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Recife - Brasil

del 05 al 08 de noviembre de 2024
Integración y experiencia compartida en protección radiológica

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168-1 Radiation dose assessment from NORM residue used in the circular economy

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Abstract:

Biota and human beings are exposed to naturally occurring radionuclides present in several natural resources [1]. Phosphogypsum (PG) is classified as a Naturally Occurring Radioactive Material (NORM) residue of the phosphate fertilizer industry. PG residue presents in its composition radionuclides of the natural U and Th decay series and stored in stacks by the phosphate industries, which can represent risks to environment and human from the radiological protection point of view, such as: atmospheric contamination, pollution of groundwater, trace elements and radionuclides, radon emanation, inhalation of dust and direct exposure to gamma radiation. Some possible applications of this residue are soil conditioners, resulting in an increase of agriculture productivity, or building materials [2].

The Brazilian regulatory body ruled that PG would only be permitted for use in agriculture if ^{226}Ra and ^{228}Ra activity concentrations do not exceed 1 Bq g^{-1} , for each radionuclide [3]. On the other hand, the safe reuse of PG residue avoids depletion of non-renewable resources, decreases the stacks and consequent reduces the possible environmental impact. Also adds value to PG, considering the principles of sustainable development and the principle of the circular economy.

This study's aims were to evaluate the estimated radiation doses in biotas and humans considering two scenarios: PG stack and application of PG in agriculture, using the ERICA Tool 2.0 [4] and NORMALYSA Tool 2.0 [5].

For the PG stack, estimated radiation doses (external and internal) to the worker and biota around the stack were evaluated.

In the agriculture (soil amended with PG residue), the estimated radiation doses to the farmer (external and internal), consumers of agricultural products (internal) and biota (external and internal) were evaluated. In this paper, one application per year of PG residue in the soil and the maximum value of the Brazilian regulatory were considered.

Keywords:

NORM residue , Phosphogypsum, estimated radiation doses , ERICA Tool , NORMALYSA Tool