Asude Hanedar[1]*, Elçin Güneş[1], Gül Kaykioğlu[1], Evren Cabi[2] Determination Of Polychlorinated Biphenils In The Soil, Atmospheric Deposition And Bioindicator Samples In The Meric-Ergene River Basin,Turkey Acta Scientifica Malaysia (ASM) 1(1) (2017) 13-15

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Descriptive statistics of the total PCB concentration values are presented in Table 2. As it is seen, the total PCB values varied between 10-63 ng/g for soil samples at all sampling points, and the highest values were determined in Ind areas. PCB values varied between 10-68 ng/g for lichen samples, and the highest concentrations were measured in the IndR area. It was measured between 11-33 ng/g for pine needle samples, and the highest values were determined in the Agr area. The values varied between 0-144 ng/m²-day for the total deposition samples, and the highest values were measured in the IndR area. For the total PCB values, generally higher values were obtained in the soil samples and the lowest values were observed for pine needle samples. In general, the seasons in which the highest values are obtained for each matrix are Spring 2014 and Winter 2015.

PCB species are also evaluated according to their homolog groups. In Table 3, distributions of homolog groups of measured PCBs are given. The hepta and octa groups were evaluated together. Spatial distributions of determined homolog groups of PCBs are given in Figure 1. In general, heavy PCB species are predominantly determined for all sampling matrices. Maximum concentrations were measured for hepta-octa PCBs in all sampling areas Given the distribution of weights, it can be said that the heavier species are more abundant in industrial areas and the light species are dominant in background areas.

*Bolds are the highest values.

Table 3. Homologue Groups of PCBs

Homologue Groups	Chlorine Number	PCB species
Tri-PCBs	3 Chlorines	PCB118, PCB20, PCB28, PCB31
Tetra-PCBs	4 Chlorines	PCB52, PCB44
Penta-PCBs	5 Chlorines	PCB101, PCB105, PCB118
Hexa-PCBs	6 Chlorines	PCB138, PCB149, PCB153
Hepta-Octa PCBs	7 and 8 Chlorines	PCB170-, PCB180, PCB194

3.1. Cancer Risk Calculation: In the study Incremental Lifetime Cancer Risk (ILCR) were used for evaluation cancer risk according to USEPA methods. ILCR values were calculated for direct ingestion, dermal contact and inhalation routes by these formulas [5, 6, 7].

$$ILCRs_{Ingestion} = \frac{CS \times (CSF_{Ingestion} \times \sqrt[3]{(BW/70)}) \times IR_{soil} \times EF \times ED}{BW \times AT \times 10^6}$$

$$ILCRs_{Dermal} = \frac{CS \times (CSF_{Dermal} \times \sqrt[3]{(BW/70)}) \times SA \times AF \times ABS \times EF \times ED}{BW \times AT \times 10^6}$$

$$ILCRs_{Inhalation} = \frac{CS \times (CSF_{Inhalation} \times \sqrt[3]{(BW/70)}) \times IR_{air} \times EF \times ED}{BW \times AT \times PEF}$$

The determination of carcinogenic slope factor was based on the cancer-causing ability of total

PCBs. $CSF_{Ingestion}$, CSF_{Dermal}, and $CSF_{Inhalation}$ of total PCBs were 2, 2,22 and 2 (mg kg^{-1} d^{-1})$^{-1}$, respectively [8, 9, 10]. The risks for children and adults were calculated separately. The total risks were the sum of risks associated with each exposure route. The variables used in the exposure calculation are given in Table 4. Calculated ILCR values are given in Table 5.

Table 4. Parameters used in the ILCR assessment [7]

Exposure variable	Unit	Child	Adult
Body weight (BW)	kg	15	60
Exposure frequency (EF)	day/year	350	350
Exposure duration (ED)	year	2	7
Inhalation rate (IR$_{air}$)	m³/day	5	20
Soil intake rate (IR$_{soil}$)	mg/day	200	100
Dermal surface exposure (SA)	cm²/day	1800	5000
Dermal adherence (AF)	mg/cm²	0,2	0,2
Dermal adsorption (ABS)	unitless	0,1	0,1
Averaging life span (AT)	year	70	70
Soil dust produce factor (PEF)	m³/kg	1,32	1,32

