Radiological risk assessment to workers of a phosphate industry (NORM)

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In 2010, Spain issued a new directive (RD 1439/2010) concerning the regulation of NORM activities. This new law enforces NORM industry holders to declare its activities to the Spanish regulatory bodies, as well as to undertake a series of studies that include the radiological characterization of the industrial process and the dose assessment to workers. Phosphate industry is one of such industries, also included in the positive list of the revised version of the European Basic Safety Standards (Euratom 2996). Here we present the results of a case study in a dicalcium phosphate (DCP) production plant located in the northeast of Spain. The objective of the present work was to determine the dose assessment to the workers, mainly due to external radiation and inhalation of Rn and dust. Original concentrations of U-decay series (~1700 $Bq \cdot kg^{-1}$) in the phosphate rock are disrupted after the acid digestion of the raw material, leading to a non-homogeneous distribution in the different products (DCP) and wastes (muds and water). Hence, the distribution of external dose and the dose due to the dust and Rn were also irregularly distributed in the plant. Gamma dose was mapped, illustrating that external dose was enhanced in the area where muds are decanted from the liquid phase, mainly due to the high concentration of ^{226}Ra in the ebonite pipes. Doses in that area and in direct contact to the pipes reached values as high as 30 $\mu Sv \cdot h^{-1}$. ^{210}Pb and ^{210}Po measured in dust ranged from 1 to 147 and 1 and 100 $mBq \cdot m^{-3}$ in filtered air, respectively, being particularly high in areas where DCP and phosphate rock is stored. Concentration of Rn was negligible in open areas, but reached maximum values of 200 $Bq \cdot m^{-3}$ in closed areas such the phosphate rock storage warehouse and offices. Although total doses received by the workers were lower than 1 $mSv \cdot y^{-1}$, some cleaning and maintenance works of this area with particularly enhanced ^{226}Ra activities, could result into higher doses. The company is now working on trying to apply the ALARA principle at the facility.