PCBs IN PINE NEEDLES OF POLAND

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Introduction

An intentional use of polychlorinated biphenyls (PCBs) caused diffusion of this compounds in the environment and toxicological problems [1]. These compounds have been manufactured from 1929 till early the 1990s. Apart from the intentional synthesis also by-side formation of PCBs take place and also causes environmental pollution with this compounds. One of such unintentional sources of PCBs is synthesis of some organochlorine compounds, *e.g*. massively manufactured from ~1910 till the 1970s polychlorinated naphthalenes (PCNs) [2]. Another source of PCBs is thermal reactions like these during combustion or incineration processes [3]. Pine needles collected from a whole territory of Poland in fall 2002 were used to assess possible sources and degree of environmental (ambient air) pollution with PCBs.

Materials and Methods

The one year old pine needles were collected in October 2002 at 25 locations in Poland (Fig. 1). The pine needles were packed in aluminum foil, put in plastic bags and kept frozen at -20 °C until analysis. Subsequently, before Soxhlet apparatus extraction, each pine needles sample was spiked with an internal standard containing a mixture of $^{13}C_{12}$-labeled PCBs (EC-4937, CIL, USA). The internal standard recovery rate was from 71 to 119 %. An extract after concentration was cleaned-up and fractionated using a multi-layer silica gel column chromatography with activated basic alumina, Hypercarb-HPLC and PYE-HPLC. Further separation as well as detection, identification and quantification of PCBs was done by high-resolution gas chromatography (HRGC and high-resolution mass spectrometery (HRMS). Details of analytical procedure are given elsewhere [4]. To identify and quantify di- to octachlorobiphenyls an equivalent mixture of Kanechlor 300, 400, 500 and 600 (1:1:1:1) was used, while for nona- and decachlorobiphenyl an equivalent mixture of the chlorobiphenyl congeners nos. 206, 207, 208 and 209 (1:1:1:1) (Accu Standard, New Haven, CT, USA). Non-, mono- and di-*ortho*PCBs were identified and quantified using a PCB standard kit (EPA 1668PAR; Wellington Laboratories Inc., Ontario, Canada).

Results and discussion

Up to 117 of 206 di- to deca- chlorobiphenyl congeners have been identified in pine needle samples collected. The total PCBs concentration of pine needles at 25 sites ranged from 2.7 to 49 ng/g wet weight. The pine needles at the site 11a (Opole), 8a (Kutno), 4b (Włocławek) and 2b (Człuchów) were relatively more contaminated, while less were these from the sites considered as rural or located relatively far from an industrialized and urbanized regions, *i.e*.: 1a (Dębno), 3a (Kudypy), 5a (Krosno), 5b (Sława Śląska), 6c (Kalisz) and 7b (Siedlce) (Fig. 1). The profiles both of chlorobiphenyl homologue groups and congeners in pine needles varied depending on the location (a selected profiles are presented at the Fig. 2a and 2b). Tetra- (22-39 %) and haxachlorobiphenyls (14-35 %) dominated in chlorobiphenyl

Fig. 1. Location of the sampling sites and level of PCNs of pine needles in Poland.

homologue group's profile, and followed by tri- (5-37 %), penta- (10-29 %), hepta- (5-18 %), octa- (0.5-3 %), nona- (<0.2 %) and decachlorobiphenyl (<0.05 %). Hexachlorobiphenyls nos. 138 and 153 dominated in congener's profile at most of the sites, while at four sites (5b, 7a, 7c and 10b) trichlorobiphenyls nos 28/31 were major constituents (Fig. 2).

The surface layer of the wax, which covers leafs of coniferous trees is in equilibrium (usually rapidly) with airborne hydrophobic contaminants and enables high-quality monitoring of spatial differences and similarities in concentrations between the sampling sites as well as source identification and temporal time-trend of these type of contaminants [5,6]. The data on profiles and concentrations of PCBs in pine needles of Poland did indicate on multiple and still existing sources of ambient air pollution with those compounds. An extent of pine needles contamination with PCBs in this study was highly influenced by location of the sampling site with greater total PCBs concentration observed near some of an industrial and urban regions.

