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RADIOLOGICAL ASSESSMENT OF PHOSPHOGYPSUM AS A BUILDING MATERIAL

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Phosphogypsum is a by-product obtained in the wet-acid processing of phosphate rock to produce phosphoric acid. For every ton of phosphoric acid produced in the reaction of phosphate rock with sulphuric acid, about four to five tons of phosphogypsum are produced. Brazilian annual production of phosphogypsum reaches 5.4 million tons. The recycling of the phosphogypsum waste is very important from the social-economic point of view and also regarding environmental preservation.

Phosphogypsum waste can be used in road construction, as building material and in agriculture, as soil amendment. This by-product can contain naturally occurring radionuclides, particularly ^{40}K and gamma emitters comprised in the uranium and thorium series. The main concern from a radiological point of view is ^{226}Ra (member of uranium series) and its decay product, ^{222}Rn, which is an inert gas and may become airborne by diffusing into the air. Radon and its short-lived

decay products in the atmosphere are the most important contributors to human exposure from natural sources.

In order to assess the feasibility of the use of phosphogypsum as a building material, an experimental house was built with phosphogypsum plates (manufactured with phosphogypsum from different producers) in São Carlos, São Paulo State, Brazil, by Inovamat Company. The aim of this study is to assess the external and internal exposures for residents of this experimental house constructed with phosphogypsum plates.

Phosphogypsum samples were analyzed by high-resolution gamma spectrometry for their ^{226}Ra, ^{232}Th, ^{210}Pb and ^{40}K content. The activity concentrations varied from 15.9 to 392 $Bq \cdot kg^{-1}$ for ^{226}Ra, from 26.1 to 253 $Bq \cdot kg^{-1}$ for ^{232}Th and from 27.4 to 852 $Bq \cdot kg^{-1}$ for ^{210}Pb. The results of ^{40}K were lower than 81 $Bq \cdot kg^{-1}$. The effective dose was evaluated for each type of phosphogypsum plates. The effective doses due to external exposure were always below 1 mSv y^{-1}, the annual dose limit for the general public.

Radon measurements were carried out through the passive method with solid-state nuclear track detectors (CR-39) over a period of 15 months. The detectors were changed every three months, in order to determine the long-term average levels of the indoor radon concentrations with varying seasons. The detectors were placed in two bedrooms and the bathroom.

The radon concentrations varied from 45.5 to 120 $Bq \cdot m^{-3}$ in the bedrooms and from 87.8 to 105 $Bq \cdot m^{-3}$ in the bathroom. These results are below 200 $Bq \cdot m^{-3}$, the recommended investigation level for radon in dwellings.

Therefore, according to the results obtained the use of phosphogypsum as building material pose no additional health risk to dwellers.