



How a Steel Plant Affects Air Quality of a Nearby Urban Area: A Study on Metals and PAH Concentrations

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ABSTRACT

Taranto (in the Apulia Region of southern Italy) has been included in a list of the most polluted sites of national interest because of its large industrial area that is situated near the urban centre. The impact of this on urban air quality has been evaluated by monitoring PM_{2.5} and PM₁₀ at the industrial site of 'via Orsini' and the urban station of 'via Dante'. At both sites, the temporal distribution and chemical composition of PM, in terms of PAHs and element concentrations, were used to characterize the air quality in the urban area and to deduce the possible and theoretical carcinogenic indices, and thus the impact on human health. High PM concentrations were found to be caused by wind coming from the north (industrial area), and during days when the wind was from this direction the PAH and elemental concentrations (such as iron, manganese and zinc) were the highest of the sampling period. These data confirm the impact of this industrial area, in particular its steel plant activities, on urban air quality in Taranto. In order to determine the source contributions to PM levels at the two investigated sites, Principal Component Analysis was applied to the collected data. Statistical investigations also included PAH and elemental concentrations determined at two other sites in Apulia Region, characterized by traffic and biomass burning sources. These investigations made it possible to distinguish the samples collected in via Dante and via Orsini from those collected at the two other sites, confirming the effects of industrial activities on urban air quality in Taranto.

Keywords: Industrial source; PAHs; Heavy metals; PCA; Coke oven.

INTRODUCTION

The visible air pollution, such as smoke, dust and smog, has disappeared from many cities thanks to local, national and European regulations. Nevertheless, in many European cities, air quality is still a concern and therefore it is monitored around the clock. In particular, air pollution controlling and curtailment of industrial sources is essential for improving air quality in a selected area. In recent years, the growing interest in Particulate Matter (PM) has been related to its dangerous consequences to human health. As a matter of fact, several epidemiological studies have indicated a strong association between high concentrations of inhalable particles and increased mortality and morbidity (Lin and Lee, 2004; Arditoglou and Samara, 2005; Namdeo and Bell, 2005; Lammel *et al.*, 2010). The chemical composition of PM and particle size distributions are the most significant factors affecting air quality. In particular, the exposure to finer particles can cause short and long-term effects such as

increased respiratory symptoms, decreased lung function, alterations in tissue and structure lung, in respiratory tract and premature death (Prieditis *et al.*, 2002, Damek-Poprawa, 2003, Wahab *et al.*, 2004, Huang and Ghio, 2006, Ahumada *et al.*, 2007, Huang *et al.*, 2007, Magas *et al.*, 2007, Wild *et al.*, 2009, Daresta *et al.*, 2010, Liuzzi *et al.*, 2011). Moreover, near industrial areas, where elements and Polycyclic Aromatic Hydrocarbons (PAHs) are strongly associated with fine particles, increased toxicity and PM carcinogenicity have been determined (Bruno *et al.*, 2002; Caselli *et al.*, 2003; Pozzoli *et al.*, 2004; Vione *et al.*, 2004; Dvorska *et al.*, 2011; Castro-Jiménez *et al.*, 2012; Tobiszewski and Namiesnik, 2012).

In combustion processes, elements can be emitted in gaseous form, adsorbed on fine particles and retained within heavier ash (Helble *et al.*, 1996). Some elements are essential to maintain metabolism of human body but, at higher concentrations, they can lead to poisoning (Carpi, 1997; Lighty *et al.*, 2000; Linak, 2000; Huggins, 2004). Among these, more attention is required for "Heavy metals", usually referred to any metallic chemical elements having a relatively high density and toxic or poisonous at low concentrations (mercury: Hg, cadmium: Cd, arsenic: As, chromium: Cr, nickel: Ni and lead: Pb).

PAHs include a large group of compounds consisting of

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