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Distribution and Sources Of Polychlorinated Biphynal(PCB) in Sediment of The Coastal Area of Iraq

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Abstract. The concentrations of Σ13 PCBs compound in sediment samples were determined and analyzed at each site by using gas chromatography-mass spectrometry (GC–MS, Agilent), six stations were chosen along iraqi Coast, at Basrah city, south of Iraq. The Σ13 (PCB-18, PCB-29, PCB-31, PCB-28, PCB-44, PCB-52, PCB-101, PCB-141, PCB-149, PCB-138, PCB-153, PCB-189, and PCB-194)it recorded the highest concentration of PCB18 (0.351ng/g) in the sediment samples were found at station 3 and the lowest concentration was recorded in station 2 (0.150 ng/g),PCB 28 it found its highest concentration (0.299ng/g)in station 2 and lowest concentration (0.006 ng/g)were found at station five ,the highest concentration of PCB 29 (0.149 ng/g)in station1 and lowest concentration were found (0.007 ng/g) in station 3 ,as for PCB31 it had the highest concentration (0.106 ng/g) at station 1 and lowest concentration (0.014 ng/g) at station 2, PCB44 its highest concentration (0.138 ng/g) in 5 station while its lowest concentration (0.019 ng/g) in station 2. ,PCB52 highest concentration (0.492 ng/g) in station 5 while less concentation (0.068 ng/g) at station 4 ,highest concentration of PCB101(0.208 ng/g) in station 3 and lowest concentration (0.024 ng/g) at station 1 ,PCB138 highest concentration (0.042 ng/g) in station 4 and lowest concentration (0.010 ng/g) in station 2,PCB141 highest concentration (0.230 ng/g) at station 4 and lowest concentration (0.003 ng/g) at station 3 ,PCB149 highest concentration (0.190 ng/g) a ant station 1and lowest concetration (0.022 ng/g) at ,the]station 2. concentration PCB153 (0.210 ng/g) in station 3 was while it was less (0.016 ng/g) in station 2 ,it also had the highest concentration of PCB189 (0.166 ng/g) in station 1 while the lowest concentration was found in the station 5 (0.010 ng/g) ,the highest concentration of PCB194 was measured at the station 2 and was (0.277 ng/g) and the lowest concentration at the station 3(0.017 ng/g). This project is the first of its kind in Basrah and first in the area . this study of PCB concentrations in the region could be used as a baseline study and can be used for subsequent studies.If we compare these data with other study in world it could be lies with other study in the world. The main sources of the PCB in sediment could be anthropogenic sources.

Highlights:

1. Study Overview: First PCB baseline study in Basrah, analyzing 13 compounds.
2. Key Findings: PCB concentrations vary significantly across six coastal stations.
3. Sources: PCB contamination primarily attributed to anthropogenic activities

Keywords: PCBs, sediment , GC-MS.

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Introduction

Iraq is characterized by the abundance of fresh surface water represented by the Tigris and Euphrates rivers and their tributaries and what they form in the Shatt al-Arab Canal, in addition to the waters of the vast lakes and marshes. Iraq occupies the northwestern part of the Arabian Gulf, as its coast is about 64 km long, which is short compared to the Kuwaiti coast, which ranges from 170-200 km, while the length of the Iranian coast ranges about 2000 km [1]. This coast is the only front of Iraq that overlooks the Arabian Gulf.A class of similar substances known as polychlorinated biphenyls (PCBs)has found widespread application throughout the world as additives in rubber transformers, capacitors, paints, and plastics. But because of their mutagenic, teratogenic, and toxic effects, as well as the fact that they are resistant to natural environmental attenuation and that recent international agreements have banned their production and use, more research is being done to find and track the presence of (PCBs) in the relevant aquatic compartments. large ocean temperatures, large rates of evaporation, very little freshwater precipitation inputs, extremely high salinity, and high pH are characteristics of the Gulf. Heavy metals and polychlorinated biphenyls(PCBs) are among the many harmful pollutants that are highly likely to be present in the Gulf due to the aforementioned features of the water quality and other man-made dissipation.

