COMPARING THE ELEMENTAL CONCENTRATION OF AEROSOLS FROM URBAN AND RURAL AREAS WITH APPLYING THE CALCULATION OF STOCHASTIC LUNG MODEL

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INTRODUCTION

The Stochastic Lung Model [1,2] is a new important tool for the investigation of the health impact of atmospheric aerosols. This model has already been applied for urban aerosols [3], cave aerosols [4,5], and radon progeny [6,7] deposition. The aim of this work was to compare the elemental concentrations of urban and rural aerosols and apply the Stochastic Lung Model for lung deposition calculations.

METHODS

Atmospheric aerosol samples were collected in a sampling campaign from 24 July to 1 August, 2003 in Hungary. Collection was performed in two places simultaneously: in Budapest as crowded city and K-puszta as remote area. Two PIXE International 7-stage cascade impactors were used for aerosol sampling with 24 hours duration. These impactors separate the aerosol into 7 size ranges.

Table 1. Impactor size ranges

Stage	1	2	3	4	5	6	7
Size range (μm)	0.25-0.5	0.5-1	1-2	2-4	4-8	8-16	>16

The elemental concentrations of the samples were obtained by proton-induced X-ray Emission (PIXE) analysis. Distribution of elemental concentrations were determinated in case of K-puszta (K-p) and Budapest (Bp). Particularly the S, Si, Ca, W, Zn, Pb and Fe elements were investigated. From the obtained distributions, the average rate of the elemental concentrations was calculated for each stage.

Table 2. The average rate of the elemental concentration for each stage in %

	Fe		S		Si		Ca		Zn		Pb		W	
Stage	K-p	Bp	K-p	Bp	K-p	Bp	K-p	Bp	K-p	Bp	K-p	Bp	K-p	Bp
1	4.6	4.4	**45.6**	**62.2**	3.7	2.2	0.5	0.9	14.5	***19.6***	**26.2**	**43.1**	-	**37.3**
2	12.5	5.6	**32.3**	**20.9**	8.3	4.8	2.2	1.8	**28.8**	***14.7***	**40.8**	**16.2**	-	**12.0**
3	**24.3**	16.6	12.1	5.4	**28.6**	12.9	22.3	9.3	**25.4**	***19.4***	16.7	14.2	-	11.2
4	**30.2**	**35.2**	3.7	4.8	**24.0**	**30.5**	**36.9**	**32.0**	15.8	***18.0***	7.5	9.2	-	13.9
5	**21.6**	**31.3**	2.8	5.2	**19.5**	**36.1**	**34.9**	**43.0**	10.1	***18.4***	4.7	10.5	-	10.8
6	3.3	6.4	1.6	1.4	8.0	11.2	1.7	12.5	3.0	8.3	0.8	4.4	-	8.4
7	3.6	0.5	1.8	0.1	7.9	2.4	1.6	0.6	2.5	1.7	3.3	2.4	-	6.3

The health effects of the inhaled particles may strongly depend on the location of deposition within the lung. The Stochastic Lung Model was applied in order to calculate the deposition efficiencies of the measured aerosols in the tracheo-bronchial and the acinar regions of human respiratory system.

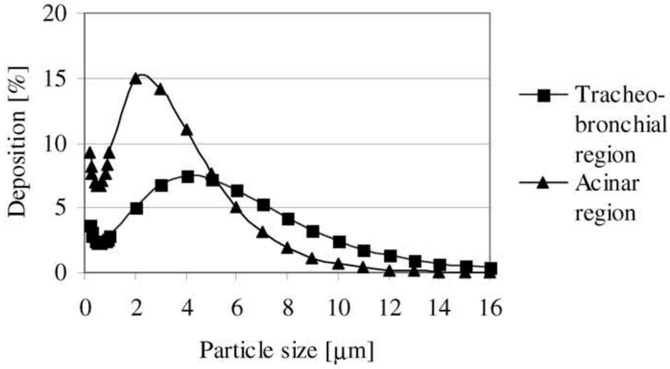

Figure 1. Deposition probabilities of the measured aerosols in the bronchial and acinar regions of the lung.

Inspection of Fig. 1 demonstrates that the acinar deposition has a maximum at 1-3 µm particle size and above 10 µm the particles practically do not reach the acinar region at sitting breathing conditions.

CONCLUSIONS

The elements can be grouped on the basis of Table 2. The first group was constituted Fe, Si and Ca. These elements can be found in 2-8 µm size range with the largest rate. The deposition of these elements has the largest probability in acinar region. The elemental concentrations in Budapest are much larger than in K-puszta. Thus, the acinar deposition of particles containing Fe, Si and Ca is relatively more significant in Budapest than in K-puszta. The second group was constituted S, Pb and W. The majority of these elements in the 0,25-1 µm size range. These elements also deposit in acinar region, but with less probability. Because their particles have large concentration they can also deposit in large amount. The behaviour of Zn is different and does not belong to any group. Zn has uniform distribution in Budapest.

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