

RELATIONSHIP BETWEEN POLYCHLORINATED BIPHENYLS RESIDUE AND ORGANIC CARBON CONTENT OF ER-JEN RIVER SEDIMENTS IN SOUTHERN TAIWAN

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Introduction

Polychlorinated biphenyls (PCBs) were hydrophobic compounds with a stable physicochemical properties. They became an important worldwide contaminant after been banned for several decades^{5,6}. From our previous works, the soil organic carbon content was an important parameter affecting the fate of organic pollutant in soil, especially the hydrophobic compound^{3,7,8}. Er-Jen River was a well know river in Taiwan that contamination by PCBs. There are many factories placed along the both side of river to burn the waster metallic products that was imported from the world by wholesale since 1966. Although this industry was banned after twenty years, unfortunately, the river was contamination by PCB, dioxine and heavy metals.

In this study, the concentrations of PCBs and the contents of organic carbon in the sediment depth were determined in every 5cm depth and the relationships between them were discussed.

Methods and Materials

Soil sediments were collected from Er-Jen River in Wan-Li area, Tainan prefecture of Taiwan. Columns of soil sediments were collected from different locations near the northern side of Er-Jen River from surface to a depth of 35 ~ 45 cm by a sediment sampling apparatus. Five Sampling sites were selected at the eastern side of Nan-Din Bridge (Column A to E, downstream to upstream) with 50 m apart. Sampled soil columns were sliced into 5 cm long for each fraction and labelled. Samples were air-dried and sieved (< 2 mm) prior to being store at 4 °C.

The concentrations of PCBs and the distribution of specific PCB congeners were analyzed as follows: 2 g of soil from each sample was extracted with a hexane-acetone (9:1) solution by hand shake and sonification two times each. Extracts were collected and cleaned through a florisil column. Samples were analyzed with an ECD gas chromatograph (Varian 3600, Walnut Creek, CA) equipped with a DB-5 fused silica capillary column (0.53 mm ID_30 m, film thickness 1.5 μ m, (J & W Scientific, Folsom, CA). Extraction and analysis was performed in triplicate. The detail description of the analytic procedures with some modification can be found in previous study¹. The recoveries of 8 selected PCB congeners for quality control check sample test were found in a range of 78.1 ~ 87.4%. The temperature program of GC condition was held at 170°C for 2 min, then raised to 260°C at a rate of 3°C/min and held for 18 min. The injector and detector temperatures were 280°C and 300°C, respectively. By using nitrogen as both carrier and make-up gases, the linear velocity was 27.3 cm/s and split ratio was 15:1. Total concentration of PCBs in sample was calculated by the sum of all individual PCB congeners present in soil sediment. The organic carbon was determinate by Walley-Black wet oxidation method⁴.

Results and Discussion

Higher organic carbon content was found in middle layer at all five sediment samples (Table 1). As shown in Table 1, the organic carbon contents in 21-25 cm of column B is higher than the other layers. The same result was also found in column C (21-25cm) and E (21-30cm). Disturbance of organic carbon in column A and D were more homogeneous than that above three columns. This is referred to the strongly disturbance of sediment at sampling sites A and D and less disturbing at sampling sites B, C and E. If the organic carbon content at upper and lower layers were homogenized, may be floated and sink the sediment interfered by the stronger stream flow.

Table 1. The organic carbon content of the sediment at different depth

| Depth (cm) | Organic carbon content (%) | | | | |
|------------|----------------------------|------|------|------|------|
| | A | B | C | D | E |
| 0~5 | 0.45 | 0.39 | 0.79 | 0.76 | 0.54 |
| 6~10 | 0.52 | 0.49 | 0.85 | 0.86 | 0.58 |
| 11~15 | 0.49 | 0.47 | 0.65 | 0.67 | 0.57 |
| 16~20 | 0.56 | 0.55 | 0.37 | 0.61 | 0.64 |
| 21~25 | 0.46 | 0.97 | 0.94 | 0.77 | 0.97 |
| 26~30 | 0.43 | 0.65 | 0.65 | 0.60 | 0.93 |
| 31~35 | 0.42 | 0.72 | 0.60 | 0.69 | 0.47 |
| 36~40 | 0.42 | 0.59 | | | |
| 41~45 | | 0.50 | | | |

The PCBs concentration was decreased from downstream to upstream at the upper layer (0-5cm). (Table 2). The same tendency was also found at the next layer (6-10cm). Such phenomenon was not found at deeper layers of sediment. As shown in Table 2, maximum PCBs residue was found at depth of 21 to 25 cm for sampling sites C, D and E, and at depth of 16 to 30 cm for sampling sites of A and B. It seems, that the higher organic matter content, the more PCBs residue.

