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Analysis for Radioactivity of Negative Ion Powder

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Lots of reports about inhalation risk and external exposure caused by negative ion technology products which include toiletry, wristbands, clothing, and bed mattresses. Negative ion technology can involve the use of minerals that contain a naturally occurring source of radiation such as thorium or uranium. Hassan et al. investigated thirteen NORM-added negative-ion products in terms of organ equivalent and annual effective dose and one of them would contribute about 2 mSv per year annual effective doses. Negative ion powder, which is the raw material of negative ions products containing wallpaper and textile, is available for purchase in several countries. To investigate the radioactive level of negative ion powder in the Chinese market, radioactivity monitoring of negative ion powder was carried out, 12 samples purchased online from different manufacturers were analyzed through γ-spectrometry and α-spectrometry. Samples were measured by HPGe at first, then samples were digested using a microwave to prepare the solution for Ra-226 and Th-232 measurement. Th-232 isolated from other metal ions using an anion exchange column. Ra-226 was isolated from other metal ions using a cation exchange column Ra-226 and Th-232 used Ra-225 and Th-229 as a tracer to assess chemical yield. After the purified step, the thorium and radium were electrodeposited on stainless steel disc, then insert into the PIPS detector for counting. The determination of 12 kinds of negative-ion powder through gamma spectroscopy was shown in Table 1. From the analysis results, this batch of material contains natural long-lived radionuclides from the uranium and thorium series and without artificial radionuclides. According to the provisions of the IAEA recommended exemption radionuclides activity limit of 1 Bq/g for each radionuclide in the U-238 and Th-232 series. This batch of samples, except NM12, were seriously exceeded the activity concentration, and some of them have high radioactivity of thorium and it is necessary to evaluate the external dose. Comparing the activity concentrated of Th-234 and Bi-214, Ac-228 and Tl-208, we found that long-living radionuclides, U-238 and Th-232, did not reach the equilibrium balance. If the equilibrium balance of living radionuclide, U-series and Th-series, was destroyed, only measuring the activity concentration of a single daughter cannot guarantee that the activity of U-238 and Th-232 activity concentration do not exceed the standards. To assess the radioactivity risk of negative ion powder, we used α-spectrometry to determine the activity of Ra-226 and Th-232. To determine elemental compositions of the negative ion powder, 5 samples from different manufacturers were analyzed via EDS spectrometer, and the result showed the 5 analyzed samples mainly contained C, O, Si, Al, Ag, Th, and a small number of rare earth elements. The negative ion is mainly released from radionuclides rather than tourmaline powder and rare earth mineral powder. According to the elemental compositions of the sample, negative ion powder is associated with ore or waste residue of associated ore. α-spectrometry was used to determine the radioactive of Ra-226 and Th-232. The source for alpha spectrometer analysis was prepared by the electrodeposition technique. The electrodeposited yield over 90% for both thorium and radium can be achieved by using 2~3 mL of 0.5M HNO_3 and 17 mL of ethanol as electrolyte with 0.4 mA in 60 min deposition time. The next step is to develop an optimal radiochemical procedure to separate thorium and radium from the matrix.

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