

Characterization of stockpiled phosphogypsum Environmental contamination by naturally occurring radioactive material - NORM

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Phosphogypsum, a waste by-product derived from the wet process production of phosphoric acid, represents a serious problem facing the phosphate industry in Brazil. This by-product (mainly calcium sulphate dihydrate) precipitates during the reaction of sulphuric acid with phosphate rock and is stored at a rate of about 2,500 ton per day on several stacks in Cubatão, Brazil. Contents of natural radionuclides from thorium and uranium series were measured in Brazilian phosphogypsum samples from stacks, using high-resolution gamma spectrometry. As a complementary study, trace and microelements (Ba, Co, Cr, Fe, Hf, Sb, Sc, Ta, Th, U, and rare earths Ce, Eu, La, Lu, Nd, Sm, Tb and Yb) were also determined by instrumental neutron activation analysis (INAA). This phosphogypsum stacks present a potential threat to the surrounding environment and to the individual occupationally exposed. The most critical pathway between phosphogypsum and the public is through water contamination. The aquatic environment near the disposal area was assessed by measuring natural radionuclides activity in groundwater, river water and sediment samples. As for the individual occupationally exposed, the pathways considered were internal exposure due to inhalation of radon emanated from phosphogypsum stacks and inhalation of dust particulates, and external gamma and beta exposures due to immersion in the radioactive plume. The results obtained in this study show that radionuclides, although present in relatively high concentrations in phosphogypsum, do not imply in significant doses for individuals occupationally exposed and for the general public.