A comparative study between ⁷Be detected in TSP and PM₁₀

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In the present study, ⁷Be collected with different systems is compared, one of them uses a PM_{10} head and the other captures total suspended particles (TSP), examining whether there are significant differences in their quantification.

Airborne dust samples were periodically collected from February 2024 until January 2025 over 1-week periods using: 1) PM_{10} : a high-volume MCV sampler at a flow rate of 30 m³h⁻¹ using glass micro-fiber filters (150 mm in diameter, type GF20, MCV) and 2) TSP: a high-volume sampler PTI (air-flow rate 90,000 L min⁻¹) fitted with square polypropylene filters (440 mm side).

The sampling point of the aerosol samples discussed here is located at the University of Málaga (4° 28' 4" W; 36° 43' 40" N), at a height of 10 m above the ground and approximately at 5 km from the coastline. This is one of the environmental radioactivity monitoring network stations operated by the Spanish Nuclear Security Council (CSN).

Activity concentrations of ⁷Be were determined by low level gamma spectrometry using a coaxial-type germanium detector (Canberra Nuclear: Genie 2000). Gamma line of 477.7 keV was used. The counting intervals ranged from 172,800 to 216,000 s. The concentrations were corrected for decay to the mid-collection period.

The activities of ⁷Be measured in the two collectors yield a correlation coefficient of 0.87, suggesting that they are providing consistent results. Although there are no significant differences in the measured activities, that high correlation is a good indicator that both methods are reliable. The activities measured in PM₁₀ are, almost always, higher than those in the TSP samples, with differences ranging from 4% to 44%, being the correlation coefficients r=0.86. The only points at which the activities of ⁷Be measured in TSP exceeds the measurements in PM10 are in weeks where the highest concentrations of dust are detected in both filters, suggesting that extreme conditions can influence the measurements. Besides, in those weeks ¹³⁷Cs is detected and the analysis of back-trajectories shows the African origin of the air masses. To study these differences, some meteorological data has been collected: average temperature, precipitation, wind speed and direction, and a VARIMAX analysis has been conducted. The conclusion drawn from this VARIMAX analysis is that the meteorological variables and measured activities can be effectively summarized into two principal components, which together account for 71% of the total variance: First Component associates the concentrations of ⁷Be in both PM₁₀ and TSP with temperature and wind direction. This suggests that these factors are likely influencing the behavior or distribution of ⁷Be in the atmosphere. Second Component links dust concentration (measured in both filters) with wind speed, indicating that wind plays a significant role in the dispersion or accumulation of dust particles.

Overall, the analysis highlights that: (1) ⁷Be is more concentrated in smaller particles, (2) measurements further support the consistency between these two sampling methods, (3) PM_{10} and TSP collectors are reliable for measuring ⁷Be activities, with PM_{10} typically showing higher values except under specific conditions of high dust concentration.