Therefore, from an ecological and conservation perspective, particular studies that analyze the type and extent of the contamination as well as the effects of these pollutants in this unique location are valuable. In order to evaluate future regulations pertaining to the release of these pollutants into this region, such a study will provide a baseline of contamination by harmful chemicals. Therefore, the purpose of this study is to find out if PCBs are present in the NWG sediments and to talk about how this degree of pollution affects the local biota and human health. [2,3,4,5]. The fact that PCBs, which are known to be harmful and to cause cancer, are found around the world and exhibit low levels in urbanized industries and semi-urbanized areas, high levels in the Arctic and subarctic, and intermediate levels in the tropics raises concerns. Investigations of the type and degree of PCB presence in local environmental samples, excluding the biota, were recommended due to the aforementioned environmental and worldwide impact as well as the Arabian Gulf region's geographic location. Few papers discuss the concentration of PCBs in the Arabian Gulf's marine sediments, based on a summary of the previously

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common PCBs in relation to the environmental compartme (air, water, soil, and sediment). In 2022, [6,7]This work provides compelling evidence in favor of reconstructing PCB histories in near-shore marine habitats using dated sediment cores. Numerous chlorinated hydrocarbon concentrations in the marine environment can be precisely recorded using sediments. In order to control point-source PCB emissions into marine habitats, the data shows that the ratios of advected to point-source PCBs have increased over time. PCBs and chlorinated hydrocarbons were also shown to be correlated with "regional" sources, such as sewage and "fugitive" deposits. Such information can be used to set restrictions on "secondary" regional sources of chlorinated hydrocarbons and PCBs. Through atmospheric discharges, they might also be utilized to evaluate and restrict the input of PCBs and chlorinated hydrocarbons.

Methods

The research area includes Basra Governance' coastline region from Al-Faw to Umm Qasr .We collected samples from six locations along the western shore of the Arabian Gulf fig(1) . The chosen stations were 2 km apart. The grab samplers collected sediment samples from the designated region. We allowed water to drip from the samples, wrapped them in aluminum foil, identified them, and sent them to the lab for research studies. We dried, powdered, and sieved the materials using a 63-micron sieve for PCBS compound analysis and quantification.Upon arrival, the laboratory freeze-dried the sediment samples. After removing pollutants, we crushed sediment samples using a FRITSCH mill and sieved them through a 63-micron aperture sieve. To estimate the PCBs in the sediment, we followed the steps outlined by[8]. We put 20 grams of salt in a thimble. Our Soxhlet Intermittent Extraction device extracted polychlorinated biphenyls (PCBs) from 100 milliliters of a mixture in a labeled glass container. When the mixture dried, we sealed it until the GC-MASS apparatus analyzed it.We kept hexane and methylene chloride (v/v 1:1) at 40°C for 48 hours. After cooling the extract, we saponified it for two hours using 15 ml of 4M potassium hydroxide in methanol. We placed the contents in a separating funnel and added 50 cc of the 1:1 hexane/methylene chloride combination after cooling. We firmly shook the separating funnel and allowed it to stand until the solution separated into two layers. We removed and discarded the soaped bottom layer, then transferred the unsoaped top organic layer containing PCBs

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to a chromatographic separation column, which had glass wool at the base, 2 grams of silica gel, and alumina on top. After removing fatty acids, we used 2 grams of anhydrous sodium sulfate to extract water. We label, dry, and seal the extract in a glass container until we measure it using the GC-MASS instrument.

Fig(1)Sample Location

Result and Discussion

The table(1) below shows the PCB compound research findings from the chosen stations. The sixth station had the lowest PCB18 (0.143), and the third station the highest (0.351). PCB28 was greatest in the second station (0.229 ng/g) and lowest in the sixth (0.004 ng/g). The first station had the highest PCB29 content (0.149 ng/g), and the third the lowest (0.007 ng/g). The second station had the lowest PCB31 content (0.014 ng/g), whereas the first station had the highest (0.106 ng/g). The fifth station had the highest PCB44 content (0.138 ng/g), and the second station the lowest (0.019 ng/g). The highest value of the compound PCB52 was at the fifth station (0.494 ng/g), and the lowest value was at the fourth station (0.068 ng/g). The highest value of the compound PCB101 was at the third site (0.208 ng/g), and the lowest value was at the first site (0.042 ng/g). The values of the compound PCB138 were (0.042 ng/g) at the fourth station, and the

