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Radiation level in production of rare earths in China

Rare earth deposits have been discovered widely in China, mostly occur in Inner Mongolia, Sichuan, Jiangxi, and other provinces in southern China. In Bayan Obo, Inner Mongolia, exposure for workers to gamma radiation is from 600 to 2000 nGy/h in mining site, 400 to 800 nGy/h in dumping sites. Contents of U₃O₈ and ThO₂ in ores are 0.0005-0.005 % and 0.01-0.05 %. A type of ion absorbed weathering deposit in southern Jiangxi Province, gamma dose rates are from 120 to 203 nGy/h in in-situ leaching mining area. Radioactivity concentrations of ²³⁸U and ²³²Th are 60.5-383 Bq/kg and 36.9-251 Bq/kg in weathering ores, about 7300 Bq/kg and 20 Bq/kg in products of carbonated rare earth, 0.54-3.69 Bq/g and 0.047-3.4 Bq/g in filtrate residue respectively. Another type of placer deposits for monazites in China were mined in Hunan and Hainan Province, but were closed. Heavy mineral concentrates are now imported from Australia, Africa, Sri Lanka etc. Gamma dose rates are 250-400 nGy/h nearby feeding raw materials, but 500-2000 nGy/h around concentrate products, especially higher than 2000 nGy/h at the location of monazite product in beneficiation plant. Radioactivity concentrations of ²³⁸U and ²³²Th are 0.457-4.21 Bq/g and 0.165-3.932 Bq/g in raw materials, 14.9-27.6 Bq/g and 186.5-189.2 Bq/g in monazite; 73.0-407 Bq/kg and 73-386 Bq/kg in tailings respectively.

In the process of manufacture of rare earth products, gamma dose rates were measured in different workshops, 74-139 nGy/h in chemical workshop, 77.5-259 nGy/h in roasting workshop, 40-245 nGy/h in individual rare earths product workshop, 540-610 nGy/h outside the door of chemical slag storage. Nuclide Radioactivity concentrations in most of individual rare earths products are very low. For example, radioactivity concentrations of ²²⁶Ra, ²¹⁰Pb and ²³²Th are 21 Bq/kg, 12.7 Bq/kg and 98.8 Bq/kg in yttrium products, but, 2.67 Bq/g, 3.37 Bq/g and 3.44 Bq/g in chemical slag.

In general, exposure of workers is mostly to gamma radiation. Higher exposure to workers who work at the site with ores or concentrates, and highest in working place for chemical slag. In terms of radiation environment, waste water once discharged into the Yellow River in Baotou, Inner Mongolia from rare earths plants, as a result polluted to some extent. Assessment of radiological impact has been conducted. At present, rare earth production has been required regulatory control.

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