ASSESSMENT OF NATURAL RADIACTIVITY FROM BUILDING MATERIALS IN SPAIN

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INTRODUCTION.-The industrial construction sector is very important in Spain. Building materials used in this industry are sources of radiation from natural radionuclides they contain. All building materials have varying amounts of natural radionuclides. They belong to natural radionuclides of uranium (238U) and thorium (232Th) series, together with the radioactive isotope of potassium (40K). The aim of this work is to measure the natural radioactivity in building materials. The relevance of the contribution of natural radiation that they generate implies their analysis taking into account the limitations imposed by national and international regulations and legislations. The studies about this subject have increased notably during last years. This, probably, can be associated with the increase interest from natural radiation radiological risk on indoor exposure. Radioactivity of some building materials could be increase, during the manufacturing processes, as results of the addition of NORM products to improve their properties. The analyzed samples come from factories located in different parts of the Iberian Peninsula and the Canary Islands.

MATERIAL AND METHODS

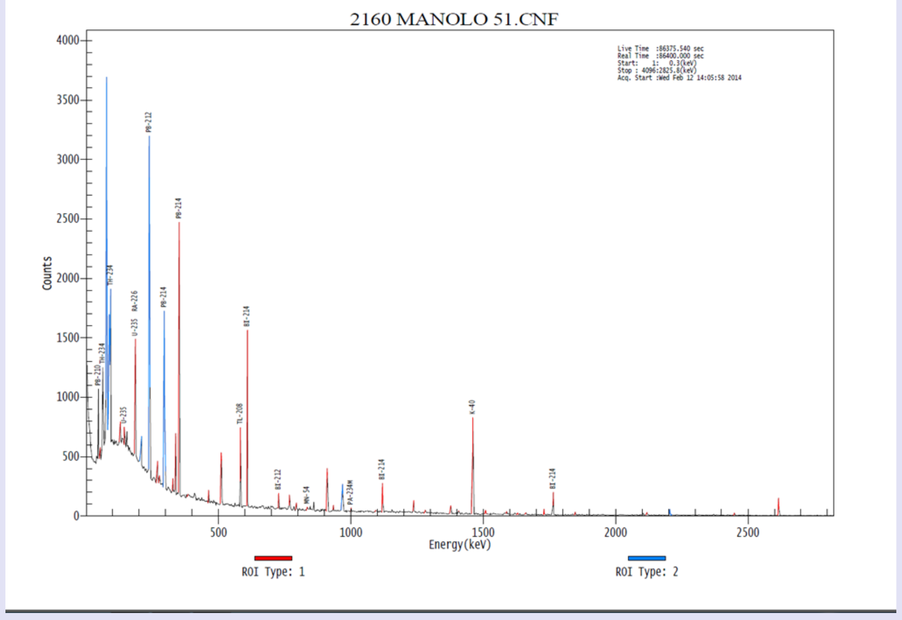
This survey involved 18 cement plants, 40 tile factories, and several quarries of limestone, siliceous and granitic nature.The samples were supplied by manufacturers of Spain, have been classified and have been made a physic-chemical characterization of the samples received. The chemical composition of the samples of cement, brick, ceramic and roofing tile has been made using ICP-MS and XRPD. All building materials have varying amounts of natural radionuclides. They belong to natural radionuclides of uranium (^{238}U) and thorium (^{232}Th) series, together with the radioactive isotope of potassium (^{40}K). The concentration of the natural radioactivity in the selected cements and ceramics were conducted with a coaxial ReGe detector. The energy an absolute efficiency calibration of the spectrometer was made using a sample certificated by IAEA-312 and IAEA-385. Software use to analyze the spectrum is the Cenie-2000 v.2.0 Canberra Nuclear. The activity concentrations from ^{226}Ra, ^{232}Th and ^{40}K respectively from samples of Portland cements, tiles, ceramic and natural stones were.

The activity concentration index (I) is derived for identifying whether a dose criterion is according to the radiological protection principles concerning the natural radioactivity of buildings materials

$$I_\gamma = \frac{A_{Ra}}{300\ \mathrm{Bq.kg^{-1}}} + \frac{A_{Th}}{200\mathrm{Bq.kg^{-1}}} + \frac{A_K}{3000\mathrm{Bq.kg^{-1}}}$$

RESULTS

In this paper 150 samples from granitic, calcareous, sedimentary zones of Spain have been evaluated. All the samples are subjected even spraying process, drying at 100 ºC and sieved. You are placed in a cylinder of polyethylene for containers sealed to analyze. The samples were stored for the time necessary to help achieve the balance between the daughters of the ^{226}Ra. The ^{226}Ra activity was determined by quantifying the activity from ^{214}Bi peak (1764.5 keV) and ^{214}Pb. The activity of the ^{232}Th is obtained from the measurement of ^{208}Tl peak (2614.5 keV). El ^{40} K was measured directly, from the emission line of 1460.8 keV. To compare the radiological effects of the materials used in the building which contain ^{226}Ra, ^{232}Th and ^{40}K, a common index is required to obtain the sum of activities and according to RP 112 the absorbed dose in air can be calculated. Some indices dealing with the assessment of the excess gamma radiation arising from building materials such as Radium Equivalent Activity (Ra_{eq}); External Hazard Index (Hex); the Activity Concentration Index (I); Absorbed Gamma Dose Rate in indoor air (D) and Annual Effective Dose Equivalent (AEDE)



RADIOLOGICAL INDEX	CEMENTS	SANDS	BRICKS	TILES	NATURAL STONES
Dose rate D(nGy/h)	33,23	23,03	7,44	16,42	47,22
AEDE (μSv/y)	40,78	28,26	9,13	20,15	57,95
$Ra_{Eq\ (Bq/kg)}$	68,71	46,90	11,71	133,97	88,05
$H_{ex\ (mSv/y)}$	0,19	0,13	0,04	0,16	0,24
$H_{in(mSv/y)}$	0,28	0,18	0,07	0,23	0,30

Mean Activity Concentration	Ra-226 (Bq/Kg)	Th-232 (Bq/Kg)	K-40 (Bq/Kg)	I index EU+RP-112
Granitic Zone	72,5	62,5	855,5	0,84
Sedimentary Zone	39,0	45,2	690,2	O,58
Calcareous Zone	37,0	36,1	466,4	0,43

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CONCLUSION

The results of this study clearly show that the concentration activities from samples from different locations are mostly low and below the proposed reference level of European Commission Report 112 and the Council Directive 2013/59 / Euratom.

The current research have demonstrate the importance of control the building materials with addition coming from NORM industry (coal ash, phosphogypsum…).