



Particulate matter and particulate-bound mercury in a heavily polluted site related with ancient mining and metallurgy

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The Almadén mercury mining district (South-Central Spain) has supported the extraction of one third of the total production of this element. More than 95% of the production came from the Almadén mine; the rest comes from other minor mines in the district, including those located in the neighborhood of Almadenejos, a small village located some 14 km to the West of Almadén. In this area, the presence of the El Entredicho open pit as well as the old mines of Vieja- and Nueva Concepción suppose the presence of scattered sources of mercury, including an old metallurgical precinct, old dumps (most, but not all restored) and outcrops of cinnabar-containing rocks in the mining areas.

In this communication we present data from mercury bound to particulates as well as from particulate-matter measured in Almadenejos. The measuring device was installed in an active waste-water treatment plant, located some 100 m to the East of the urban area, and so, 500 m. to the SE of the metallurgical precinct, 1400 m to the East of La Nueva Concepción mine, and 2700 m to the NW of El Entredicho open pit.

Samples of atmospheric particulate matter were taken with a high-volume sampler MCV CAV-A/mb in fiber glass filters, on 24 hours cycles. Total gaseous mercury (TGM) was measured in the same period with the aid of a Tekran 2537B device. Simultaneously, an automatic meteorological station Davis Vantage-Pro recorded each 15-minute main meteorological parameters: temperature, relative humidity, atmospheric pressure, solar radiation, wind direction and speed and rain.

Total particulate matter was calculated by weights differences using an analytical balance Ohaus/Kern, mod Adventurer Pro. Total mercury concentration was measured by direct total mercury determinations by pyrolysis using an Atomic Absorption Spectrometer AMA-254 in half part of each sample. Mercury speciation was performed with a Lumex PYRO device by thermal desorption.

Our results indicate that particulate matter contents in the atmosphere of this mining related site are in average ($25 \mu\text{g m}^{-3}$) below EU limits for PM10 for 24 hours periods and for one-year period. PM contents reaches values up to $50 \mu\text{g m}^{-3}$ only in summer ($62 \mu\text{g m}^{-3}$) and autumn ($64 \mu\text{g m}^{-3}$), mainly due to Saharan dust intrusion events. Particulate bound mercury contents are 1.8 ng m^{-3} in average during the whole sampling period, with higher values in summer (3.2 ng m^{-3}) and lower in winter (1 ng m^{-3}). The major proportion of mercury in particulate matter appears as cinnabar, with a minor proportion bound to organic matter, mainly pollen and small fragments of local vegetation.

After a multiple regression analysis to identify main relationships between measured factors, evapotranspiration appears as a common factor explaining particulate matter contents and Particulate bound mercury concentrations during all sampling period and especially on autumn and winter months.

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