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Accelerator Mass Spectrometry Analysis of Isotopes of Plutonium in $PM_{2.5}$

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Abstract : Plutonium is present in different concentrations in the environment and biological samples related to nuclear weapons testing, nuclear waste recycling and accidental discharges of nuclear plants. This radioisotope is considered the most radiotoxic substance, particularly when it enters the human body through inhalation of powders insoluble or aerosols. This is the main reason of the determination of the concentration of this radioisotope in the atmosphere. Besides that, the isotopic ratio of $^{240}Pu/^{239}Pu$ provides information about the origin of the source. $PM_{2.5}$ sampling was carried out in the Metropolitan Zone of the Valley of Mexico (MZVM) from February 18th to March 17th in 2015 on quartz filter. There have been significant developments recently due to the establishment of new methods for sample preparation and accurate measurement to detect ultra trace levels as the plutonium is found in the environment. The accelerator mass spectrometry (AMS) is a technique that allows measuring levels of detection around of femtograms (10-15 g). The AMS determinations include the chemical isolation of Pu. The Pu separation involved an acidic digestion and a radiochemical purification using an anion exchange resin. Finally, the source is prepared, when Pu is pressed in the corresponding cathodes. According to the author's knowledge on these aerosols showed variations on the $^{235}U/^{238}U$ ratio of the natural value, suggesting that could be an anthropogenic source altering it. The determination of the concentration of the isotopes of Pu can be a useful tool in order the clarify this presence in the atmosphere. The first results showed a mean value of activity concentration of ^{239}Pu of 280 nBq m^{-3} thus the $^{240}Pu/^{239}Pu$ was 0.025 corresponding to the weapon production source; these results corroborate that there is an anthropogenic influence that is increasing the concentration of radioactive material in $PM_{2.5}$. According to the author's knowledge in Total Suspended Particles (TSP) have been reported activity concentrations of $^{239+240}Pu$ around few tens of nBq m^{-3} and 0.17 of $^{240}Pu/^{239}Pu$ ratios. The preliminary results in MZVM show high activity concentrations of isotopes of Pu (40 and 700 nBq m^{-3}) and low $^{240}Pu/^{239}Pu$ ratio than reported. These results are in the order of the activity concentrations of Pu in weapons-grade of high purity.

Keywords : aerosols, fallout, mass spectrometry, radiochemistry, tracer, $^{240}Pu/^{239}Pu$ ratio
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