Table 2. The concentration of Polychlorinated biphenyls at different depth of Er-Jen river

| Depth (cm) | PCB_s Concentration ($\mu\text{g/g}$ sediment) | | | | |
|------------|---|------|------|------|------|
| | A | B | C | D | E |
| 0~5 | 1.63 | 1.66 | 1.55 | 0.49 | 0.50 |
| 6~10 | 1.53 | 1.69 | 0.84 | 0.52 | 0.46 |
| 11~15 | 0.84 | 1.69 | 0.88 | 1.42 | 0.61 |
| 16~20 | 3.29 | 2.90 | 2.24 | 0.98 | 1.17 |
| 21~25 | 1.91 | 2.03 | 3.58 | 2.48 | 2.34 |
| 26~30 | 2.40 | 4.32 | 2.54 | 0.84 | 1.37 |
| 31~35 | 1.23 | 1.02 | 2.24 | 0.77 | 0.84 |
| 36~40 | 1.55 | 1.31 | | | |
| 41~45 | | 0.81 | | | |
| 0~35 | 1.83 | 2.19 | 1.98 | 1.07 | 0.67 |

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The relationship between PCB concentrations and organic carbon contents at each layer were plotted as in Figure 1. The significant correlation coefficient between them was not found, except the column E between the PCBs concentration and organic carbon content the correlation coefficient $r=0.858$. Chevreuil et al. 1998 found the PCB concentration and POC (particulate organic carbon) in sediment of Seine River has significant correlation². Because the sampling sites are at the downstream of Er-Jen River, many interference may be affected the sedimentation of sediment and also affected the accumulation of PCBs. More samples are necessary to investigate and determine for conforming the relationship between the PCB concentration and organic carbon contents in sediment.

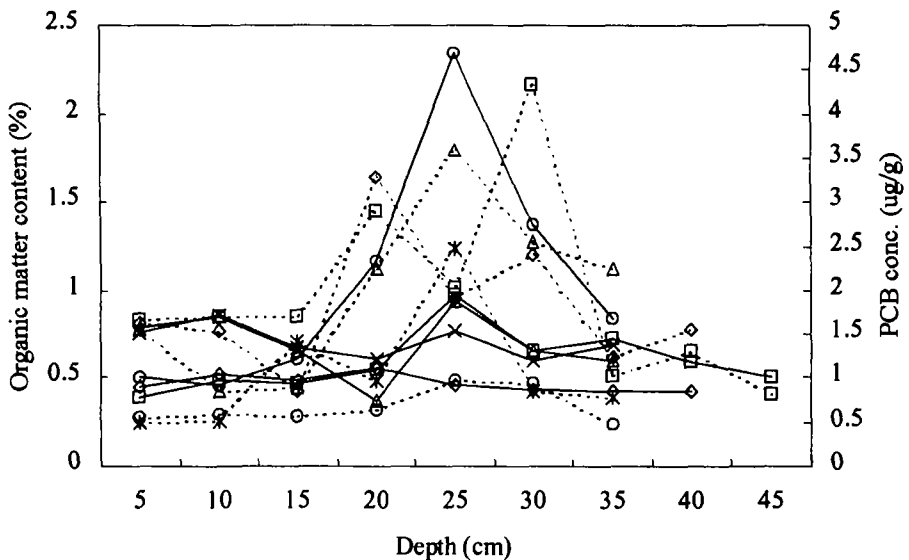


Figure 1 PCB residues ($\square \mu\text{g/g}$) and organic carbon contents (----) in different depth of Er-Jen River sediment at each 50 m apart sampling site A (\diamond), B(\square), C(Δ), D(\times) and E(\circ).

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