Camini e stufe a pellet inquinano più di caldaie a gas

Ricerca del centro studi della Camera di Commercio di Milano

Camini, stufe a legna e stufe a pellet vengono spesso presentati come sistemi di riscaldamento "ecologici". In realtà, sono molto più inquinanti delle caldaie a metano o gpl e perfino di quelle a gasolio. Lo rivela uno studio di Innovhub-Stazioni Sperimentali per l'Industria, l'azienda di ricerca e consulenza della Camera di Commercio di Milano.

Le differenze con gli altri combustibili si riscontrano soprattutto sulle emissioni di particolato o polveri sottili (PM), l'inquinante di maggior rilievo. Gli apparecchi a gas naturale e GPL registrano valori pressoché nulli di emissioni di particolato rispetto al pellet. Lo stesso vale per le emissioni di Benzo(a)pirene, altra sostanza particolarmente inquinante.

Sono state oggetto di prova 2 stufe a pellet, una di gamma medio-alta, fra le più vendute in Italia, l'altra di tipo economico, venduta nella grande distribuzione. Entrambe le stufe sono state testate sia con pellet di classe A1 (la qualità più elevata sul mercato) sia con pellet di classe A2 (la tipologia di minor qualità).

Il gas naturale e il GPL fanno registrare un fattore di emissione di Particolato inferiore ai 0,04 g/GJ (grammi per gigajoule), il gasolio di 0,1 g/GJ, la legna di 254 g/GJ, il pellet di qualità A1 impiegato su stufa di alta gamma 23,9 g/GJ, lo stesso pellet in stufa a bassa gamma 44,1 g/GJ, il pellet di qualità A2 in stufa ad alta gamma 83,8 g/GJ e in stufa a bassa gamma 82,9 g/GJ.

In più, le piccole caldaie a combustibili gassosi presentano emissioni di Monossido di Carbonio (CO) da 3 a 6 volte inferiori al pellet e 100 volte inferiori alla legna.

Nel caso degli Ossidi di azoto (NOx), i valori relativi al pellet sono circa 3 volte quelli rilevati per i combustibili gassosi e per il gasolio da riscaldamento.

I valori degli Ossidi di zolfo (SOx) ricavati per i combustibili gassosi risultano da 3 a 40 volte inferiori rispetto al pellet e da 10 a 30 volte inferiori rispetto alla legna.

Per quanto riguarda gli Idrocarburi Policiclici Aromatici (IPA), con specifica attenzione al Benzo(a)pirene, i valori più alti sono stati rilevati di gran lunga sulla legna (68,7 g/MJ, microgrammi per megajoule) e, tra gli altri combustibili, sul pellet (0,22 g/MJ, quello di qualità A1 su stufa ad alta gamma), mentre la concentrazione degli stessi nei fumi delle caldaie a gas naturale e GPL è risultata non rilevabile (inferiore a 0,08 g/MJ).

Fire, or combustion of biomass, is arguably the oldest known and most widely used controllable energy source on earth. In recent years, rising costs of fossil fuels and the development of advanced equipment have made biomass combustion an economical, efficient, and practical energy source.

Boman, Christoffer
Umeå University, Faculty of Science and Technology, Applied Physics and Electronics.
2005 (English)Doctoral thesis, comprehensive summary (Other academic)

Abstract [en]

Biomass is considered to be a sustainable energy source with significant potentials for replacing electricity and fossil fuels, not at least in the residential sector. However, present wood combustion is a major source of ambient concentrations of hydrocarbons (e.g. VOC and PAH) and particulate matter (PM) and exposure to these pollutants have been associated with adverse health effects. Increased focus on combustion related particulate emissions has been seen concerning the formation, characteristics and implications to human health. Upgraded biomass fuels (e.g. pellets) provide possibilities of more controlled and optimized combustion with less emission of products of incomplete combustion (PIC´s). For air quality and health impact assessments, regulatory standards and evaluations concerning residential biomass combustion, there is still a need for detailed emission characterization and quantification when using different fuels and combustion techniques.

