Analysis of Physicochemical Properties of NORM Airborne Particulates in Monazite Industry

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Chronic inhalation of particulates containing naturally occurring radioactive materials (NORMs) has given rise to concerns about health effects of workers. Monazite contains relatively high thorium series compared with the other raw materials. NORMs may give rise to enhanced exposure that may need a dose assessment of workers. Radiation dose due to inhalation of airborne particulates depends on particulate physicochemical properties, including particle size and concentration, mass density, shape, and radioactive concentration. The objective of this study was to establish a database of information on the airborne particulate physicochemical properties at the monazite industries in Korea. A cascade impactor was employed to sample airborne particulates at various processing areas in monazite processing plants. The mass density of raw materials, byproducts, and final products were measured using pycnometer. Physical shapes of airborne particulate samples were analyzed using scanning electron microscopy to determine shape factor for inhalation dose assessment. The radioactive concentration uranium and thorium decay series were measured by gamma-spectroscopy. Particulate concentrations in the air varied widely by sampling areas more than two orders of magnitude. The concentrations by size were distributed log-normally with maximums at particle sizes range of 4.7-9.0 μm. The mass density of monazite was 5.1 g/cm3 and mass density of other raw materials and by-products were lower by about 12-47%. The airborne particulates appeared as spheroids or rough spherical fragments across all sampling areas and sampled size intervals. Radioactive concentration of Ra-226 and Ra-228 were 21.4 Bq/g and 213 Bq/g for monazite. Radioactive concentrations of other materials were lower by about 8-99.8% for Ra-226 and 15-99.8% for Ra-228. The database of particulate characteristics established in this study can be used for radiation dose assessment resulting from inhalation of airborne particulates. *This work was supported by Korea Institute of Nuclear Safety.

Keywords: Monazite, Particle size, Mass density, Shape, Radioactive concentration.

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