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Radiological study of building stones from a Spanish Region: Castilla and Leon

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Natural stone as construction and building material has a great potential to promote the commercial activities of some European regions. Such is the case of Castilla and Leon, in Spain, where many different rocks are commercialized for building purposes, from sedimentary to metamorphic and igneous. However, to be able to compete in a market subjected to an economic crisis, increased in the construction sector, and the lower prices offered from the emergent countries, a major attractiveness has to be facilitated. We propose a complete characterization of the rock regarding their radiological properties, which will be related to the mineralogy and the geochemistry. One important point is that rocks emit natural radioactivity and, although most of them are within the accepted values from the Radiology Protection European Norm 112 and the Euratom Basic Safety Standards Directive, the inclusion of the proper radiological characterization among other characteristics would guarantee the quality for their use.

In this work we have analyzed 28 samples of ornamental stones commercialized in that region, in order to determine their radionuclide contents and subsequently the I index proposed in the Norm 112, which determines the possible use of the rocks on the basis of the radiological risk they present, and also radon exhalation rates. A ORTEC gamma ray spectrometry, using a NaI(Tl) detector with 3”, was used for the purpose, and U, Th and K determined in the assumption of secular equilibrium from Bi-214, Tl-206 and K-40.

The results obtained for U (ppm), grouped by lithology, were the following: arenites 1.2±0.8 (n=8), limestones 0.7±0.6 (n=4), conglomerates 2.8 (n=1), quartzites 1.6±0.8 (n=2), schists 4.5 (n=1), gneisses 6.3 (n=1) and granites 5.1±2.1 (n=9). As expected, granites and related lithologies (gneisses) present the highest average U concentrations, however within regular values for such type of rocks and without any significant anomalous enrichment. Average radon exhalation rates (Bq.kg-1.h-1) for the same lithologies and samples were the following: arenites 0.017±0.013, limestones 0.012±0.008, conglomerates 0.023, quartzites 0.030±0.001, schists 0.039, gneisses 0.172 and granites 0.060±0.059. The correlation of U contents with radon exhalation shows the presence of two different trends, that significantly differ by an increased radon emanation rate for equivalent uranium concentrations; this is particularly evident for granites and gneisses and can be related with the mineralogical distribution of uranium in the rock.

The I index proposed in the Norm 112 presents values <1 for most samples in the scenario of integral use of the rock (walls, floors and ceilings), which means that they can be used for any type of building purposes. There are 3 exceptions (granites and gneisses), with values comprised between 1,08 and 1,24. More samples for these commercial varieties need to be determined in order to confirm the results obtained and the homogeneity of the rocks. An eventual restriction on the use for integral building of dwellings could be applied.