Fonte: INEMAR.EU

	PM10 g/GJ	NOx g/GJ	COV g/GJ	SO2 g/GJ	CO g/GJ	CO2 fossile kg/GJ
Camino aperto tradizionale	500	100	2800	13	5600	–
Stufa tradizionale a legna	250	100	1100	13	5600	–
Camino chiuso o inserto	250	100	1100	13	5600	–
Stufa o caldaia innovativa	150	60	550	13	2300	–
Stufa automatica a pellet o cippato o BAT* legna	**70**	**100**	**110**	**13**	**1100**	–
Sistema BAT* pellet	**30**	**60**	**60**	**13**	**620**	–
Metano	**0.2**	**38**	**5**	**0.5**	**25**	**55**
Gasolio	5	60	3	100	20	74
GPL	0.2	60	2		10	64

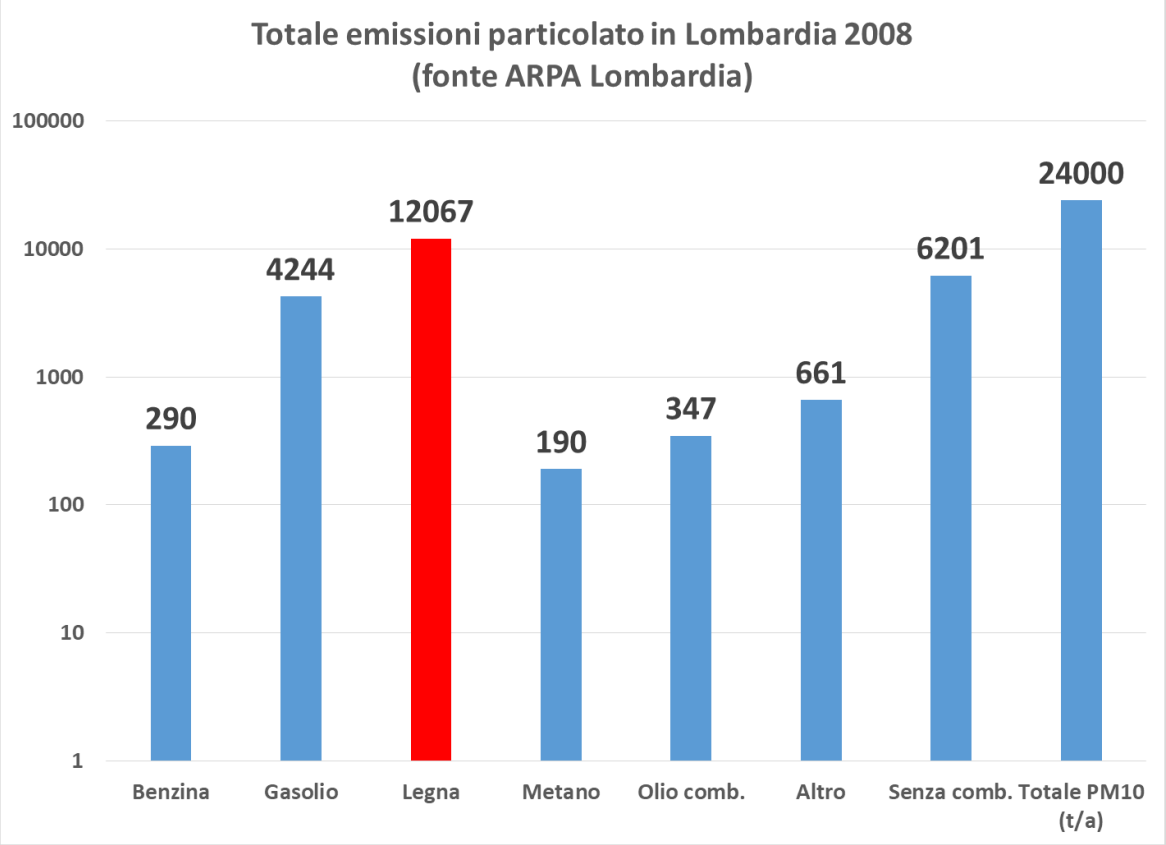
*: BAT – Best Available Technology

Joule = 1 Watt/sec

1 Kw = 3.600.000 Joule

1 metro cubo di metano sviluppa circa 10 kWh di potenza

1kg di pellet sviluppa circa 4,8 kWh di potenza



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Indoor exposure to particles emitted by biomass-burning heating systems and evaluation of dose and lung cancer risk received by population.

