Distribution of Mercury in Surface Dust End Topsoil in Slovenian Rural and Urban Areas

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Abstract: The aim of this study was to establish contents and distribution of mercury in surface dust in Slovenia, and to define them according to geology and anthropogenic influence. Sampling locations in the rural area of Slovenia were set within settlements with less than 2000 inhabitants and without known pollution, and in six largest towns in Slovenia. The distribution of mercury in all used materials shows a strong Hg anomaly in the south-western part of Slovenia. The Hg distribution pattern is the result of the impacts of the Hg ore deposit, mine and mercury smelter in Idrija. The use of Hg rich blasting material used in the WW I had also contributed to the heightened contents of Hg, especially in the Soča Valley. The highest contents of Hg in sampling materials collected in town centres were determined in the samples from the Koper area. The causes for those high concentrations were Hg rich sediments brought to the Bay of Trieste by the Soča River. High Hg contents in the area of Jesenice show the impact of metallurgic industry.

Key words: mercury, pollution, dwelling dust, soil, Slovenia

INTRODUCTION

Attic dust is a substance that is formed mostly by sedimentation of small particles onto exposed surfaces. Its formation is influenced by numerous factors, such as concentration of particles in the air, precipitations and the processes of condensation, in urban environments also weathering of building materials, soil and street dust and mostly human activities. According to FERGUSSON[4] 40 to 50 % is contributed by weathering of soils, 3-5 % by fossil fuels combustion, and 10-15 % by transport emissions. The remaining part is contributed by other less important sources.

Surface dust can be divided into street dust, which is dust deposited in the open air, and dwelling dust (household and attic dust). Street dust is a typical product of urban environment. Its composition changes as to climatic conditions and time. Dust that can be found exclusively in rooms in which people actually spend their time is called household dust. The composition of that type of dust depends strongly on habits and types of activity of the inhabitants [5]. Attic dust represents dust deposited in abandoned attics, so that influence of inhabitants is minimized. Attic dust originates predominantly from external sources and less from household activities [9, 10].

RESULTS AND DISCUSSION

Sampling locations in the rural area of Slovenia were set within settlements with less than 2000 inhabitants and without known industry or pollution, following the scheme developed by PIRC[7], and in six largest towns in Slovenia: Celje, Jesenice, Koper, Ljubljana, Maribor and Novo Mesto. 269 samples of street, household, attic dust and topsoil (0-5 cm) were collected [9, 10].

Soil was sampled from the surface to the depth of 5 cm; the possible organic horizon was excluded. Within towns, we sampled urban soil such as soil in the gardens and on the grass verges. We collected the sample of street dust by sweeping dips in pavements and along curbs. The sample was a composite of about 20 subsamples. The sample of household dust was a composite of the contents of sacks from vacuum cleaners, which were used exclusively in households. The attic dust samples were brushed from wooden constructions that were not in immediate contact with roof tiles or floors. Buildings as old as possible were selected for sampling locations [9, 10]. All samples were air-dried. A fraction smaller than 0.125 mm was prepared for the chemical analyses by sieving. Soil samples were gently crushed, then fraction smaller than 2 mm was pulverised. Hg was determined with CV-AAS after aqua regia digestion.

