

## Some preliminary results obtained when indoor radon mitigation methods are applied

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Remedial actions are necessary in environments with high radon concentrations. A first survey about measurements of indoor radon concentration in working places was performed in Extremadura (Spain). Sites studied included resorts, spas, caves, tunnels, mines, facilities storing or dealing with water, and other underground and surface suspected work places (warehouses, parking lots, hotels, museums, educational centres, etc.). Results showed that about 85% of more than 300 working places measured, were below an annual average concentration of 200 Bq/m<sup>3</sup>, 9% were between 200 and 400 Bq/m<sup>3</sup>, and 6% were above 400 Bq/m<sup>3</sup>. A second study was undertaken, performing surveillance and applying mitigation methods when necessary. Four surveys were performed to fulfil one year study. Remedial or mitigation actions (ventilation, changing the working place inside the same building, limiting the time of residence of people, or architectonics actuations) were applied. A total of 240 measurements were performed in 35 sites. At this time, following the actual Spanish legislation, the working places were classified as 191 results (in 26 sites) with average indoor radon concentration lower than 600 Bq/m<sup>3</sup>, 38 results (in 6 sites) between 600 and 1000 Bq/m<sup>3</sup>, and 11 results (in 3 sites) with concentrations above 1000 Bq/m<sup>3</sup>. In some special cases, a continuous monitoring device was used to study the hourly variation of the indoor radon concentration. Results showed then a very great variability. Concentration variations in the working day and journey should be considered in this case because otherwise the dose received by workers could be erroneously estimated.

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## Spectrometric characterization techniques applied to artworks belonging to the historic and cultural heritage

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The development and application of the spectrometric techniques to the cultural heritage provides an increasingly knowledge of human behavior. X-ray fluorescence (XRF), X-ray diffraction (XRD), Raman spectrometry, Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) among others have become very useful for the application to the characterization of pigments used in artworks, such as paintings, frescos, rupestrian pictures, sculptures, vellum inks, etc. In this work, some results obtained by a portable XRF device, assembled in our laboratory a few years ago, are presented. This technique identifies the chemical elements forming the surface shells of a sample and is neither destructive nor aggressive i.e., samples are not damaged in the analysis procedure nor previous treatment is necessary. Characterization of pigments coming from a wide range of material such as glazed ceramic pots, rock art, modern paintings, ancient parchment and Roman rests were studied with XRF. Extremadura is a region were the Roman culture has a prevalent importance and some places are now included in the World Cultural Heritage catalogue by UNESCO. In the case of pieces coming from the recent found Roman theater of Medellin (Badajoz, Spain) and from a near noble house, results from XRD and SEM techniques were also used to clarify the materials used in the buildings and in their decoration. All the techniques used help to classify and catalogue the corresponding artworks and they have been revealed as very useful tools for archeologists and curators in their works.

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