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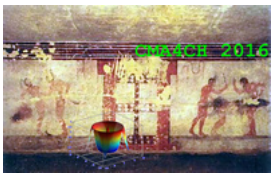

Polycyclic Aromatic Hydrocarbons in Indoor air of a Bakery

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Abstract

In the laboratory of a bakery, PM2,5 indoor samplings have been performed every each six hour meanly from 7th to 19th April 2013.

For each daily sampling four PM2,5 samples have been collected. In total 40 samples were obtained. On each sample the following PAHs were determined: BaA(228), Bb,kF (252), BaP (252), BgP (276), Ip (276), DbA (278).

The mean PAHs concentrations per sampling hourly range have shown, in the first and last sampling range, higher values than the other two hourly ranges. Because of it was not possible to perform samplings in the store of the baker, we have used the Computational Fluid Dynamics model in order to obtain information about dynamics and dispertion of human health hazard pollutants in the store and have an extimation of B(a)P concentration in that area.

Introduction

It has been shown that indoor air quality (IAQ) is usually worse than the outdoor air (Kotzias et al., 2009; Pegas et al., 2011). This paper focus on the indoor air of a working place, that is a bakery located in Bari province (South Italy). The bakery of our study has two ovens: a gas oven that is composed by 7 levels, with 3.7 m^2 per level, and has a thermal power of 80.000 kcal/h, and a wood oven with area of 13 m^2 and a thermal power of 80.000 kcal/h. In the wood oven oaken and olive wood is burned. Among pollutants with toxic and carcinogenic effects on human health this paper focus on the PAHs (Polyciclyc Aromatic hydrocarbons) collected on PM2,5 indoor samples. In particular, benzo[a]anthracene (BaA), benzo[b]fluoranthene (BbF), benzo[k]fluoranthene (BkF), benzo[a]pyrene (BaP), indeno[1,2,3-cd]pyrene (Ip), dibenzo[a,h]anthracene (DbA) and benzo[g,h,i]perylene (BgP) were analyzed as they represent harmful substances for human health. In fact, these PAHs are classified by the International Agency for Research on Cancer (IARC, 1984) as possible carcinogenic.

Materials & Methods

The PM2,5 sampler was positioned in a zone of laboratory at an height of 1,70 meter in order to simulate the mean human height. The PAHs in indoor airborne particulate matter were collected on QM-A Whatman (Maidstone, Kent, UK) filters of quartz fibers (i.d. 47 mm). The sampling was performed by a Silent Sequential Air Sampler (FAI Instruments s.r.l., Roma, Italy). The extraction of PAHs was realized by a microwave-assisted solvent (acetone and hexane) extraction (model Ethos D Milestone). The extracted was concentrated by Turbovap2 Concentration workstation (Caliper) and recovered by isoctane up to 0.5 ml. The final analysis was performed by GC-MS-MS (MSD 5975 C XL triple axis detector, Agilent).

3D CFD (Computational Fluid Dynamics) simulations were performed by means of the general purpose code Fluent at the Dipartimento di Ingegneria dell'Innovazione - University of Salento in order to obtain information about pollutants dynamics and dispertion in the store of bakery.

Results

During the day four samples were collected according the following hourly ranges: 03:00-09:00 (I), 09:00-13:30 (II), 14:00-21:00 (III), 21:00-03:00 (IV) in order to perform a PAHs monitoring regarding the different working activities performed in the bakery. The biggest PAHs values were obtained during the first hourly range, when the bakery activities are intense, and fourth range, when the bakery is closed and the PAHs sources (ovens) are switched off, but also the doors of the bakery are closed, on the contrary of the other sampling time.

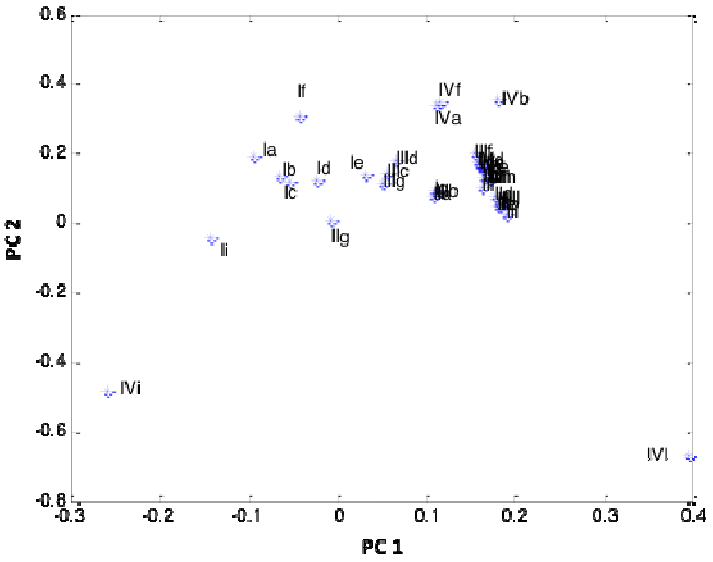

Fig. 1; PAHs score plot in the plane of first and second PC; I, II, III and IV indicate the hourly range, while the letters: a, b, c,…indicate the sampling day.

By applying Principal Component Analysis it is possible to note that the most of part of samples collected in the first (I) and fourth hourly (IV) range scattered from the main cluster.

Conclusions

The PAHs analyses, performed on the PM2.5 samples collected in the laboratory of bakery, pointed out the presence of these pollutants in the indoor air. B(a)P mean values for the first and fourth hourly sampling range are bigger than 1 ng/m3. CFD modelling simulations show advection of warm air in the laboratory and sales'areas. This implies a transportation of pollutants released from the wood and gas ovens. Simulation results confirm the presence of B(a)P in the laboratory as obtained from the measurements and suggests its presence in the sales' area of the bakery. The influence of gas oven emissions on total indoor concentrations is much lower than the wood oven.

Although the simulated concentrations are larger than measured ones in the laboratory, the modelling suggests in the sales' area B(a)P concentrations are similar to those found in the laboratory.

References

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