Indoor particles collected passively in urban and rural primary schools of Portugal

N. Canha[1], S.M. Almeida[1], M.C. Freitas[1], H.T. Wolterbeek[2]

[1] URSN, IST/ITN, Instituto Superior Técnico, Universidade Técnica de Lisboa
Polo de Loures - Campus Tecnológico e Nuclear, E.N. 10, 2686-953 Sacavém, Portugal
[2]Department of Radiation, Radionuclides and Reactors, Faculty of Applied Sciences, Delft University of Technology, Mekelweg 15, 2629 JB Delft, The Netherlands
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Presenting author email: nunocanha@ctn.ist.utl.pt

Over the last decade, several studies have been conducted to assess the indoor air quality in schools since its importance concerning health, performance and attendance of students have been demonstrated. In fact, children spend most of their time in indoor environments which conducts to a higher exposure to indoor pollutants than outdoor ones. By the other hand, children breathe higher volumes of air relative to their body weights and have a lower capacity to deal with toxic chemicals, which consequently enhances their susceptibility to potential health consequences due to the indoor air contaminants.

This study focuses on the application of a new passive methodology to collect particulate matter in classrooms of primary schools since there are some disadvantages of active samplers, such as: 1) the need of expensive equipment and additional accessories (power supply, air-flow meters and pump); 2) interference with the activities of the classrooms, due to the noise of the equipments; and 3) not convenient or feasible for use in remote areas or to do a simultaneous sampling on a great number of sites.

A passive sampling methodology was applied to collect particulate matter (PM) in classrooms of urban and rural primary schools. Shortly, particles were collected by passive deposition in polycarbonate filters exposed inside the classrooms. The sampling was carried out for 1 year, which allowed to study the seasonal variability of the particles, concerning their masses and chemical content.

Figure 1. Location of the studied primary schools in the urban (left) and rural (right) clusters.

The chemical characterization of the collected particles was conducted to assess the soluble ions content (by ion chromatography and atomic absorption spectrometry) and their elemental composition (by instrumental neutron activation analysis). To identify main polluting sources, correlations between parameters and enrichment factors were studied.

Autumn revealed the higher particle masses concentration among all seasons.

Table 1. Mean values of the particles concentration collected in the studied primary schools over the sampling seasons.

	Particles Concentration (µg.day^{-1}.cm^{2})	
Season	Urban	Rural
Autumn	1.54 ± 0.74	n.a.
Winter	1.49 ± 0.58	1.35 ± 0.73
Spring	1.05 ± 0.38	1.22 ± 0.32
Summer	0.27 ± 0.20	0.14 ± 0.14

The major element in the collected particles was calcium, representing 59 to 64% of the analyzed mass of the particles inside the urban classrooms when the students were attending. In the rural cluster, calcium remained the major component but with a slight lower contribution to the overall particles composition (42 to 29%).

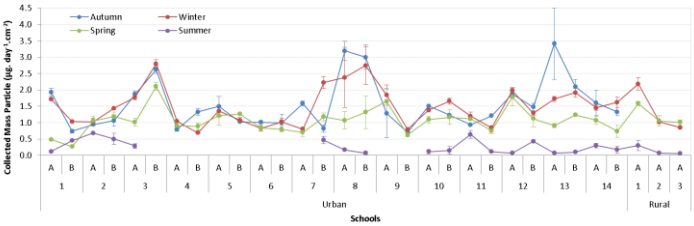

Figure 1. Seasonal variability of particles concentration over the studied clusters.

The calcium source was the chalk used in the blackboards of the classrooms since a strong correlation between Ca^{2+} and SO_4^{2-} was found. Soil re-suspension, traffic and other anthropogenic emission sources could be identified. Enrichment of the particles with Br, Ca, Zn and Sb was found in the urban cluster while in the rural cluster it was found enrichment for the same elements, except for Ca. The comparison between the results of the schools from both clusters allowed to identify classrooms with higher particles concentrations that can indicate potential indoor air quality problems (reflected by an indoor accumulation of pollutants).

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