

Aluminium and iron air pollution near an iron casting and aluminium foundry in Turin district (Italy)

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Abstract

This work reports the results of an environmental survey carried out in an industrial area in the Province of Turin: its main aim is to assess the levels of iron and aluminium in the outside air during the period from July to September to assess the influence of industrial activity (a cast-iron and aluminium foundry) which is interrupted during the month of August, on the level of metals present in the air. Conducting the analysis during this period of time made it possible to avoid the confounding effect of pollution due to domestic central heating.

The measurements were taken from nine areas at different distances from the foundry in the area and according to the direction of the prevailing winds, as deduced from the historical data.

The results of this survey show a statistically significant difference in iron and aluminium levels in the outside air in the geographic areas between the two main periods examined: during August (no foundry activity) v/s July–September (foundry activity). The values recorded are: Aluminium $0.4 \pm 0.45 \mu\text{g}/\text{m}^3$ v/s $1.12 \pm 1.29 \mu\text{g}/\text{m}^3$ ($p < 0.0001$); Iron $0.95 \pm 0.56 \mu\text{g}/\text{m}^3$ v/s $1.6 \pm 1.0 \mu\text{g}/\text{m}^3$ ($p < 0.0001$).

There were no statistically significant differences between the nine sampling points from the point of view of the sampling sites, climate conditions and wind directions. We found no correlation with car traffic, in terms of the number of vehicles, and metals.

The values of iron tended to be higher in the areas farther away from the foundry site in the areas located along the path of the prevailing winds.

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1. Introduction

Many studies have been conducted on the health effects of inhalable particulate matter (PM 10) pollution. These particles are of concern because they can penetrate into the lower airways where they can cause lung injury, whereas particles with an aerodynamic diameter greater than $10 \mu\text{m}$ are to a large extent removed in the upper airways. Many epidemiological studies have reported an acute impact of particulate air pollutants on the pulmonary sys-

tem, including the reversible decrement of pulmonary function and the increase of bronchial hyperreactivity [1].

In the course of our investigations funded by ISPESL (a Public institution devoted to research, information, training and advice on legislation in the area of occupational safety and health) which were carried out to quantify aluminium and other metal levels in a foundry of cast-iron and aluminium, we assessed the effect of this industrial activity on the air pollution of the surrounding atmosphere, taking into account the criteria and legislation in force in Italy with regard on the control of atmospheric pollution [2].

The study was carried out in the regional health area near the city of Turin, 25 km from the regional capital

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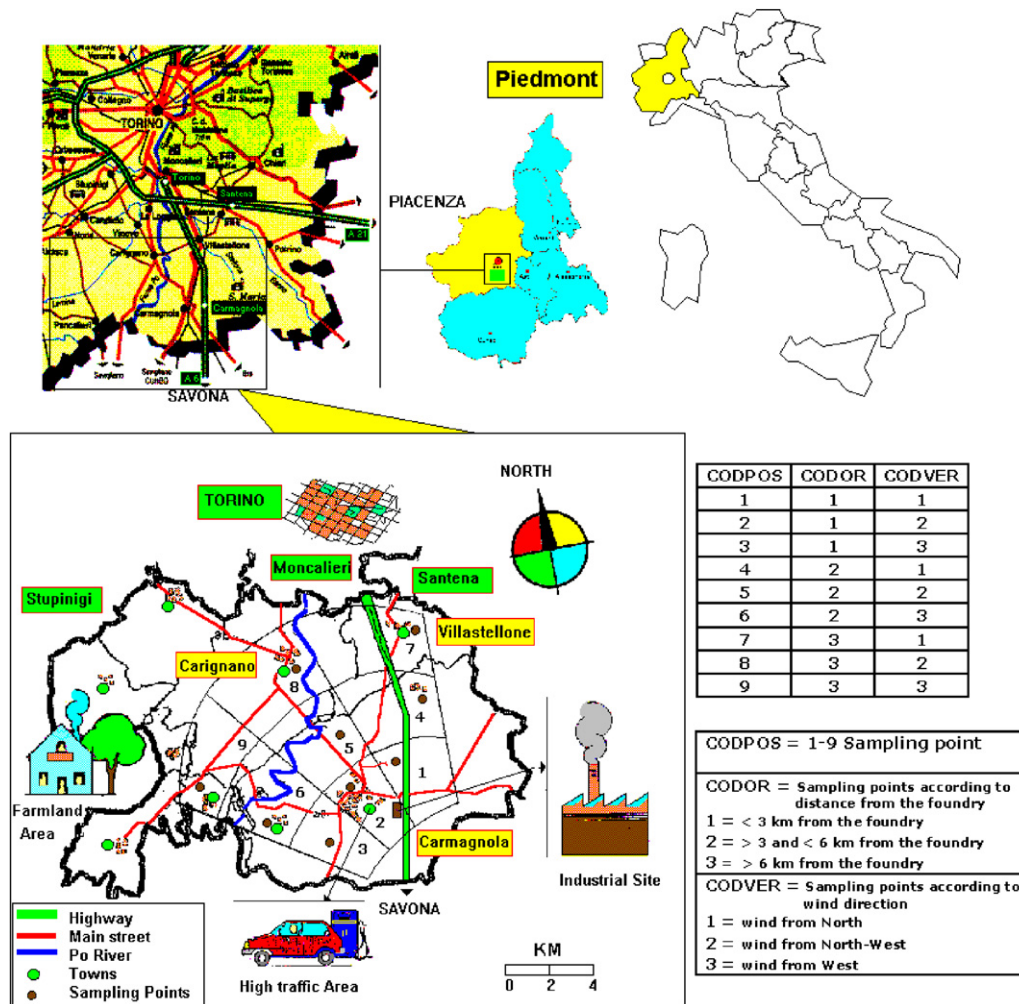


Fig. 1. Map of the area investigated in Torino Province – Piedmont – Italy.

during the period from July to September. In this way we were able to avoid the effects of home central heating systems on particulate air pollution.

The area considered (Fig. 1) is located in flat countryside and it is protected from air currents by the Alps to the North (N) and North-West (NW) and by hills to the North-East (NE); there are weak winds (1–2 m/s) mostly in a NW direction.

The climate features a high temperature range, high humidity and frequent sudden changes of temperature with thermal inversion phenomena: for these reasons pollutants can remain in the air for a long time or can be carried kilometres away.

In the area studied there are:

- one of the biggest aluminium and cast-iron foundries in Europe (indicated as *Industrial Site* in Fig. 1),
- motorway networks and
- vast farmland.

All these factors may act on the air pollution of metals.

In a previous paper we assessed the effects of occupational exposure to aluminium and iron on the cognitive functions of workers [3]. The aim of the present study was to assess the level of iron and aluminium in the particulate matter of the air around an industrial site. We hypothesized that levels of metal components in particulate matter may be associated with health effects, particularly on lung function. This hypothesis will be the subject of our next study.

2. Materials and methods

We used fixed samplers in nine sampling points to estimate 106 measurements of about 50 cubic meters every 24 h in different districts, located around the industrial estate, using the foundry as landmark (Fig. 1). Air monitoring was carried out accordingly (Tables 1 and 2).

We considered:

- Three concentric horizontal areas with different distances – Codor = 1: inside 3 km (sampling points no.

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