Comparative study of indoor aerosols collected at educational institutions: kindergarten, elementary school, and secondary grammar school.

Z. Szoboszlai[1], E. Furu[1,2], A. Angyal[1], Zs. Török[1,2] and Zs. Kertész[1]

[1]Institute for Nuclear Research, Hungarian Academy of Sciences (ATOMKI), Debrecen, H-4001, P.O Box 51., Hungary
[2]University of Debrecen, Debrecen, H-4032, Egyetem tér 1, Hungary
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Presenting author email: szoboszlai.zoltan@atomki.mta.hu

In Hungary everybody is required to attend to a sort of educational institution between 6 and 18 years of age. This means that an average schoolchild is in a limited space at least six to eight hours a day. It is well known that the exposure to particulate matter (PM) during school-age, when children are in their growing stage, can have lifelong adverse effects on their health. Because of these facts, it is particularly important to better investigate the air parameters of scholastic environments.

The goal of the present study is to characterize and compare the concentration, elemental composition and mass size distribution of particle matter sampled in a heating and non-heating season in three educational institutes in the centre of Debrecen, Hungary. Two schools (a primary and a secondary grammar) and a kindergarten were selected. The sampling campaigns were carried out during teaching ours i.e. from 8 am to 4-6 pm in the following microenvironments: different classrooms, school yards, gymnasiums, a computer lab, a chemical lab, a director's office and a so-called salt-room. Outdoor aerosol collection was carried out at the same time in the yards of the institutions.

The elemental compositions of the samples were measured by particle induced X-ray emission (PIXE) method in the IBA Laboratory of ATOMKI. Macro-PIXE was used to determine the elemental composition (for $Z \geq 13$) and elemental mass size distributions of bulk samples. Moreover single particle analysis was performed with micro-PIXE and scanning electron microscopy (SEM) at the ATOMKI. On the basis of the obtained data, the total and regional deposition efficiencies of the different types of particles within the human respiratory system were also calculated by using a stochastic lung deposition model.

In our previous study (Szoboszlai, 2011), carried out in a heating season (2009/2010) in the three educational institutions, we found high concentration of coarse aerosols and showed that the concentration increased in the lower educational levels. In the non-heating season (2010), we found that the concentrations followed the trend which was observed in the heating season ($C_{kindergarden.} > C_{primary\ school} > C_{secondary\ school}$) but the amount of the PM concentration was lower than in the heating season (Fig. 1.). We also found that the concentrations of coarse aerosols were higher inside the institutions than in outdoor in the non-heating season. On the basis of elemental concentration, we observed that most part of the PM mass inside the institutions is originated from the crust and transported from outdoors through the windows and foot transport in all seasons. Minor part of the PM is derived from local indoor sources, such as detergents, chalk, building materials, magnesia powder, and chemical reactions from the chemistry laboratory.

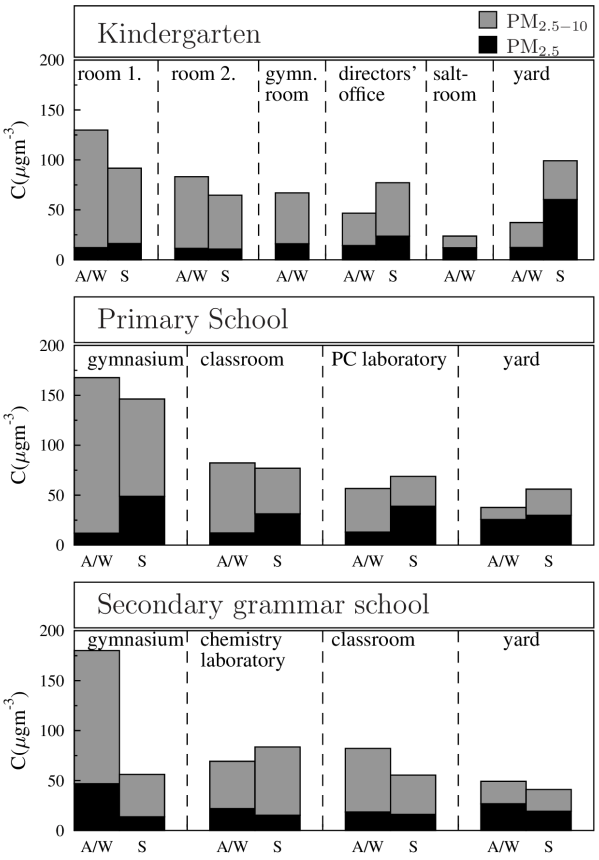

Figure 1. $PM_{2.5}$ and $PM_{2.5-10}$ average concentrations in 3 educational institutions of Debrecen. (A/W= autumn/winter, S=summer)

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