plant have been identified as a source of releases of air-borne alphaemitters with an exposure equivalent to few tenths –281.27 mSv yr⁻¹. Substandard and poor operational practices e.g., feeding task of mineral into magnetic or electrostatic separators using hand and buckets could liberate more radioactive dust in air. Storing and dumping amang mineral inside storeroom have been identified as a source of high accumulation of radon and thoron gases ~ few Bq l⁻¹ to 160 Bq l⁻¹. The exacerbating circumstance arises as the industries practicing unsystematic working environment, with poor hygiene working environment. Some plants have been spotted fail to comply with basic occupational health and safety legislation for instance implementation of film badge, protective mask and cloth during operations. This indicated feeble radiological protection consideration in amang plant against hazardous radiation in Peninsular Malaysia. Statistical graphical and hypothesis tests show that the catastrophic impact on ecology system emerged as results from soil contamination due to past operational processing minerals. This paper review occupational exposure and radioactivity associated with amang processing minerals in Peninsular Malaysia with statistical evaluations of mineral inventories, cumulative probability analyses of threshold values, and assessment cancer and mortality risks among amang workers.

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