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lowest value was at the sixth station (0.005 ng/g). The highest concentration of the compound PCB141 was at the fourth station (0.230 ng/g), and the lowest concentration was at the third station (0.003 ng/g). As for PCB149, its highest concentration was in the first station (0.190 ng/g). The lowest concentration was in the second station (0.022 ng/g). As for PCB153, its highest concentration was in the third station (0.210 ng/g), and its lowest concentration was in the fifth station (0.012 ng/g). The highest concentration of PCB 189 was in the sixth station (0.017 ng/g), and its lowest concentration was in the fifth station (0.010 ng/g). The highest concentration of PCB194 was in the second station (0.017 ng/g), and its lowest concentration was in the third station (0.017 ng/g).

The results of the study were close to the results of the study [9]conducted on sediments in Imam Khomeini Port, while the results of the study conducted by[10] in Kuwait were higher than the readings recorded in the current study.table (2) Because of their widespread presence and detrimental effects on living things, including humans, polychlorinated biphenyls,or PCBs, are generally considered environmental issues. They are persistent, bioaccumulative, and linked to a wide spectrum of detrimental health effects. Therefore, understanding the origins and spread of PCBs is crucial for managing contaminated sites and safeguarding public health.The extensive distribution and sources of PCBs in sediment, which build up on the sediment surface, have been the subject of several investigations. In the Arabian Gulf, where ecological health is at risk due to rapid industrial development brought on by a rise in urbanization, petroleum industrialization, transportation, and untreated sewage discharges, among other activities, there haven't been many studies conducted up to this point on these pollutants and their sources in sediments. Moreover, neither the initial PCB inventories and reviews nor the subsequent databases of the region have included PCB monitoring data for the Arabian Gulf. The destinies and the environmental impact of PCBs in the sediments of the Gulf have been the subject of minimal investigations, necessitating more focused research. [11,12.13,14].In this study, the spatial distribution patterns of PCBs observed in the sediments throughout the Arabian Gulf were revealed. The overall spatial distribution patterns indicate considerable variations in the PCB residue levels all over the investigated areas. This suggests that such distribution patterns were majorly affected by several geographical factors, particularly in terms of local biogeochemical

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settings, which have positive and negative effects on the pollution rate of PCBs and potentially reduce anthropogenic PCB loads from industrial areas through discharges to the Arabian Gulf.[14,15,12,16,17] .These sites are closely located to refinery discharges and/or near heavy urban runoff, which leads to higher production shifts due to the increasing chlorine content of environmental PCBs.It is noteworthy that the spatial distribution of PCB loads was mostly triggered by worldwide factors; indeed, such spatial variations are directed by biogeochemical settings combined with input sources of PCBs from anthropogenic and industrial activities. Local emissions are considered the major source of PCB redistribution in sediments, originating from refinery effluents and shipping routes. The location maps of studied PCB residues at each site reveal the existence or distribution of high levels of PCB pollution throughout the sampling points. [18].The Arabian Gulf has been identified as a regional pollution 'hotspot,' and the presence of PCBs in the environment is indicative of the destruction or malfunction of equipment such as electrical substations and shredding equipment.Exposures of particular concern are to marine organisms near the mouth of present and proposed sewage outfall pipes, including fish and edible bivalves. Ecologically, the slow degradation and dispersion of PCBs suggest long-term consequences.[19].

Table(1) Concentration of pcbs in sediment(ng/g dw)

compound name	1	2	3	4	5	6
PCB18	0.192	0.15	0.351	0.187	0.165	0.143
PCB28	0.142	0.299	0.02	0.153	0.006	0.004
PCB29	0.149	0.067	0.007	0.122	0.017	0.012
PCB31	0.106	0.014	0.065	0.09	0.018	0.127
PCB44	0.075	0.019	0.095	0.05	0.138	0.126
PCB52	0.188	0.425	0.357	0.068	0.492	0.122
PCB101	0.024	0.083	0.208	0.051	0.133	0.032
PCB138	0.029	0.010	0.018	0.042	0.036	0.005

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PCB141	0.219	0.092	0.003	0.23	0.007	0.043
PCB149	0.190	0.022	0.057	0.169	0.053	0.085
PCB153	0.038	0.016	0.210	0.072	0.086	0.012
PCB189	0.166	0.023	0.034	0.153	0.010	0.176
PCB194	0.151	0.277	0.017	0.019	0.187	0.030
TOTAL PCBs	1.669	1.497	1.442	1.406	1.348	0.917
mean	0.128	0.115	0.110	0.108	0.1036	0.0705
±SD	0.067	0.134	0.1280	0.0653	0.133	0.0612

