



## Indoor Airborne Particulate Matter of a Bakery: Size Distribution and Chemical Characterization

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### Abstract

The present study deals with indoor air quality of a bakery located in Bari province (South Italy) by combining optical particle counter (OPC) data and analytical chemistry analyses on PM<sub>2,5</sub> indoor samples. OPC data and PM<sub>2,5</sub> samples were collected from 7 to 19 April 2013 in the proximity of two bakery ovens powered by gas and wood, respectively.

PM<sub>2,5</sub> samples were analyzed for OC (organic carbon), EC (elemental carbon), LG (levoglucosane) Cl<sup>-</sup> (chloride), NO<sub>2</sub><sup>-</sup> (nitrite), NO<sub>3</sub><sup>-</sup> (nitrate), SO<sub>4</sub><sup>2-</sup> (sulphate), C<sub>2</sub>O<sub>4</sub><sup>2-</sup> (oxalate), Na<sup>+</sup> (sodium), NH<sub>4</sub><sup>+</sup> (ammonium), K<sup>+</sup> (potassio), Mg<sup>2+</sup> (magnesium) e Ca<sup>2+</sup> (calcium).

During our indoor monitoring campaign, finer particles, which diameter ranging between 0.28 and 0.50 μm, revealed bigger concentrations during the first part of working day, that is from 3:00 to 9:00 o'clock with intense peaks when ovens were switched on. Moreover, during the same sampling interval, higher mean concentrations of OC (36.01 μg/m<sup>3</sup>), EC (1.08 μg/m<sup>3</sup>) e levoglucosan (0.76 μg/m<sup>3</sup>) were found.

### Introduction

Literature indicates that indoor air quality (IAQ) may be poorer than the outdoor one [1, 2] and highlights a significant correlation between indoor environmental quality and health and productivity [3].

This paper focuses on the assessment of indoor air in a nonindustrial working place, using a combination of approaches including analytical chemistry analyses and OPC data to investigate the indoor air quality in response to the bakery working activities. Information about polycyclic aromatic hydrocarbons trends, dynamics and dispersion in the bakery are widely discussed in Ielpo et al., 2018 [4].

### Materials & Methods

During indoor sampling, an OPC Monitor multichannel (FAI Instruments s.r.l., Rome, Italy) and a Silent Sequential Air Sampler (FAI Instruments s.r.l., Rome, Italy) were positioned in the laboratory area at 1.70 m height (i.e., simulating the mean human height in that geographic region). By OPC monitor, particle counts collected in eight different size ranges (from 0.28 to 5 μm) were obtained at high time resolution (1 minute).

OPC data were clustered by means of a Self-Organizing Map (SOM) Neural Network [5]. To reduce the sample dimensions, the eight size ranges of the OPC were reduced to three by bundling together adjacent ranges.

The Silent Sequential Air Sampler used with a volumetric flow rate of 10 l/min and a size selective inlet (SSI), allowed the collection on membranes of particles with an aerodynamic diameter less than 2.5  $\mu\text{m}$ . During the day, four samples were collected at specific time intervals: from 03:00 to 09:00 h, from 09:00 to 13:30 h, from 14:00 to 21:00 h, and from 21:00 to 03:00 h. For each sampling day, 4 PM<sub>2.5</sub> samples were collected. In total 40 PM<sub>2.5</sub> samples were obtained. On half part of each sample OC, EC, levoglucosan, Cl<sup>-</sup>, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup> and Ca<sup>2+</sup> were determined [6].

## Results

By OPC monitor, particles size trends have been obtained during sampling days: finer particles, which diameter ranging between 0.28 and 0.50  $\mu\text{m}$ , revealed bigger concentrations during the first part of working day, that is from 3:00 to 9:00 o'clock.

The map in fig. 1 shows the distance between adjacent neurons of the network in a hexagonal topology: the darker the coloured area between two neurons (grey hexagons), the longer the distance between the relevant neurons.

Chemical characterization of PM samples highlighted different concentration levels of parameters investigated related to the different hourly sampling intervals: higher values were found during the first interval.

## Conclusions

Bakery working activities included ovens starting can be linked with both higher number of particles and higher mean concentrations of chemical parameters investigated.

## References

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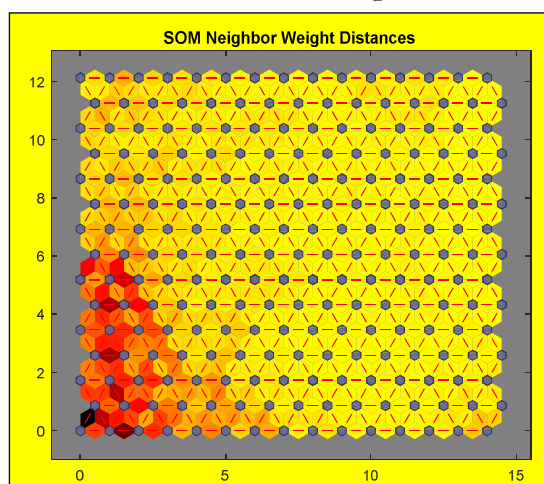


Fig. 1; sample visualization of the SOM's clustering. Darker lines separating lighter areas represent the clusters' boundaries.