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Atmospheric filter measurements by gamma-ray spectrometry with Ge detector

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Natural radionuclides, such as ^{210}Pband ^{7}Be, condensed on suspended particulate matter in the atmosphere (commonly called aerosols) have been widely used to examine a large variety of relevant atmospheric processes. ^{210}Pb has a half-life (22.3 y) higher than the aerosols ones (a few weeks), fact that made this radionuclide an important candidate as tracer to study both the atmospheric aerosol transport and removal processes. Cosmogenic particles hitting the atmosphere lead to the production of ^{7}Be (half-life 53.28 day) in the lower stratosphere and upper troposphere. Due to differences in the source terms for ^{210}Pb and ^{7}Be, simultaneous measurements at ground level of these two radionuclides can provide a powerful tool to study the vertical air mass mixing. For example, the ^{7}Be/^{210}Pb ratio is a good signature of the vertical mixing between both the upper atmosphere and the middle and lower troposphere.

^{210}Pband ^{7}Be activity concentrations in the superficial air aerosols from Huelva (SW of Spain) were determined in samples collected from July 2004 until June 2005. Aerosol contents of the filters were determined gravimetrically by weighting the filters, while the radiometric measurements were performed by low-level gamma spectrometry with a thin window coaxial germanium detector.

A rapid and non-destructive analysis of ^{210}Pband ^{7}Be is possible by direct measurement of 46.5 keV and 477.6 keV γ-rays, respectively. In this work we have employed an original method to find an empirical function which relates the full-energy-peak-efficiency with energy in a rectangular geometry. A dusty Reference Standard Material (phosphate rock) containing high levels in ^{238}U-series radionuclides, specially ^{226}Ra, was used as calibration sample. This solid matrix (grain size smaller than 63 μm) was

taken to impregnate homogenously the filters so that the real geometry of measurement was reproduced. This method allows to solve the problems that could happen with the use of liquid calibrating tracers.

The average activity concentrations of both ^{210}Pband ^{7}Be in the PM_{10} fraction for the collecting period were 20.0 $\pm$ 2.1 and 166 $\pm$ 12.0 Bq g^{-1} for the urban area, respectively, while 24.1 $\pm$ 2.5 and 228 $\pm$ 19 Bq g^{-1} in the rural area were measured, respectively, for these same radionuclides. The activity ratios of ^{7}Be/^{210}Pb ranged from 2.3 to 30, with a maximum in spring, as it is expected, which can be due to both the higher vertical mixing in the atmosphere during this season, and the influence of air masses coming from the Atlantic Ocean, situation that could be enhanced by the lack of rain that there was in Spain during the sampling period.