



Lichen biomonitoring of the atmospheric pollution by heavy metals in the area of Merone, Como district, Italy

Summary

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The main goal of this experimental study was to assess the potential impact of the cement kiln “Holcim Italia SpA” based in Merone, Como district, Italy, with regard to atmospheric emissions of heavy metals which can deposit and subsequently concentrate in lichens. Lichens are very important organisms for pollution biomonitoring studies.



The lichen Xanthoria-Parietina

On the 9th and 10th of October, 2007 lichens were transplanted into 14 selected sites in the area of Merone. Thalli of the foliose epiphytic lichen *Xanthoria parietina* were placed on trees, shrubby vegetation and artificial supports.

<u>Site</u> <u>kms)</u>	<u>City</u>	<u>Distance from the Holcim cement plant (air distance in</u>
1) Site 1.	Merone - north	0.3
2) Site 2.	Merone - centre	0.4
3) Site 3.	Merone - south	0.6
4) Site 4.	Monguzzo - Buerga Bassa	0.4
5) Site 5.	Monguzzo - Buerga Alta	1.0
6) Site 6.	Monguzzo - Nobile	0.4
7) Site 7.	Monguzzo - Cavolto	1.7
8) Site 8.	Costa Masnaga - Camisasca	2.1
9) Site 9. (initially planned, but later rejected as non-suitable)		
9) Site 10.	Rogeno - Cavieraga	2.1
10) Site 11.	Merone - La Specola	0.9
11) Site 12.	Lurago d’Erba	2.0

12) Site 13.	Arosio	7.0
13) Site 14.	Canzo	8.2
14) Site 15.	Orsenigo	4.6

Site 16. (initially planned, but later rejected as non-suitable)		
Site 17.	Parma city centre	



Sites 18-19-20.

Parma suburbs

On the 17th and 18th of January, 2008, 16th and 17th of April, 2008 and 25th of July 2008 the transplanted lichens were collected and then analysed for concentrations of Arsenic (As), Chromium (Cr), Cadmium (Cd), Nickel (Ni), Lead (Pb), Copper (Cu), Selenium (Se), Thallium (Tl), Vanadium (V) and Zinc (Zn).

Results and discussion

Compared to the benchmark sites of Arosio, Canzo, Orsenigo and Parma the lichen thalli situated in the area of Merone contained: higher or much higher concentrations of Ni and Pb; relatively higher concentrations of Cu, Cr and Zn; similar concentrations of Cd, Sb, Se and Ca. Other elements found, such as As, Tl, and V, were below instrumental sensitivity.

The absolute concentrations of heavy metals in the area of Merone were not extremely high, although the median values were often higher than those found in other areas, including polluted areas, biomonitoring using lichens of the same species. However, heavy metals relative concentration values in these sites compared to benchmark sites were more indicative and informative. On average, these values were much higher, showing that the air quality in the area of Merone is rather compromised, especially moving from east to west from the Holcim cement plant. Furthermore, fallout diagrams showed, with a fair degree of reproducibility, that the concentration of metals in lichens gradually decreases as one moved away from the Holcim cement kiln.

In consideration of: 1) the critical points raised by the local authorities in the Integrated Environmental Permit of the 19th of October, 2007; 2) the quantities of raw materials moved and storage methods in the the Holcim cement plant; 3) the typologies and quantities of traditional and alternative fuels used in cement plant; 4) clinker production and clinker transport practices of the Holcim cement plant; 5) the conclusions of the previous “Study on the metal contamination in the soil around the Holcim cement kiln in Merone” (Valerio, 2006), it cannot be excluded that the source of the metals found in the lichen thalli analysed in the present study is, at least to a great extent, the Holcim cement plant in Merone.

Therefore, since the situation in the analysed sites was, on balance, poorer than the benchmark sites, the present study stresses the urgent need to carry out further and more targeted monitoring studies of atmospheric pollution in the area of Merone, especially with regard to toxic metals. In this respect, in addition to traditional measurements of emissions and distribution of pollutants dispersed in the atmosphere, it is advisable to carry out long-term measurements of biodeposition and bioaccumulation of metals in suitable organisms, such as lichens and other bioindicators of environmental quality. This should be done before belatedly realising about irreversible environmental damage and recurrent diseases in the population.