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Challenges in measuring ^{22}Na in rainfall by gamma spectrometry in the city of São Paulo, Brazil

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Na-22 is a naturally occurring radionuclide of cosmogenic origin with half live of 2.6 years, being a beta and gamma emitter (541keV and 1274.5keV, respectively). This cosmogenic radionuclide is mainly formed when cosmic rays interact with argon nucleus, occurring a fragmentation of this nucleus. The process of production of ^{22}Na occur continually in upper atmosphere, lower stratosphere and rainfall is the predominantly process of deposition of cosmogenic radionuclides in terrestrial surface. Na-22 together with ^7Be ($T_{1/2}$) = 53.3 d, gamma ray 476.7keV) can be used as tracers in studies of aerosol transport between layers of the atmosphere. At the same time ^{22}Na is rarely used in these studies due to its extremely low abundance in rainfall. The objectives of this work were to present the first results ^{22}Na activity concentration measured in rainfall collected at the IPEN campus located in São Paulo, Brazil. Large volumes of rainfall samples were collected from October 2022 to April 2023, totaling 20 samples, and ^{22}Na activity concentration was measured by non-destructive gamma-ray spectrometry using a coaxial Be-layer HPGe detector with 46% relative efficiency and associated electronic devices and live counting time varying from 250,000 s to 500,000 s; the rainfall volumes ranged from 14 L to 164 L. The collection container was previously acidified with 1 mol L^{-1} HNO_3 to avoid loss of radionuclide by absorption on the container walls. The first eight rainfall samples were collected in a catchment area of 1 m^2 , which was not enough to measure the radionuclide, since all the determined results were smaller than the detection limit of the methodology. After these results, it was decided to increase the catchment area by collecting rainfall samples from the roof of the laboratory building, in an area of 78 m^2 ; the container used to collect samples from this area was also acidified with 1 mol L^{-1} HNO_3 . In this new area, 12 rainfall samples were collected, however, as the volume of rainfall was very large in the rains collected, only one sample was acidified, a rainfall of 2 mm and a volume of 98 L; in the other samples, the large volume of rain did not allow the water to become acidic because the collection container overflowed with water. In the acidified rainfall sample, the result of $0.725 \pm 0.252\text{ Bq L}^{-1}$ was determined for the radionuclide ^{22}Na . With this result, it is possible to prove the importance of both the catchment area and the acidulation of the sample in the determination of trace radionuclides in rainfall samples