

CHEMICAL COMPOSITION OF PM₁₀ IN THE ATMOSPHERE OF ATHENS, GREECE

J. MANTIS¹, C. SAMARA¹ and TH. KOUIMTZIS¹
G.GRIVAS², V. KANOUTA², A. KARAMPERI², V. PROTONOTARIOS², N. MANALIS²,
A. MOUTSATSOU², A. CHALOULAKOU² and N. SPYRELLIS²

¹Environmental Pollution Control Laboratory, Department of Chemistry, Aristotle University of Thessaloniki, 541 24 Thessaloniki, Greece,

²Chemical Engineering Department, National Technical University of Athens, 9 Heron Polytechniou str., 157 80 Zografos, Athens, Greece.

E-mail: dchal@central.ntua.gr

EXTENDED ABSTRACT

The present study analyzes the results of an approximately 1-year PM₁₀ measurement and chemical analysis campaign, carried out in larger Athens Metropolitan Area. The scope of the study was to obtain information on the spatial and temporal variation of PM₁₀ concentrations in Athens and to investigate their chemical composition especially on heavy metals/toxic elements and polycyclic aromatic hydrocarbons (PAHs). The collection of samples was conducted using high-volume samplers at three sites of the larger Athens Metropolitan Area: two urban sites, Maroussi (MAR) and Aristotelous street (ARIS), and one urban-industrial location (Elefsina, ELEF). PM₁₀ samples were also collected from an urban-background location (Thrakomakedones, THRAK), at different time periods. The mean PM₁₀ concentrations found in Maroussi, Aristotelous, Elefsina and Thrakomakedones were 75.0, 82.6, 55.5 and 32.4 µg/m³, respectively, exceeding the annual limit value of 40 µg/m³. The 24-h standard (50 µg/m³) was exceeded at the 69%, 92%, 48.6% and 10.3% of cases in Maroussi, Aristotelous, Elefsina, and Thrakomakedones, respectively.

The PM₁₀ samples were analyzed for 8 trace elements (As, V, Pb, Cu, Cr, Mn, Cd, Ni) and 13 PAHs, EPA Priority Pollutants. The mean concentrations of trace elements examined, were found within the limits proposed by the EU and WHO, although elevated levels of As and Ni are a potential cause of concern. PAH concentrations were highest in Aristotelous and Elefsina and lowest in Maroussi. Even lower PAH levels were found in Thrakomakedones, which, however, represented mainly the warm time period. The mean concentration of the well known carcinogen B[α]Py ranged between 0.037 ng/m³ at Thrakomakedones and 0.714 ng/m³ at Elefsina, being at all four sites below the standard of 1 ng/m³ (annual average) legally established in certain European countries.

All parameters exhibited seasonal variation, particularly PAHs which showed concentrations during the cold time period 3.5–7.8 times higher than those in the warm time period. Significant spatial correlations were found for PM₁₀. Inter-site correlations between PM₁₀ and other pollutants and meteorological parameters allowed a further insight on the factors affecting the measured ambient levels. Diagnostic PAH ratio values suggested that all four sites are affected by mixed combustion sources with variable seasonal contribution. The lowest contribution of combustion sources appeared in Thrakomakedones, along with the lowest traffic indicator during the warm time period. The greatest contribution of automobile traffic was observed in Aristotelous and Maroussi.

Key words: Particulate matter, PM₁₀, trace metals, PAHs