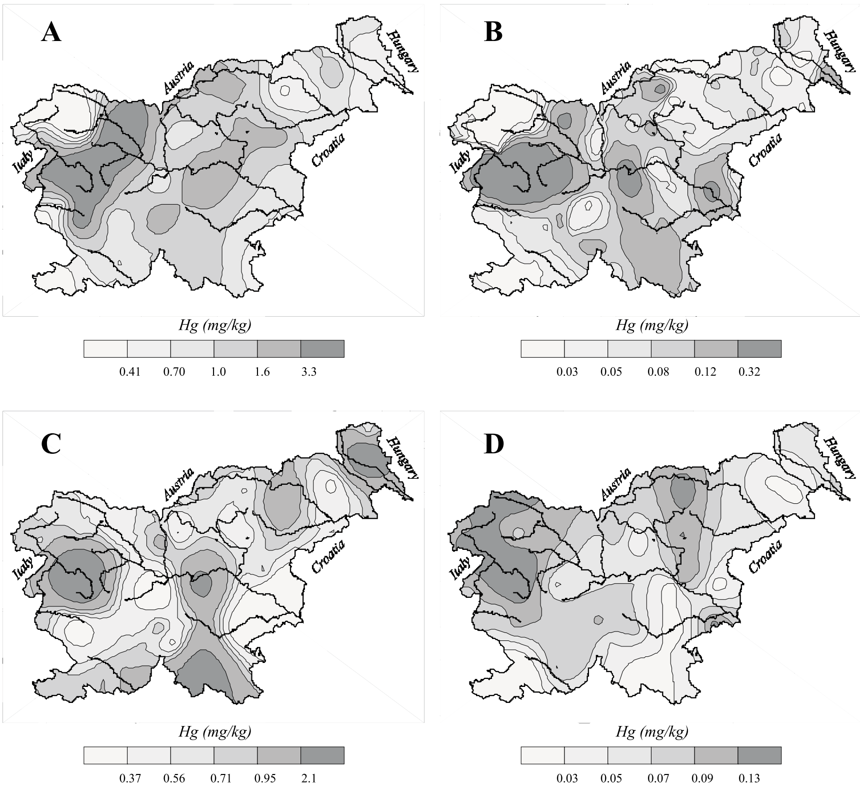

Figure 1. Areal distribution of mercury in attic dust[10] (A), household dust[9] (B), overbank sediment [9] (C) and topsoil[10] (D) in Slovenia

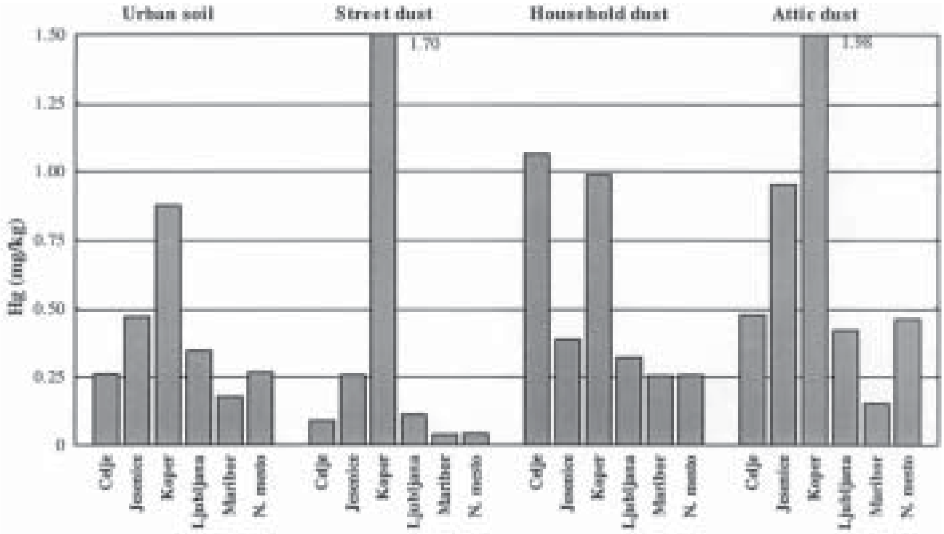

Figure 2. Distribution of mercury in sampling materials of Slovenian towns[9]

According to BOWEN[2], a clarke of Hg distribution in unpolluted soils is 0.06 mg/kg and oscillates between 0.01 and 0.05 mg/kg. In the Slovenian countryside, the estimated median of the contents of Hg in soils is 0.07 mg/kg. The samples of household (0.69 mg/kg) and attic dust (1.03 mg/kg) showed the highest medians. The samples collected in town centres showed a median of 0.44 mg/kg for household and 0.46 mg/kg for attic dust. It is interesting that the estimated medians in the centres of towns are distinctively lower than the estimated averages for Slovenia.

The distributions of Hg in attic and household dust of the Slovenian countryside agree very well with one another. The same can be determined if they are compared with the distributions of Hg in natural sampling materials such soils[10] and overbank sediment[1]. Samples of all four materials show a strong Hg anomaly in the south-western part of Slovenia (Fig. 1). The Hg distribution pattern is the result of the impacts of the Hg ore deposit, mine and mercury smelter in Idrija [6]. A possible source of Hg can also be natural evaporation from rocks. That source, however, is of secondary importance. The use of Hg rich blasting material used in the WW I had also contributed to the heightened contents of Hg, especially in the Soča Valley[8].

The highest contents of Hg in sampling materials collected in town centres were determined in the samples from the Koper area (Fig. 2). The causes for those high concentrations were Hg rich sediments brought to the Bay of Trieste by the Soča River[3]. High contents of Hg were also determined in the soil and attic dust samples collected in Ljubljana[11]. The mechanisms of Hg enrichment of the banks of the Ljubljanica River are hitherto unclear. High Hg contents in the area of Jesenice show the impact of metallurgic industry[12].

CONCLUSIONS

The results of our study show a strong resemblance between the distribution of Hg in household and attic dust and natural sampling materials, such as soil and overbank sediments, with the average content of Hg in attic dust being considerably higher. Contrary to our expectation, the Hg content in surface dust was much higher in the Slovenian countryside than in town centres. The only exception was the town of Koper, where relatively high values were found in all sampling materials. An important outcome of our study is also the confirmation of surface dust, especially attic dust, to be a very good and sensitive sampling material for the identification of Hg pollution. Attic dust together with other sampling materials, especially soils, ensures distinctive separation between anthropogenic and natural sources of Hg in the environment

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