Stabile L[1], Buonanno G[2], Avino P[3], Frattolillo A[4], Guerriero E[5].
Environ Pollut. 2018 Apr;235:65-73. doi: 10.1016/j.envpol.2017.12.055. Epub 2017 Dec 21.
Author information
Abstract

Homes represent a critical microenvironment in terms of air quality due to the proximity to main particle sources and the lack of proper ventilation systems. Biomass-fed heating systems are still extensively used worldwide, then likely emitting a significant amount of particles in indoor environments. Nonetheless, research on biomass emissions are limited to their effects on outdoor air quality then not properly investigating the emission in indoor environments. To this purpose, the present paper aims to evaluate the exposure to different airborne particle metrics (including both sub- and super-micron particles) and attached carcinogenic compounds in dwellings where three different heating systems were used: open fireplaces, closed fireplaces and pellet stoves. Measurements in terms of particle number, lung-deposited surface area, and PM fraction concentrations were measured during the biomass combustion activities, moreover, PM_{10} samples were collected and chemically analyzed to obtain mass fractions of carcinogenic compounds attached onto particles. Airborne particle doses received by people exposed in such environments were evaluated as well as their excess lung cancer risk. Most probable surface area extra-doses received by people exposed to open fireplaces on hourly basis (56 $mm^2 h^{-1}$) resulted one order of magnitude larger than those experienced for exposure to closed fireplaces and pellet stoves. Lifetime extra risk of Italian people exposed to the heating systems under investigation were larger than the acceptable lifetime risk (10^{-5}): in particular, the risk due to the open fireplace (8.8×10^{-3}) was non-negligible when compared to the overall lung cancer risk of typical Italian population

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Environ Pollut. 2017 Dec;231(Pt 2):1265-1273. doi: 10.1016/j.envpol.2017.08.087. Epub 2017 Sep 22.

Emission factors of polycyclic and nitro-polycyclic aromatic hydrocarbons from residential combustion of coal and crop residue pellets.

Yang X[1], Liu S[2], Xu Y[1], Liu Y[3], Chen L[3], Tang N[4], Hayakawa K[4].
Author information
Abstract

Polycyclic aromatic hydrocarbons (PAHs) and nitro-polycyclic aromatic hydrocarbons (NPAHs) are toxic pollutants mainly produced during fossil fuel combustion. Domestic coal stoves, which emit large amounts of PAHs and NPAHs, are widely used in the Chinese countryside. In this study, emission factors (Efs) for 13 PAH species and 21 NPAH species for four raw coal (three bituminous and one anthracite), one honeycomb briquette, and one crop residue pellet (peanut hulls) samples burned in a typical Chinese rural cooking stove were determined experimentally. The PAH and NPAH Efs for the six fuels were 3.15-49 mg/kg and 0.32-100 μg/kg, respectively. Peanut hulls had very high Efs for both PAHs and NPAHs, and honeycomb briquettes had the lowest Efs. 2-Nitropyrene and 2-nitrofluoranthene, which are NPAHs typically found in secondary organic aerosol, were detected in the emissions from some fuels, suggesting that chemical reactions may have occurred in the dilution tunnel between the flue gas leaving the stove

and entering the sampler. The 1-nitropyrene to pyrene diagnostic ratios for coal and peanut hulls were 0.0001 ± 0.0001 and 0.0005, respectively. These were in the same order of magnitude as reference ratios for emissions during coal combustion. The 6-nitrobenzo[a]pyrene to benzo[a]pyrene ratios for the fuels were determined, and the ratios for coal and peanut hulls were 0.0010 ± 0.0001 and 0.0014, respectively. The calculated potential toxic risks indicated that peanut hull emissions were very toxic, especially in terms of NPAHs, compared with emissions from the other fuels.

KEYWORDS:

Biomass combustion; Diagnostic ratio; Domestic coal combustion; Emission factor; NPAHs; PAHs

Particle-related exposure, dose and lung cancer risk of primary school children in two European countries.

Pacitto A[1], Stabile L[1], Viana M[2], Scungio M[1], Reche C[2], Querol X[2], Alastuey A[2], Rivas I[2], Álvarez-Pedrerol M[3], Sunyer J[3], van Drooge BL[2], Grimalt JO[2], Sozzi R[4], Vigo P[1], Buonanno G[5].
Send to Sci Total Environ. 2018 Mar;616-617:720-729. doi: 10.1016/j.scitotenv.2017.10.256. Epub 2017 Oct 28.

