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Passive Dust Samplers as More Effective Study Material than Street Dust for Characteristic of Traffic Derived Pollution

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A b s t r a c t

This study covered investigation of properties of street dust collected from 248 sites in Warsaw. The results revealed that magnetic susceptibility (χ) was in the range of 49–$1025 \cdot 10^{-8}$ m^3kg^{-1} and for most locations reflected traffic intensity. The lowest values were obtained for single-lane, suburban streets and recreational areas. The highest values were obtained for high traffic crossroads with traffic lights and along transition roads from center to residential areas. Generally, the results confirmed that street dust is a good proxy of pollution level but isn't universally applicable because complication in estimation how long the enhancement of magnetic fraction and heavy metals concentrations were accumulated on road. Using street dust also requires considering different geological properties. Awareness of these difficulties encouraged us to look for new material devoid of disadvantages. As an alternative we offer tool – "passive dust samplers" effectively accumulates traffic pollution and overcomes street dust imperfections.

Drainage pipes of 20 cm length and diameter of 10 cm were used to construct samplers. In order to obtain the mixture effectively accumulating pollution, sand (coarse and fine) and peat in different proportions were tested (Fig. 1). The best accumulation capacity showed mixture of coarse sand and peat in a 1:1 ratio for which $\chi_{total} = 449 \cdot 10^{-8}$ m^3kg^{-1} was measured after 12 months exposition at high traffic crossroad.

The next stage of study was validation and confirmation of effectiveness of passive samplers in 24 locations and comparison their accumulation capacity with street dust collected at the same sites. The concentration of Fe (Fig. 2a), Zn, Pb, Al, Cd, Co, Cr, Ni, As, Ba and Mn showed the same decreasing trend with depth as χ. Moreover, the correlation between χ and PLI index expressing collective concentrations of heavy metals confirms the effectiveness of developed filling of passive samplers (Fig. 2b).

The temperature changes of induced magnetization (M(T)) curves revealed in samplers and street dust magnetite as the main magnetic phase (Fig. 3a) and in some samples presence of the second magnetic phase identified as metallic iron (Fig. 3b).

The results confirms that passive samplers reflects the degree of pollution and overcomes the street dust disadvantages. We designed, accomplished, optimized and validated a

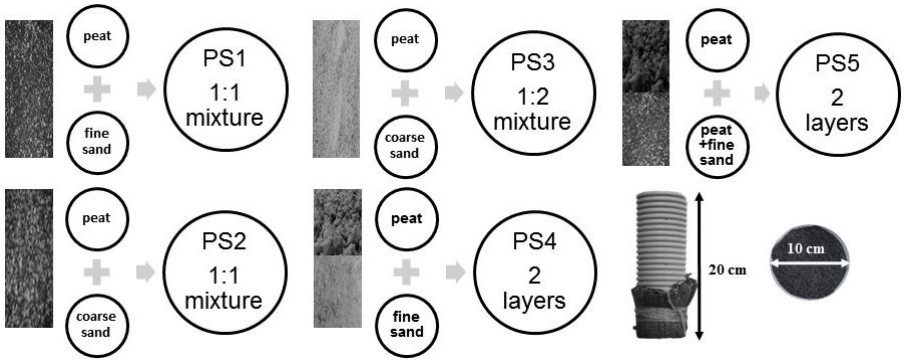

Fig. 1. Five types of tested mixtures and example of prepared sampler.

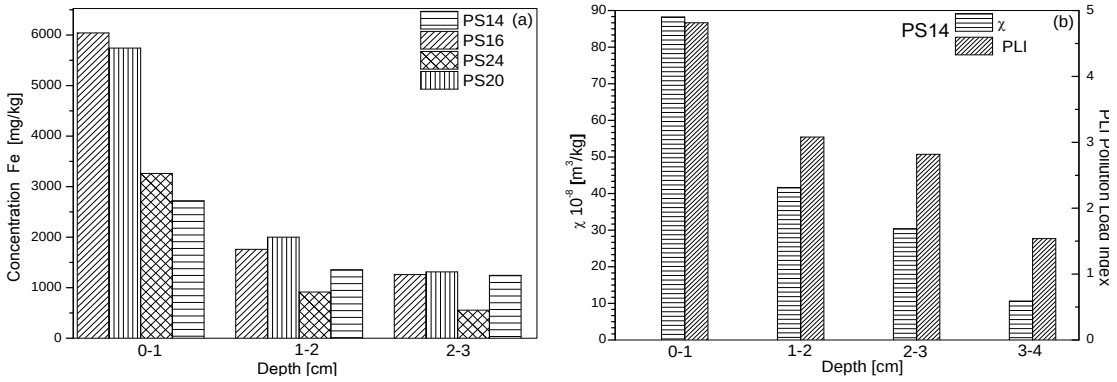

Fig. 2. Depth distribution of Fe concentrations for PS14, PS16, PS20, PS24 (a) and PLI index and χ for PS14 (b).

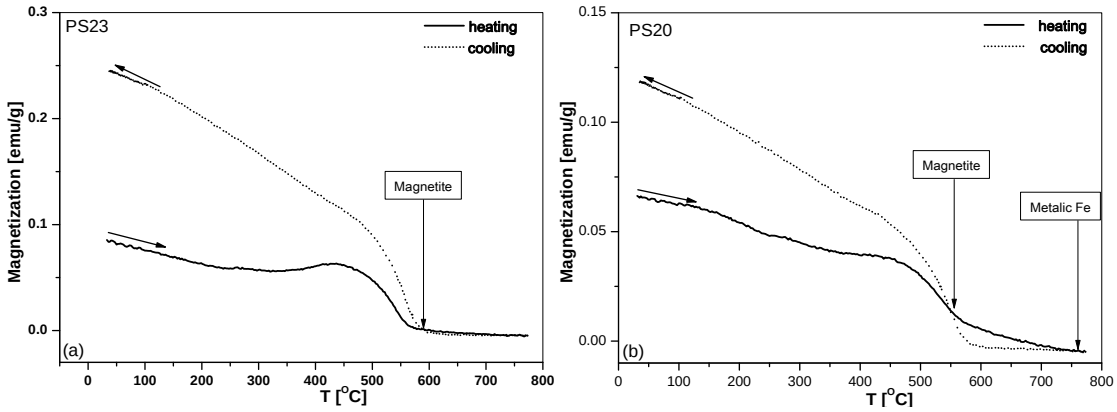

Fig. 3. The curve of M(T) for: PS23 (a) and PS20 (b).

new tool effectively used as a proxy to assess the pollution level. Additionally, we developed effective preparing strategies and experimental protocols for conducting a study using mixture of sand and peat as natural pollution collector.

Keywords: passive dust samplers, street dust, heavy metals, magnetic susceptibility.

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