Table (2)concentrations PCBs in neighboring countries

country	concentration rate of compounds PCBs
current study	0.07 -0.128 ng/g
kuwait	0.40-81.7 [10]
Iran	0.1-1 ng/g [9]
Bahrain	0.02 -20.3 [20]

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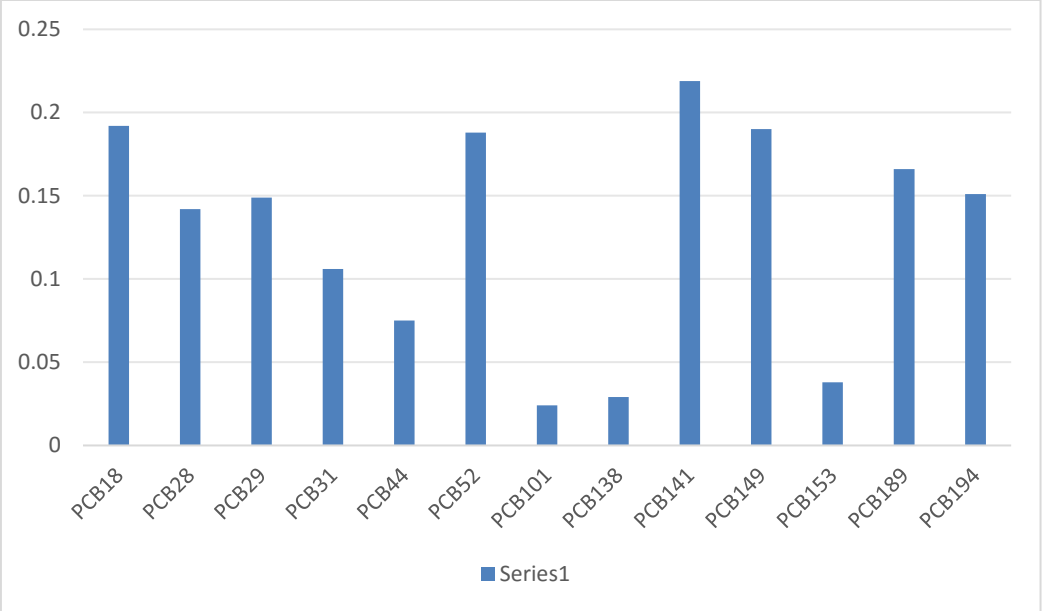
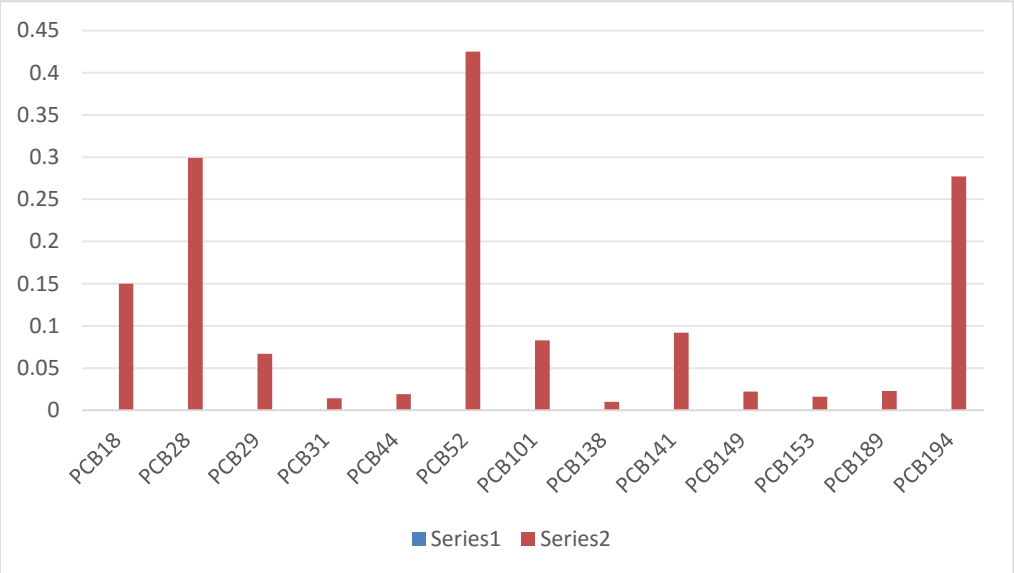