Author information

Abstract

Schools represent a critical microenvironment in terms of air quality due to the proximity to outdoor particle sources and the frequent lack of proper ventilation and filtering systems. Moreover, the population exposed in schools (i.e. children) represents a susceptible population due to their age. Air quality-based studies involving students' exposure at schools are still scarce and often limited to mass-based particle metrics and may thus underestimate the possible effect of sub-micron particles and particle toxicity. To this purpose, the present paper aims to evaluate the exposure to different airborne particle metrics (including both sub- and super-micron particles) and attached carcinogenic compounds. Measurements in terms of particle number, lung-deposited surface area, and PM fraction concentrations were measured inside and outside schools in Barcelona (Spain) and Cassino (Italy). Simultaneously, PM samples were collected and chemically analysed to obtain mass fractions of carcinogenic compounds. School time airborne particle doses received by students in classrooms were evaluated as well as their excess lung cancer risk due to a five-year primary school period. Median surface area dose received by students during school time in Barcelona and Cassino resulted equal to 110mm^{2}and 303mm^2, respectively. The risk related to the five-year primary school period was estimated as about 2.9×10^{-5} and 1.4×10^{-4} for students of Barcelona and Cassino, respectively. The riskin Barcelona is slightly higher with respect to the maximum tolerable value (10^{-5}, according to the U.S. Environmental Protection Agency), mainly due to toxic compounds on particles generated from anthropogenic emissions (mainly industry). On the other hand, the excess lung cancer risk in Cassino is cause of concern, being one order of magnitude higher than the above-mentioned threshold value due to the presence of biomass burning heating systems and winter thermal inversion that cause larger doses and great amount of toxic compounds on particles.

KEYWORDS:

Airborne particle dose; Exposure; Lung cancer risk; Schools; Ultrafine particles

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Lung cancer risk from PAHs emitted from biomass combustion.

Sarigiannis DA[1], Karakitsios SP[2], Zikopoulos D[3], Nikolaki S[3], Kermenidou M[3].

Environ Res. 2015 Feb;137:147-56. doi: 10.1016/j.envres.2014.12.009. Epub 2014 Dec 23.

Author information

Abstract

This study deals with the assessment of the cancer risk attributable to PAH exposure, attributable to the increased use of biomass for space heating in Greece in the winter of 2012-2013. Three fractions of particulates (PM1, PM2.5 and PM10) were measured in two sampling sites (urban/residential and traffic-influenced) followed by chemical analysis of 19 PAHs and levoglucosan (used as a biomarker tracer). PAH-induced lung cancer risk was estimated by a comprehensive methodology that incorporated human respiratory tract deposition modelling in order to estimate the toxic equivalent concentration (TEQ) at each target tissue. This allowed us to further differentiate internal exposure and risk by age groups. Results showed that all PM fractions are higher in Greece during the cold months of the year, mainly due to biomass use for space heating. PAH and levoglucosan levels were highly correlated, indicating that particles emitted from biomass combustion are more toxic than PM emitted from other sources. The estimated lung cancer risk was non-negligible for residents close to the urban background monitoring site. Higher risk was estimated for infants and children, due to the higher bodyweight normalized dose and the human respiratory tract (HRT) physiology. HRT structure and physiology in youngsters favor deposition of particles that are smaller and more toxic per unit mass. In all cases, the estimated risk (5.7E-07 and 1.4E-06 for the urban background site and 1.4E-07 to 5.0E-07 for the traffic site) was lower to the one estimated by the conventional methodology (2.8E-06 and 9.7E-07 for the urban background and the traffic site respectively) that is based on Inhalation Unit Risk; the latter assumes that all PAHs adsorbed on particles are taken up by humans. With the methodology proposed herein, the estimated risk presents a 5-7 times difference between the two sampling sites (depending on the age group). These differences could not have been identified had we relied only on conventional risk assessment method. Consequently, the actual cancer risk attributable to PAHs on PM emitted from biomass burning would have been significantly underestimated.

KEYWORDS:

Biomass burning; Children susceptibility; Human respiratory tract deposition modeling; Internal dose; Lung cancer risk; PAH exposure

PMID:25543545

DOI:10.1016/j.envres.2014.12.009

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