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References

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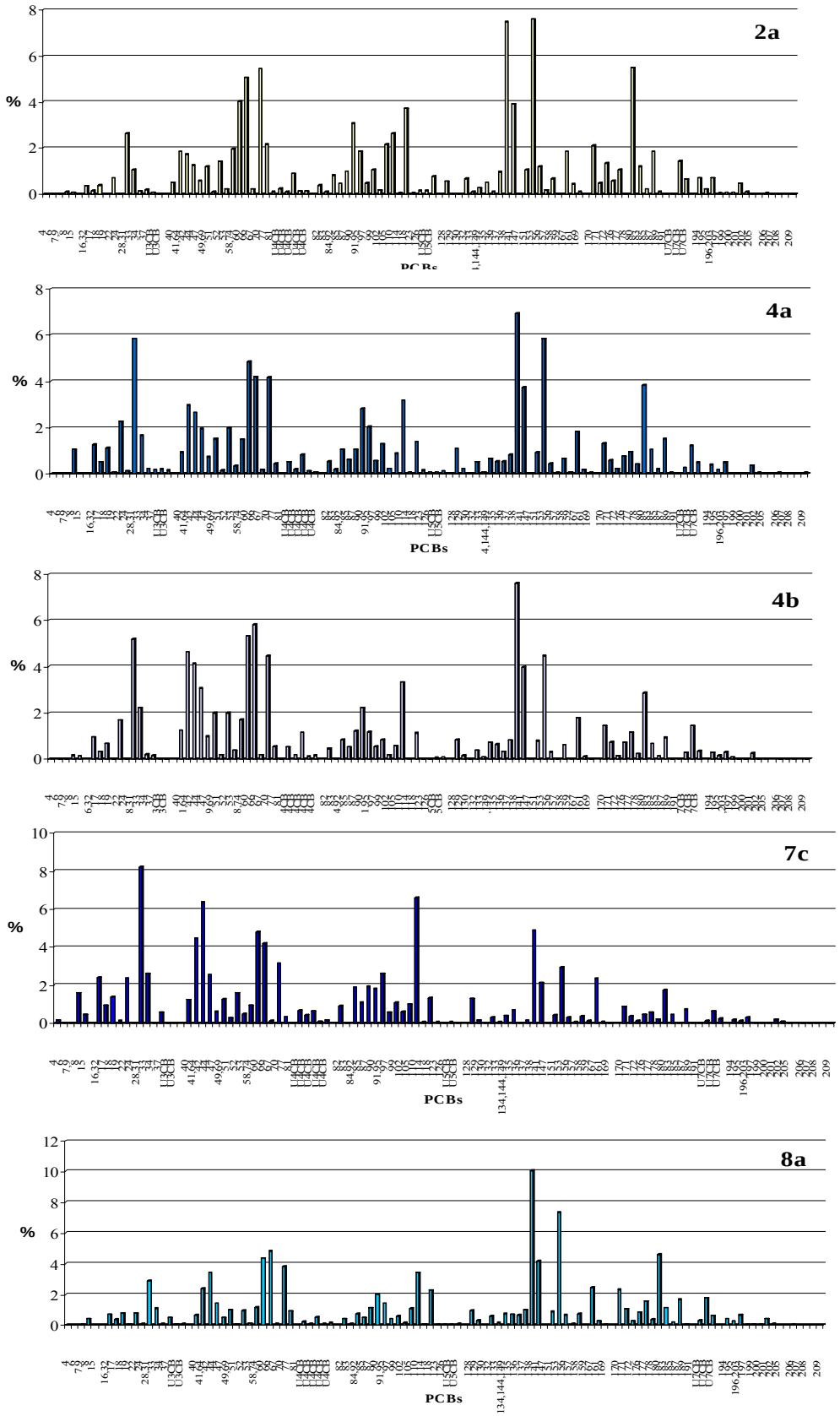

Fig. 2a. Profile (%) of PCBs in pine needles at the sites: Choczewo (2a), Żołędowo (4a), Włocławek (4b), Radom (7c) and Kutno (8a).