Fig(2)PCB concentrations at the first station



Fig(3) PCB concentration at the second station

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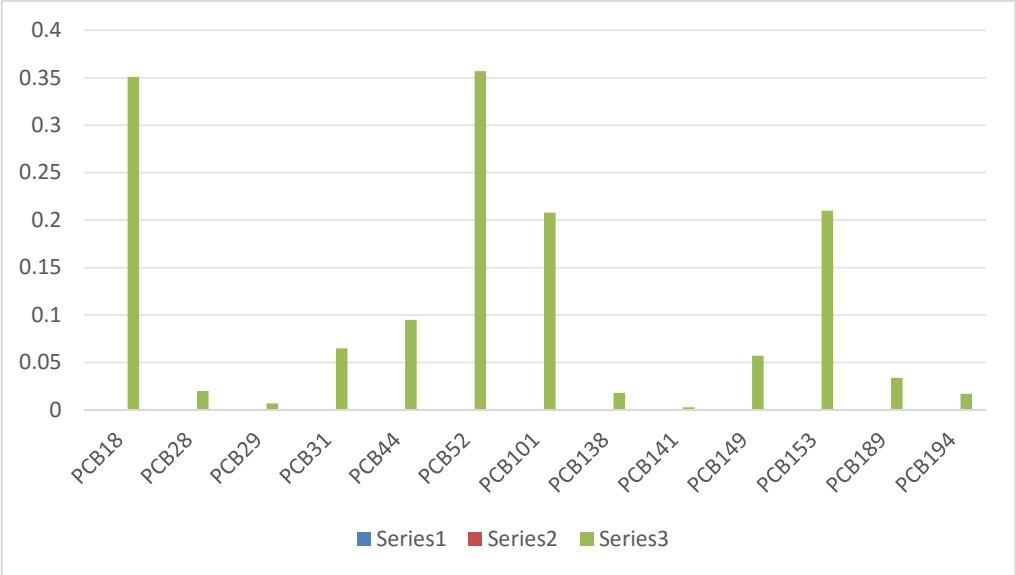
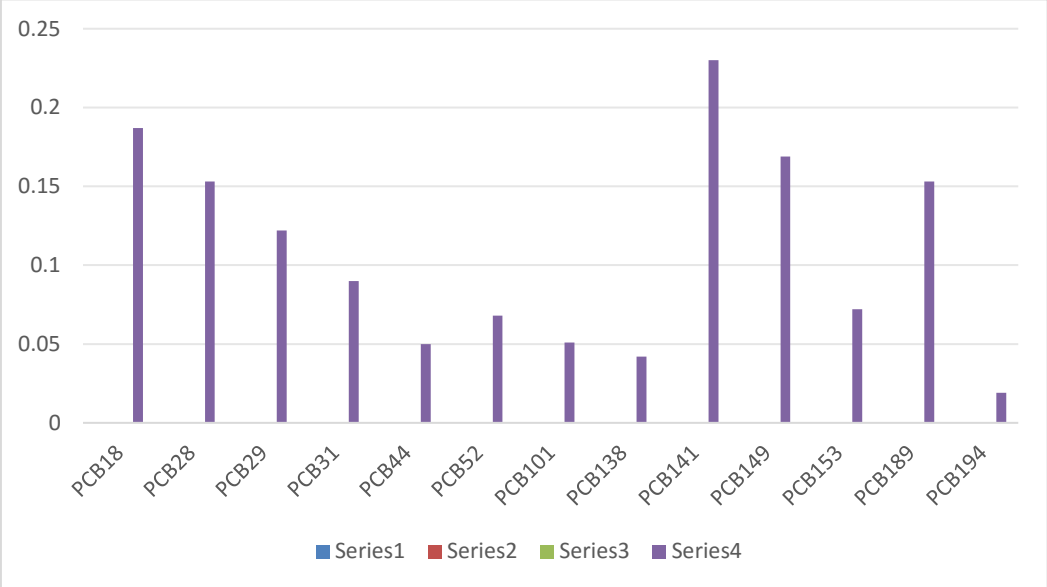


