Phthalic acid esters and polycyclic aromatic hydrocarbons in household dust

Estela Domingos Vicente[1], Ana Vicente[1], Teresa Nunes[1], Ana Calvo[2], Carlos del Blanco-Alegre[2], Fernanda Oduber[2], Amaya Castro[2], Roberto Fraile[2], Fulvio Amato[3], Xavier Querol[3], Célia Alves[1]

[1]Centre for Environmental and Marine Studies, Department of Environment and Planning, University of Aveiro, Aveiro 3810-193, Portugal
[2]Department of Physics, IMARENAB University of León, 24071 León, Spain
[3]Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, 08034, Spain

Keywords: Household dust, PAEs, PAHs, PM_{10}, Total carbon
Contact: celia.alves@ua.pt

Introduction

Household dust is a complex mixture of particles of both indoor and outdoor origin, including organic, inorganic and biological particles (Naspinski et al., 2008). Its composition depends on numerous conditions, such as environmental and seasonal factors, ventilation and air filtration, homeowner activities, and indoor and outdoor sources (Maertens et al., 2004). Residential dust is recognized as a major source of environmental contaminants, including polycyclic aromatic hydrocarbons (PAHs) and phthalic acid esters (PAEs) (Roberts et al., 2009).

Methods

To assess and characterize household dust, a sampling campaign was carried out in four Spanish (León) households. In each housing unit, three rooms were investigated (kitchen, living room and bedroom). Two samples were collected in each room with, at least, a one-week interval. For dust collection a field resuspension chamber, operating at 25 L min^{-1}, was used (Amato et al., 2011). PM_{10} was separated from the total dust through a Negretti stainless steel elutriation filter and collected onto 47 mm quartz fiber filters (Pallflex®). The sampling was performed in surface areas of 1 m^2 for 30 minutes. Two to three different square meters were sampled using the same filter to ensure enough particulate mass for the subsequent gravimetric and chemical analyses. After gravimetric determination, two punches (9 mm) of the filters were analysed by a thermo-optical transmission technique to obtain the PM_{10} carbonaceous content. The remaining portion of each filter was extracted by sonication for 15 minutes with three aliquots (25 mL each) of dichloromethane and analysed by gas chromatography-mass spectrometry.

Conclusions

The highest dust loads were observed in rugs. Regarding hard floorings, heavier dust loads were observed in general for parquet flooring compared with tile. Total carbon contribution to the PM_{10} mass ranged from 9.3 to 75%wt with the highest mass fractions usually recorded in dust samples collected in kitchens. Total PAE (Σ8) contribution to the settled dust mass varied from 0.099 to 20.9 ng/µg PM_{10}. Bis(2-ethylhexyl) phthalate (DEHP n.d.–9.42 ng/µg PM_{10}) and di-n-butyl phthalate (DnBP 0.00–10.2 ng/µg PM_{10}) were the major phthalates in the household dust. DnBP has been reported to be largely present in cosmetic and personal care products (Koniecki et al., 2011), while DEHP was the most abundant phthalate compound found in food products and packaging materials (Fierens et al., 2012). PAHs had a smaller fractional contribution to indoor dust (Σ_{20}PAH 0.005-0.411 ng/µg PM_{10}). The main PAHs contributing to the household dust mass were pyrene (n.d.–0.089 ng/µg), and retene (n.d.–0.082 ng/µg). Although the highest dust loads were recorded for rugs, PAEs and PAHs had the lowest contributions to the total dust levels compared to the ones recorded in hard floorings. This preliminary study provides a first insight on the occurrence of PAEs and PAHs in dust samples from Spanish households. Considering that people spend most of their time indoors, exposure to these pollutants might lead to an increased human health risk.

Thanks are given to the Portuguese Foundation of Science and Technology (FCT) and POHP/FSE funding program for the fellowship SFRH/BD/117993/2016. Ana Vicente is funded by national funds (OE), through FCT, I.P., in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19.

Amato, F., Pandolfi, M., Viana, M., Querol, X., Alastuey, A., Moreno, T. (2009). Atmos. Environ., 43, 1650–1659.

Fierens, T., Servaes, K., Van Holderbeke, M., Geerts, L., De Henauw, S., Sioen, I., Vanermen, G. (2012). Food Chem. Toxicol., 50, 2575–2583.

Koniecki, D., Wang, R., Moody, R.P., Zhu, J. (2011). Environ. Res., 111, 329–336.

Maertens, R.M., Bailey, J., White, P.A. (2004). Mutat. Res. - Rev. Mutat. Res., 567,401–425.

Naspinski, C., Lingenfelter, R., He, L.Y., Cizmas, L., Naufal, Z., Islamzadeh, A., Li, Z., Li, Z., Donnelly, K.C., McDonald, T. (2008). Environ. Int., 34, 988–993.