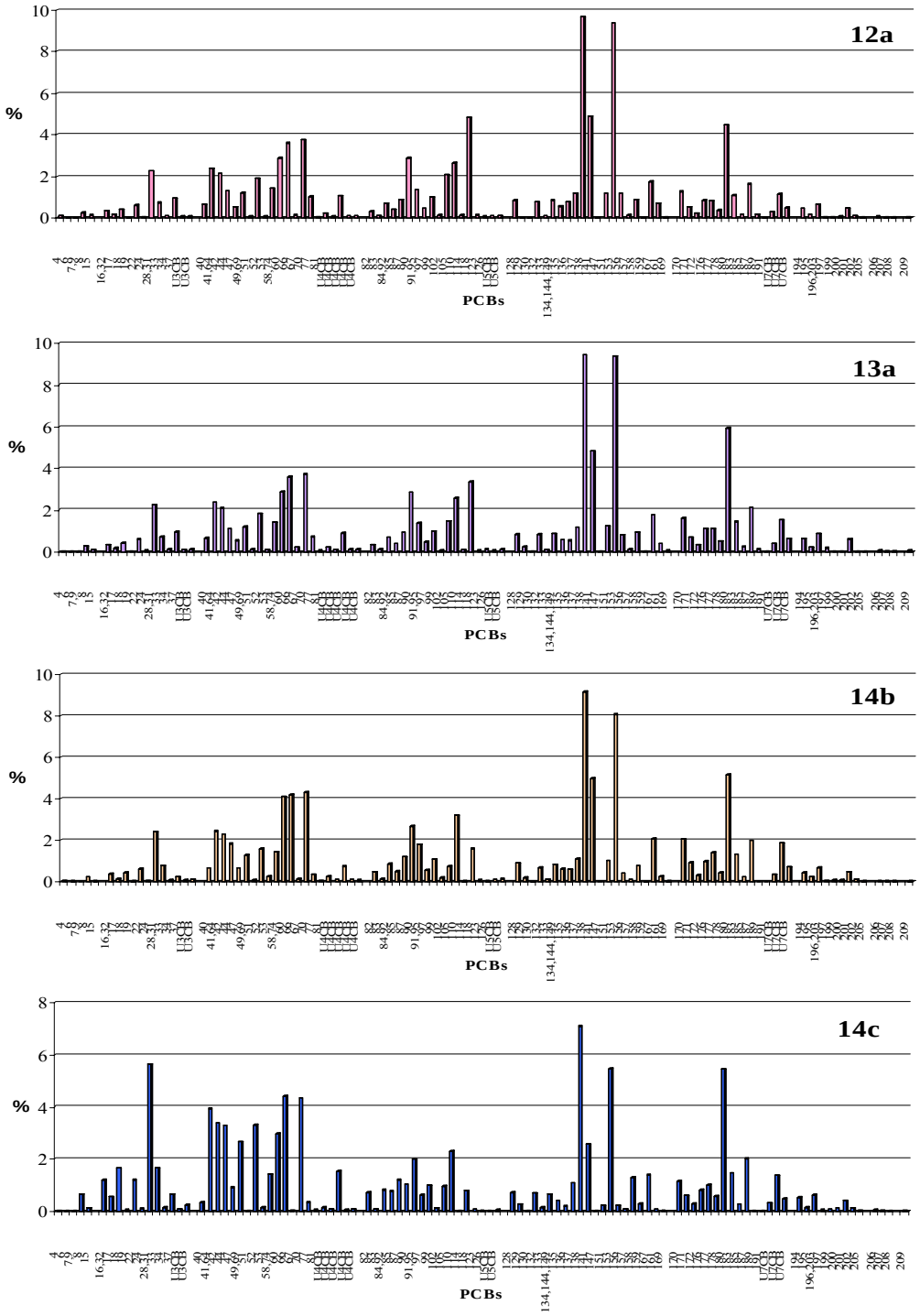

Fig. 2b. Profile (%) of PCBs in pine needles at the sites Jędrzejów (12a), Olkusz (13a), Dębica (14b) and Brzozów (14c).