Fig(4)PCB concentration at the third station



Fig(5)PCB concentrations at the fourth station

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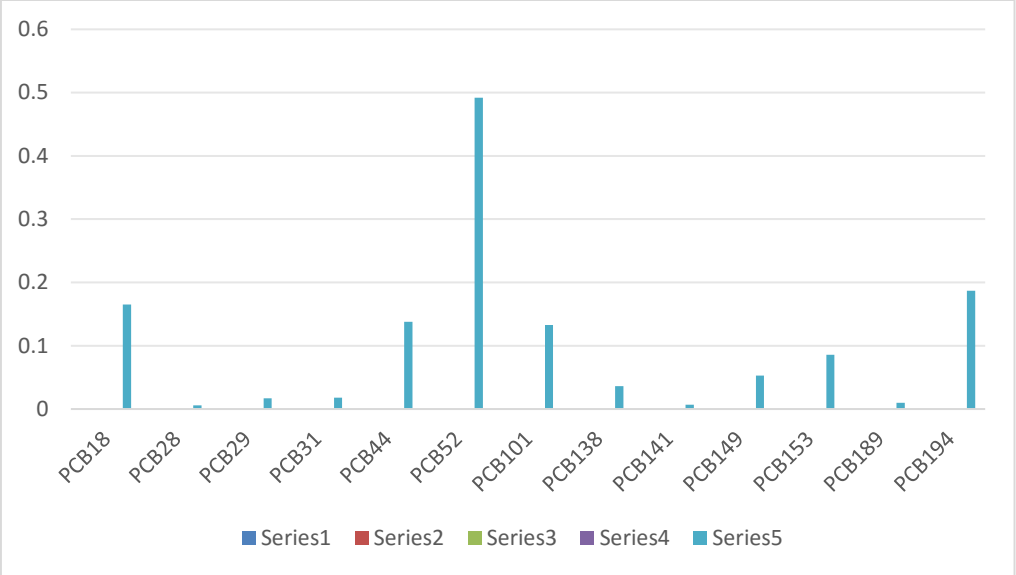
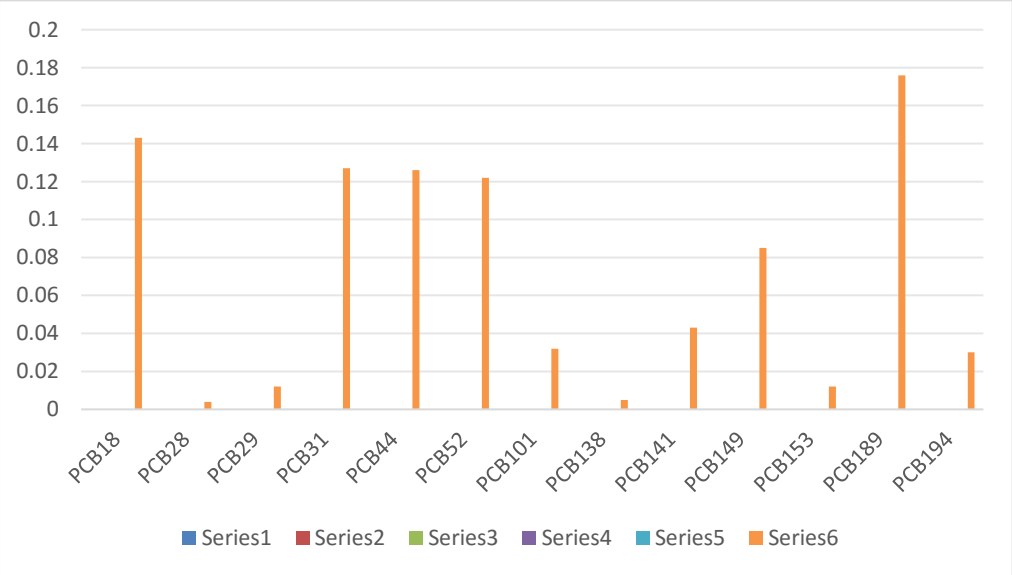


Fig(6)PCB concentrations at the fifth station



Fig(7)PCB concentrations at the sixth station.

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