Tablo 4. ILCRs of three exposure routes for adult and child for total PCBs

Exposure pathways	Children			Adult		
	Ind	IndR	Agr	Ind	IndR	Agr
Direct ingestion	1,62636E-08	7,20495E-09	5,47366E-09	1,12949E-08	5,00375E-09	3,80139E-09
Dermal contact	3,24947E-09	1,43955E-09	1,09364E-09	1,25373E-08	5,55416E-09	4,21955E-09
Inhalation	0,000308023	0,000136457	0,000103668	0,001711344	0,000758144	0,000575968
Total	**3,1x10⁻⁴**	**1,4x10⁻⁴**	**1,0x10⁻⁴**	**1,7x10⁻³**	**7,6x10⁻⁴**	**5,8x10⁻⁴**

In regulatory terms, an ILCR of 10^{-6} or less denotes virtual safety and an ILCR of greater than 10^{-4} denotes potentially high risk [11]. Under calculated exposures, the estimated ILCRs for both adult and child are greater than 10^{-4}. It appeared that the PCBs are pervasive in the sampling areas and cancer risk assessment studies are needed in this sense.

4.Conclusions

In this study, it is aimed to compare pollutants that can come from industrial, residential and agricultural areas in comparison with the reference area in the basin where industrial pollution is known to have a very significant impact. Generally increasing PCB values were clearly observed in industrial areas in the study. PCB concentrations reached the highest values for all matrixes in the 2014 Spring and 2015 winter. The increasing values were clearly observed in soil concentrations. The lowest values in terms of averages were observed in pine needle samples. Generally heavier PCB species more abundant in the sampling area. In general, hepta-octa species (-7 and -8 rings) were predominantly determined for all sampling matrices,
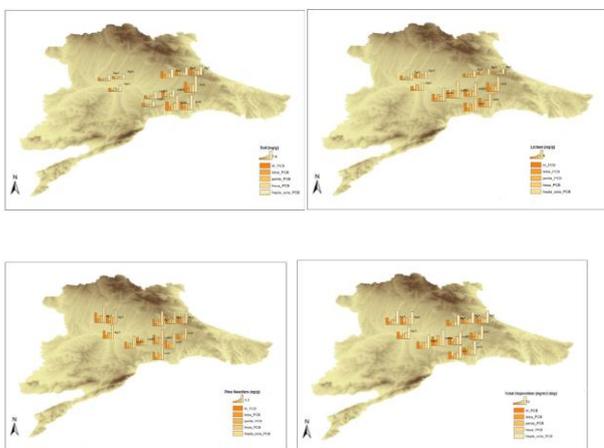
Table 2. Descriptive Statistics for total PCBs*

Sampling Area	Statistics	Σ₁₅PCB			
		Soil	Lichen	Pine Neddles	Total Deposition
		ng/g (dw)			ng/m²-day
Ind n=12	Max.	62,85	48,97	25,24	75,16
	Min.	19,34	17,06	14,21	44,01
	Median	34,77	20,53	18,35	48,28
	Average	37,2	27,47	18,93	54,02
	Std. Dev.	15,55	12,65	3,5	11,09
IndR n=12	Max.	42,19	68,08	32,69	144,44
	Min.	10,39	10,03	13,62	41,08
	Median	13,8	22,64	16,24	47,50
	Average	16,48	25,94	18,65	57,93
	Std. Dev.	8,58	15,84	5,7	28,45
Agr n=12	Max.	16,12	18,95	32,25	87,85
	Min.	9,98	10,27	13,45	41,39
	Median	11,95	13,23	16,62	44,90
	Average	12,52	13,29	20,71	50,06
	Std. Dev.	2,09	2,57	8,08	13,04
Bg n=12	Max.	39,98	15,68	32,82	61,80
	Min.	10,96	6,78	11,35	0,00
	Median	22,97	11,57	13,56	39,78
	Average	23,86	11,24	17,79	39,62
	Std. Dev.	9,43	3,1	7,84	14,70

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and the average value of the total PCB concentration was 38%. It can be said that the concentrations found in industrial areas are heavier species and the light species are dominant in the background concentrations. ILCR were conducted for the observed values in the study. According to the information obtained, "Cancer Increase Rate" due to the PCB concentration was found to be over 10^{-4} and cancer risk assessment studies are needed in the area.

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