

Chemical characterization of particles emitted from wood-fired pizza ovens in Italy

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Biomass burning represents an important source of air pollution with adverse effects on air quality, climate change and health. Emissions from wood-oven pizzerias are scarcely investigated despite representing an increasing air quality concern, especially at urban locations. In the Italian territory, 8 million pizzas are daily produced and up to 85% are cooked in wood-fired ovens. Emissions from wood-oven pizzerias are highly uncertain, due to missing legislation on emission standards and controls. The information necessary to estimate emissions from this source, like number of wood-ovens, quantity and type of wood consumed, operating hours, are uncertain and often not available. At the Italian national level, this estimate is missing in the emission inventory, while the most recent inventory of the Lombardy region (INEMAR - Arpa Lombardia, 2022) estimates a contribution to total emissions of respectively 7% and 8% for PM₁₀ and PM_{2.5}, 3% for BC and 5% for BaP. Despite these first evidences, there is a remarkable lack of experimental data on emissions and chemical characterization from this source. Moreover, there are no specific technical standards or metrology for the sampling systems or specific test methods to analyse pollutants (Bergomi et al., 2022).

A project between ENEA and the Italian Environmental Ministry, with the aim to determine the concentrations of the main pollutants emitted by this source and to characterize PM emissions, is here presented. A survey on wood-oven pizzerias in the two metropolitan areas of Milan and Rome was conducted, an innovative sampling system was designed, and different tests were carried out. The sampling line employed by ENEA was developed by Innovhub as part of the Profile Pizza project. ENEA and Innovhub projects share the same goals. The adopted sampling scheme is reported in Figure 1. Different pollutants and tracers were analysed (PM_{2.5} and PM₁₀, Total suspended particulate (TSP) sampled in the hot and diluted flue gas; PAH and BaP; CO; NO_x; OGC; Levoglucosan, to obtain emission factors for each pollutant. The measurement campaigns were conducted on different types of ovens and testing different combustion cycles and operational phases. The ovens used in the experimental tests are a traditional wood-fired with a capacity of 6 pizzas fed by both beech wood

logs and beech briquettes, and a combined gas and wood fired with a capacity of 4 pizzas used in different ways (only gas; only wood; combined gas and wood).

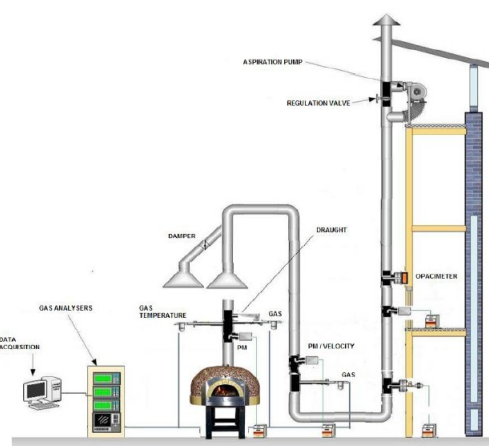


Figure 1. Sampling scheme for pizza wood-oven (from Bergomi et al., 2022).

An example of PM chemical characterization during one of the experiments is reported in Figure 2.

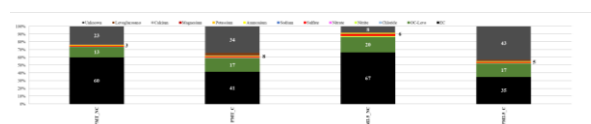


Figure 2. PM chemical characterization in the wood-fired pizza oven.

The project results are extremely innovative and would be very useful in estimating and characterizing emissions from this source.

Bergomi, A., Morreale, C., Fermo, P., Migliavacca, G., 2022. Determination of Pollutant Emissions from Wood-fired Pizza Ovens, *Chemical Engineering Transactions*, **92**, 499-504.

INEMAR - ARPA Lombardia, (2022.), INEMAR, Inventario Emissioni in Atmosfera: emissioni in Regione Lombardia nell'anno 2019 - versione in revisione pubblica. ARPA Lombardia Settore Monitoraggi Ambientali.